SECTION 1

1. SCOPE

1.1 PURPOSE

The purpose of MIL-STD-6016 is to describe the approved standards to achieve compatibility and interoperability between command and control and communications systems and equipment of U.S. military forces employed or intended to be employed in joint tactical operations. This publication is to be complemented by CJCSM 6120.01, Joint Multi-Tactical Data Link (TDL) Operating Procedures (JMTOP), which will provide for planning and common procedures to be used by forces in the joint tactical environment using Link 16 as the basis for information exchange.

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1.2 DOCUMENT STRUCTURE

MIL-STD-6016 consists of six sections and five appendices. Section 1 provides the introduction and scope. Section 2 provides the applicable documents required to operate on Link 16. Section 3 contains a glossary of terms and definitions and a summary description of The Joint Tactical Information Distribution System (JTIDS). Certain terms concerning interoperability, compatibility, and commonality are included, as well as other terms that have discrete meaning within the framework of MIL-STD-6016. Section 4 contains the general requirements, conventions, and protocols for information exchange and forwarding on Link 16. Section 5 contains the detailed requirements for the Link 16 fixed format message construction and the J-Series word descriptions. Shown for each Link 16 message is the message designator, purpose, format, transmit/receive rules, word map, word description and field coding. The specific J-Series word descriptions are contained in three parts separated from the main volume of MIL-STD 6016; Part 1 contains the detailed descriptions for Link 16 words J0 through J6; Part 2 contains the detailed descriptions for Link 16 words J7 through J12; Part 3 contains the detailed descriptions for Link 16 words J12 through the RTT words. Section 6 contains notes of a general nature that apply to the use of this document.

Appendix A identifies the minimum implementation requirements that must be met by all Service/Agency (S/A) systems participating on the Link 16 Interface. Satisfaction of these joint data exchange requirements is mandatory to establish and maintain the Link 16 Interface, to participate within a specific technical function, and to prevent adverse effects on the interface. Minimum implementation requirements must be satisfied at each of seven different levels: functional, related function, message, related message, word, data element, and data item. These requirements are defined in terms of transmission and reception for both Command and Control JTIDS Units (C^2 JUs) and nonC^2 JUs.

Appendix B contains a dictionary of the data elements used in Link 16. The data elements are uniquely specified by two numbers, the Data Field Identifier (DFI) and its Data Use Identifier (DUI). The DFI includes a single concept and is the generic representation of the DUIs grouped under it. The DUIs, which are representative of the DFI concept, contain the Data

Items (DIs) used to compose the data element. Alphabetical and numerical indexes of the DFIs and DUIs are included in Appendix B Sections 1 and 2; the DFIs are listed in numerical sequence in Section 3.

Appendix C contains the data forwarding rules, protocols, and translations required between J series and M series messages. Data forwarding is the process of receiving data on one digital data link and outputting the data in the proper format and protocol of another digital data link. In the process, a message(s) received on one link is translated to an appropriate message(s) on another link. All systems that forward data must adhere to Appendix C. In the course of implementing Link 16, it is recognized that some systems may use internal system translations (e.g., Link 16 to Link 11B) and some systems may transmit originated track data on more than one data link at the same time. Functionally, such systems are not data forwarders; however, they will adhere to the guidance in Appendix C to ensure that the closest possible relationship of data elements and data element interpretation will be maintained among all users of the data.

Appendix D, and the information for the Classified Supplements located in the TDL Development System (TDS), describes the Link 16 implementation by each service/agency participating in the Link 16 joint interface. It shows the implementation from the functional level down to the data item level for each system.

Appendix E is the repository for Interface Change Proposals (ICPs) written against MIL-STD-6016. This appendix is maintained separately by the Defense Information System Agency (DISA/IN5). A complete listing of all TDL ICPs and their current status is contained in the DISA TDL ICP Status Report, which is updated after each CCB meeting.

1.3 BACKGROUND

JCS Memorandum SM-205-71, 1 April 1971, established a program to ensure the joint interoperability of tactical command and control systems in support of the Ground and Amphibious Military Operations (GAMO) Program. The Joint Interoperability of Tactical Command and Control Systems (JINTACCS) Program was established by JCS Memorandum SM-184-78, 7 March 1978, to replace the GAMO Program, although directives that were pertinent to the GAMO Program are considered applicable to the JINTACCS Program. The JTIDS/MIDS program was established as a Joint Service Program to develop and acquire a secure, jam-resistant communications system with inherent capabilities to support information distribution, relative navigation, and identification that would support both intra- and inter-Service information exchange between tactical command and control facilities/systems. JCS Memorandum SM-362-75, 2 July 1975, stipulates the relationship between the JTIDS/MIDS and GAMO (now the JINTACCS) Programs. JTIDS/MIDS may provide either primary or alternate transmission means through which appropriate tactical data systems are interconnected. The Joint Chiefs of Staff had directed the GAMO Executive Agent (EA) (SM-575-77, 27 June 1977) to develop the message standard for the JTIDS/MIDS, which included the development of a JTIDS Technical Interface Concept (JTIC) and a JTIDS Technical Interface Design Plan - Test Edition (JTIDP-TE), as well as the responsibility to plan, schedule, conduct, and evaluate joint testing of the JTIDP in order to validate its compatibility and interoperability for the Joint Chiefs of Staff.

The Joint Chiefs of Staff and the Services determined that the requirement for the JINTACCS Program would be extended beyond FY 1985, the year the program originally was to be completed. JCS Memorandum SM-750-82, 6 December 1982, was issued to ensure that the program responsibilities would be accomplished. SM-750-82 tasked the Chief of Staff, U.S. Army as the EA responsible for managing the development and the testing of joint message standards for the JTIDS/MIDS. In addition, this memorandum expanded the previous tasking by including a requirement to develop the Link 16 Interface Management Plan to show phased implementation of the Link 16 Interface for systems/platforms that are specified by the Services in the JTIC.

On 5 July 1984, the Deputy Secretary of Defense signed DOD Directive 5154.28, which established the Joint Tactical Command, Control and Communications

Agency (JTC3A) under the Defense Communication Agency (DCA), and assigned to it responsibility for the development and maintenance of a joint architecture, interface standards, and interface definitions for tactical/mobile C^3 systems. All program activities and resources of the Joint Tactical Communication Office and the JINTACCS Program were transferred to the JTC3A. JTC3A on 1 February 1992 was changed to the Joint Information Engineering Organization (JIEO) in the Defense Information System Agency (DISA), formerly DCA.

The Joint Multi-TADIL Standards Working Group (JMSWG), chaired by JIEO, directed on 10 May 1996, that the JTIDP-TE, a test document, be superseded by MIL-STD-6016, Tactical Digital Information Link (TADIL) J Message Standard, in order to establish an approved operational baseline.

1.4 POLICY

Applicable statements of policy are contained in DOD directives and correspondence. Essentially, interoperability, compatibility, and commonality in the degree necessary to provide for flexible, effective, and economical operation of tactical forces will be achieved. Commonality, compatibility, and interoperability are objectives. Interoperability in joint tactical operations is absolutely essential for operational effectiveness.

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1.5 CONCEPT

MIL-STD-6016 complies with basic DOD policies and has been developed in consonance with the following concepts:

a. Tactical command and control, and communications systems standards are developed only for systems and equipment applicable to functional areas in which the need for interoperability and compatibility has been validated as essential by the Joint Chiefs of Staff.

b. These standards apply to operational and future tactical systems and use system characteristics previously approved for Service use where such characteristics meet the joint requirements.

c. This document establishes certain standards and criteria for message formats and transmission characteristics that will be used in the design and/or procurement of systems and equipment. Additionally, these standards will be used in computer program development and when new system designs are implemented within existing systems.

d. An interface between tactical systems should exploit the maximum capability of sensors and processors to provide precise information exchange in support of tactical operations.

e. Message format standards and information exchange criteria in those standards are designed to support established doctrine and known requirements. They will be responsive to revision, as indicated.

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1.6 DEVELOPMENT OF STANDARDS

MIL-STD-6016 was developed based on information produced by and coordinated with the U.S. Army, U.S. Navy, U.S. Air Force, U.S. Marine Corps, the National Security Agency, and the Defense Intelligence Agency, as documented in the JTIC dated April 1982 (amended and approved by the Joint Chiefs of Staff (JCS) on 5 May 1983). Additionally, coordination was accomplished with international standards under guidance of the Joint Chiefs of Staff.

a. Within the Joint Staff, standardization is accomplished by the Director for Command, Control and Communications Systems, J-6. Through the Director, J-6, the Defense Information Systems Agency (DISA/IN5) develops standards and criteria, as necessary.

b. During the development of tactical standards, it is necessary to consider the relationship to other national standards and international standards. DISA/IN5 develops these standards in consultation with other activities of the Department of Defense, including DISA, DIA, and NSA/CSS, to ensure compatibility between U.S. tactical and strategic systems and equipment. Formal coordination is obtained, where necessary, through actions of the Joint Chiefs of Staff. International applications are considered during the development and revision of standards through consultation with various national and international agencies. NATO STANAG 5516 and STANAG 5616 reflects these standards for Link 16.

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1.7 APPLICATION OF STANDARDS

MIL-STD-6016 is used by the Services, commands, and applicable DOD Agencies in developing and acquiring new systems, computer programs, and equipment as required, for updating existing systems for use on the Link 16 Interface. The application of the minimum requirements for information exchange on Link 16 is provided in the following paragraphs:

a. Application of Minimum Requirements: The mandatory minimum requirements, Appendix A, apply to all systems, existing and future, that elect to exchange information via Link 16. The applicability of these requirements is directed toward digital data exchange in a joint environment where systems of two or more Services/DOD Agencies are involved. These requirements should be used as guidelines for internal service or system data links when no external interface exists.

b. Exceptions to Minimum Requirements: Exceptions to the minimum requirements for information exchange will be considered and approved or denied on a case by case basis by DISA/IN5.

Requests for exceptions will be submitted by the individual Service/DOD Agency to DISA/IN5 for approval or resolution. Action on the request will be in accordance with CJCSI 6610.01, TADIL Standardization Policy and Procedures and with JIEO Plan 3200, Department of Defense Information Technology (IT) Standards Management Plan. The request will identify the specific tactical data system, the items for which the exception is requested, and the reason for requesting the exception.

The channel for submission of requests for exceptions is the same as that for submitting recommended changes to these standards.

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1.8 CONFIGURATION MANAGEMENT

MIL-STD-6016 will be maintained as a baseline for configuration management of the Link 16 Interface in accordance with the JIEO Configuration Management Plan (CMP).

The Director, DISA/IN5 is responsible for configuration management of MIL-STD-6016. S/A requests for changes must be prepared, submitted, and processed in accordance with the JIEO CMP. Approved changes will be promulgated to all participants by DISA/IN5. The application or waiver of a standard to a specific equipment or system is the responsibility of the Secretary of Defense.

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1.9 INTERFACE OPERATING PROCEDURES

The Link 16 Interface operating procedures are contained in CJCSM 6120.01, Joint Multi-Tactical Data Link (TDL) Operating Procedures (JMTOP).

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SECTION 2

2. APPLICABLE DOCUMENTS

2.1 MILITARY STANDARD

2.1.1 DEPARTMENT OF DEFENSE (DOD) STANDARDS

a. MIL-STD-188-203-1A - Tactical Digital Information Link (TADIL) A Message Standard.

b. MIL-STD-203-3 - Tactical Digital Information Link (TADIL) C Message Standard.

c. MIL-STD-188-212 - Tactical Digital Information Link (TADIL) B Message Standard.

d. MIL-STD-6004 - Tactical Digital Information Link (TADIL) C Message Standard.

e. MIL-STD-6011 - Tactical Data Link (TDL) 11/11B Message Standard.

f. MIL-STD-6040 - U.S. Message Text Formatting Program.

2.1.2 NORTH ATLANTIC TREATY ORGANIZATION (NATO) STANDARDIZATION AGREEMENT (STANAG)

a. STANAG 5511 - Tactical Data Exchange - Link 11.

b. STANAG 5516 - Tactical Data Exchange - Link 16.

c. STANAG 5616 - Standards for Data Forwarding Between Tactical Data Systems Employing Digital Data Link 11/11B and Tactical Data Systems Employing Link 16.

2.2 OTHER PUBLICATIONS

a. ACP 167E - Glossary of Communications-Electronics Terms.

b. Joint Pub 1-02 - Department of Defense Dictionary of Military and Associated Terms.

c. CJCSM 6120.01, Joint Multi-Tactical Data Link (TDL) Operating Procedures.

d. CJCSM 6610.01, JINTACCS Standard Policy TADIL Standardization Policy and Procedures.

e. System Segment Specification for JTIDS/MIDS Class 2 Terminal.

2.3 ORDER OF PRECEDENCE

In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however supersedes applicable laws and regulations unless a specific exemption has been obtained.

SECTION 3

3. DEFINITIONS

This section, in three subsections, contains Abbreviations, and Acronyms; Definition of Terms, and a summary description of the JTIDS/MIDS Technical Characteristics.

3.1 ABBREVIATIONS AND ACRONYMS

This section defines the abbreviations and acronyms used in the standard.

AAW	Anti-Air Warfare
AC	Action/Action Code
ACK	Acknowledge
ACLS	Automatic Carrier Landing System
ACT	Action/Action Value
AD	Air Defense
AGL	Above Ground Level
AIC	Air Intercept Control
AJ	Antijam
AIC	Air Intercept Control
ALS	Automatic Landing System
AOP	Area of Probability
AOR	Area of Responsibility
ARM	Antiradiation Missile
ASW	Antisubmarine Warfare
ATC	Air Traffic Control
ATDL-1	Army Tactical Data Link-1
C^2	Command and Control
C^2 IU	Command and Control Interface Unit
C^2 JU	Command and Control JTIDS Unit
C^3CM	Command, Control, and Communications Countermeasures
CAINS	Carrier Aircraft Inertial Navigation System
CANTCO	Cannot Comply
CANTPRO	Cannot Process
CAP	Combat Air Patrol
CAS	Close Air Support
CDS	Combat Direction System
CM	Countermeasures
COMSEC	Communications Security
CQ	Communications Quality
CRC	Control and Reporting Center
CVLL	Cryptovariable Logical Label
DF	Direction Finding
DFI	Data Field Identifier
DI	Data Item
DLA	Data Link Address
DLRP	Data Link Reference Point
DUI	Data Use Identifier
E/C	Environment/Category

EA	Executive Agent or Electronic Attack
EC	Electronic Combat
EMCON	Emission Control
EMG IND	Emergency Indicator
ENV/CAT	Environment/Category
EOB	Electronic Order of Battle
EOT	End of Transmission
EP	Electronic Protection
ES	Electronic Warfare Support
EW	Electronic Warfare
EWAC	Electronic Warfare Action Value
EWS	Electronic Warfare Surveillance
FAC	Forward Air Controller
FEBA	Forward Edge of the Battle Area
FI	Filter Indicator
FIFO	First In First Out
FJU	Forwarding JTIDS Unit
FJUA	Forwarding JTIDS Unit A (between Links 11 and 16)
FJUAB	Forwarding JTIDS Unit AB (between Links 11, 11B, and 16)
FJUB	Forwarding JTIDS Unit B (between Links 11B and 16)
FLOT	Forward Line of Own Troops
FPU	Forwarding Participating Unit
FRU	Forwarding Reporting Unit
FSCL	Fire Support Coordination Line
FT IND	Force Tell Indicator
GAF	Geographic Area Filter
GMT	Greenwich Mean Time
GPS	Global Positioning System
HAVCO	Have Complied
HD SW	Height/Depth Switch
HUMINT	Human Intelligence
ICP	Interface Change Proposal
ID	Identity
ID AMP	Identity Amplification
ID CON	Identity Confidence
IFF/SIF	Identification Friend or Foe/Selective Identification Feature
IHAWK	Improved HAWK
IND	Indicator
IOP	Interface Operating Procedures
ISN	Initial Slot Number
IU	Interface Unit
JCS	Joint Chiefs of Staff
JCS Pub	Joint Chiefs of Staff Publication
JOC	Joint Operational Commander
JTAO	Joint Tactical Air Operations
JTIDS	Joint Tactical Information Distribution System
JU	JTIDS Unit
LOB	Line of Bearing
LOS	Line of Sight
MAD	Mission Assignment Discrete
MDR	Message Directed Relay
MEZ	Missile Engagement Zone
MLI	Message Length Indicator
MOP	Memorandum of Policy

MPC	Message Processing Center
MR	Machine Receipt
MS	Message Start
MSEC	Message Security
MSL	Mean Sea Level
NA	Not Applicable
NATO	North Atlantic Treaty Organization
NC	Navigation Controller
NCS	Network Control Station
NES	Net Entry Signal
NON EW C^2	Non Electronic Warfare Command and Control JTIDS Unit
NPS IND	Network Participation Status Indicator
NRT	Nonreal-Time Track
NTR	Network Time Reference
NU	Not Used
OCC	Operational Contingency Constraint
OM	Original Message
OPNL CDR	Operational Commander
OTAR	Over-the-Air Rekeying
PAD	Precision Aircraft Direction
PG	Participation Group
PGC	Participation Group Community
PIM	Position and Intended Movement
PPLI	Precise Participant Location and Identification
PR	Position Reference
PRF	Pulse Repetition Frequency
PRI	Pulse Repetition Interval
PRI AMP	Primary Identity Amplification
PT	Point
PU	Participating Unit
Q_{ar}	Relative Azimuth Quality
Q_{pg}	Geodetic Position Quality
Q_{pr}	Relative Position Quality
Q_t	Time Quality
R^2	Reporting Responsibility
R/C	Receipt/Compliance
REF	Reference
REL NAV	Relative Navigation
RI	Relay Transmission Indicator
R/P	Reference Position
RPV	Remotely Piloted Vehicle
RRN	Recurrence Rate Number
R-S	Reed-Solomon
RTT	Round-Trip Timing
RU	Reporting Unit
RV	Response Value
SAI NUM	Slot Assignment Index Number
SAM	Surface-to-Air Missile
SAR	Search and Rescue
SCC	System Coordinate Center
SDU	Secure Data Unit
SEAD	Suppression of Enemy Air Defenses
SI	Scale Indicator
SID	Status Information Discrete
SIF	Selective Identification Feature
SIGINT	Signal Intelligence
SIS	Special Information System

SPI	Special Processing Indicator
SU	Support Unit
SW	Switch
TACAN	Tactical Air Navigation
TACC	Tactical Air Control Center (USAF, USN) or Tactical Air Command Center (USMC)
TACS	Tactical Air Control System
TACS/TADS	Tactical Air Control System/Tactical Air Defense System
TADIL	Tactical Digital Information Link
TAOC	Tactical Air Operations Center
TBD	To Be Determined
TDMA	Time Division Multiple Access
TDS	Tactical Data System
TIDP-TE	Technical Interface Design Plan - Test Edition
TN	Track Number
TOA	Time of Arrival
TPQ	Target Position Quality
TQ	Track Quality
TR	Transmit/Receive
TRANSEC	Transmission Security
UHF	Ultra High Frequency
UME	Unformatted Message Element
UPS	Universal Polar Stereographic
USS	User Source Synchronization
UTM	Universal Transverse Mercator
W/ES	Weapon Engagement Status
WES	Weapon Engagement Status
WGS-84	World Geodetic System-84
WILCO	Will Comply

3.2 TERMS, DEFINITIONS, AND CONVENTIONS

The following terms and conventions are used for the purpose of this standard:

SHALL	indicates a procedure or capability is mandatory.
MAY	indicates a procedure or capability is optional.
WILL/IS/ARE	generally used descriptively for information purposes.

This section defines the terms and definitions used in this standard.

Term	Definition
Acknowledge	The act of notifying a unit transmitting a message that the message has been received as a valid message. (MIL-STD-6011)
Active Synchronization	A procedure used by a JTIDS/MIDS 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. (Derived from MIL-STD-6011)
Air Support Operations (ASO)	Air Operations in support of friendly forces, to include action against enemy surface and ground assets exclusive of air-to-air operations.
Architecture	The timing structure of the system. (System Segment Specification for JTIDS/MIDS Class 2 Terminal)
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.

Automatic Acknowledgment	A machine verification function whereby a terminal that receives a message addressed to it retransmits a copy of that message back to the source during a later time slot, verifying the receipt of the original message. (System Segment Specification for JTIDS/MIDS Class 2 Terminal).
Bit	A binary digit. In the binary system of numbering, each digit can only have one of two values (0 or 1). (Derived from ACP 167E)
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/MIDS Class 2 Terminal).
Command	An order given by a commander; that is, the will of the commander expressed for the purpose of bringing about a particular action. (Joint Pub 1-02)
Command and Control JTIDS Unit(C^2 JU)	A JU with command and control (C^2) capability.
Common Track	A track on which an IU holds locally derived positional information, and the IU has correlated the track to a remotely reported track. (MIL-STD-6011)
Common Tracking	The process of sharing a common track number and shifting reporting responsibility between IUs.
Compatibility	The capability of two or more items or components of equipment or materiel to exist or function in the same system or environment without mutual interference. (Joint Pub 1-02)

Concurrent Operations	The process of communicating on two, or more, digital data links at the same time, as a participant. The concurrent operating unit exchanges with these links all information held in its local data base, but remote information is not forwarded. Protocols of each link are adhered to by the concurrent operating unit. The local data base of a concurrent operating unit is the normal assimilation of data by that unit and includes local sensor data, local operator inputs, and data received and accepted into the local database from a data link, e.g., ID or IFF/SIF data.
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 pseudorandomly.
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 Element	A basic unit (class) of information having a unique meaning and subcategories (data items) of distinct units or values. Examples of data elements are military personnel grade, sex, race, geographic location, and military unit. (Joint Pub 1-02) The Link 16 data element is the Data Use Identifier (DUI).
Data Field Identifier (DFI) (JTIDS/MIDS)	A category of data whose specification includes one or more Data Use Identifier (DUI) specifications. Each DUI's class of data must fall within the bounds of the DFI category.

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 link(s). In the process, a message(s) received on one link is translated to an appropriate message(s) on another link. Data forwarding is accomplished by the selected forwarding units(s) simultaneously participating on more than one type of data link. The 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 the forwarded message.
Data Item (JTIDS/MIDS)	A subunit of descriptive information or value classified under a data element. For example, the data element "military personnel grade" contains data items such as sergeant, captain, and colonel. (Joint Pub 1-02).
Data Link	The means of connecting one location to another for the purpose of transmitting and receiving data. (Joint Pub 1-02)
Data Mile (DM)	A standard unit of distance - 6000 feet. (Joint Pub 1-02)
Data Source	A unit to which data can be addressed and from which data can be identified as to source, e.g., all IUs. (MIL-STD-6011)
Data Symbol	A general term for representing both information symbols and parity symbols in aggregate. (System Segment Specification for JTIDS/ MIDS Class 2 Terminal)
Data Use Identifier (DUI) (JTIDS/MIDS)	A JTIDS/MIDS data element (class of data). The DUI specification determines the name and permitted contents of each message field to which the DUI is assigned, as explained below.

	A Data Field Identifier (DFI) specification includes a specification for each DUI under that DFI. Each DUI specification identifies the DUI name, and the data items and associated bit codes employed by the DUI. When a DUI is designated as the contents of a JTIDS message field, the DUI name is the field name, and the data items employed by the DUI are (subject to any implementation or message restrictions) the data items which may be conveyed in that field.
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. (MIL-STD-6011)
	(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. (MIL-STD-6011)
Dedicated Access Mode	A transmit access mode in which time slots are assigned to an individual unit for that unit's exclusive use.
Default Condition	The state automatically assumed by a terminal's hardware or software in the absence of an input directing otherwise.
Directive	(1) A military communication in which policy is established or a specific action is ordered. (Joint Pub 1-02)
	(2) A plan issued with a view to putting it in effect when so directed, or in the event that a stated contingency arises. (Joint Pub 1-02)
	(3) Broadly speaking, any communication that initiates or governs action, conduct, or procedure. (Joint Pub 1-02)

Drop Track	An indication from the unit having reporting responsibility for a particular track that the unit will no longer report it. Other units holding an interest in that track may continue to report it. (Derived from Joint Pub 1-02)
Dual Designation	The same track is being reported by two or more units using two or more different track numbers. (MIL-STD-6011)
Duplicate Track Number	The same track number used by two or more units for two or more different tracks. (MIL-STD-6011)
Dynamic Network Management	Management of the network by active participation of a network manager in response to changing needs during operations, typically by use of Network Management messages.
Electronic Attack (EA)	Actions taken to prevent or reduce an enemy's effective use of the electromagnetic spectrum. EA includes electronic jamming, and electronic deception including manipulative deception, simulative deceptive and imitative deception. (Derived from Joint Pub 1-02) (corresponds to the term Electronic Countermeasures (ECM) used in NATO operations)
Electronic Protection (EP)	Actions taken to ensure effective friendly use of the electromagnetic spectrum despite the enemy's use of EW. (Derived from Joint Pub 1-02) (corresponds to the term Electronic Counter-Countermeasures (ECCM) used in NATO operations)
Electronic Warfare (EW)	Actions involving the use of electromagnetic energy to determine, exploit, reduce, or prevent hostile use of the electromagnetic spectrum, and actions retaining friendly use of the electromagnetic spectrum. There are three divisions within EW: EA, EP, and ES. (Derived from Joint Pub 1-02)

Electronic Warfare Support (ES)	Actions taken to search for, intercept, locate, record, and analyze radiated electromagnetic energy for the purpose of exploiting such radiations in support of military operations. Thus, ES provides a source of EW information required to conduct EA, EP, threat detection, warning, avoidance, target acquisition, and homing. (Derived from Joint Pub 1-02) (corresponds to the term Electronic Warfare Support Measures (ESM) used in NATO operations)
Emergency Track	A track in a condition that requires immediate action or assistance; namely, an aircraft with an emergency situation or a distressed vessel. (Derived from MIL-STD-6011)
Engagement Status	The current relationship between a weapon system and a target. (Derived from MIL-STD-6011)
Environment/Category	The environment in which the associated track is operating; e.g., air, surface, subsurface.
Epoch	A 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/MIDS Class 2 Terminal)
Error Correction Encoding	The JTIDS forward error correction encoding function that utilizes Reed-Solomon encoding of data. See Reed-Solomon Code. (System Segment Specification for JTIDS/MIDS Class 2 Terminal)

Error Detection Encoding	An encoding process that allows the detection of a residual message error condition after the error correction function (Reed-Solomon) is executed. The process generates a 12-bit parity code for each block of 225 bits, using a (237, 225) polynomial generator function. (System Segment Specification for JTIDS/MIDS Class 2 Terminal)
Extended Range	The longer of two range options for a JTIDS/MIDS terminal, providing a line-of-sight range capability of 0-500 nautical miles with respect to the allocated propagation for message transmission. (Derived from System Segment Specification for JTIDS/MIDS Class 2 Terminal)
Fine Synchronization	The state of synchronization with system time that allows a terminal to transmit messages. A terminal may utilize a passive or an active synchronization procedure to achieve fine synchronization. (System Segment Specification for JTIDS/MIDS Class 2 Terminal)
Fixed Word Format (FWF)	A 70-bit structure consisting of a formalized arrangement of predefined fields of fixed length and sequence.
Fixed Word Format Message	A J-Series message utilizing fixed word format (FWF). An FWF message is started by an initial word which may be then 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. (CJCSM 6120.01)
Forwarding JTIDS Unit (FJU)	A JU that translates and forwards data among IUs using J-series messages and M-Series messages. An FJU is either an FJUA, FJUB, or FJUAB.
Forwarding JTIDS Unit A (FJUA)	A JU communicating on both Link 11 and Link 16 while forwarding information between Link 11 and Link 16 participants.

Forwarding JTIDS Unit B (FJUB)	A JU communicating on both Link 11B and Link 16 while forwarding information between Link 11B and Link 16 participants.
Forwarding JTIDS Unit AB (FJUAB)	A JU communicating on Link 16, Link 11, and Link 11B while forwarding information among Link 16, Link 11, and Link 11B participants.
Forwarding Participating Unit (FPU)	A PU that is forwarding data between Link 11 and one or more RUs.
Forwarding Reporting Unit (FRU)	An RU that is forwarding data between two or more RUs.
Free Text Message	Bit-oriented messages whose information bits may be used to represent digitized voice, teletype and other forms of free text information. (System Segment Specification for JTIDS/MIDS Class 2 Terminal)
Geodetic Position Quality (Q_{pg})	A measure of the quality of a JTIDS/MIDS terminal's geodetic positionreported in the terminal's Position and Status Reports. Geodetic Position Quality is reported as an integer from 0-15 where the higher numbers correspond to the higher qualities, i.e., lower errors in position. (System Segment Specification for JTIDS Class 2 Terminal)
Handover	The passing of control authority of an aircraft or other air vehicle from one control agency to another control agency. Handover action is complete when the receiving controller acknowledges assumption of control authority. (Derived from MIL-STD-6011)
Header (Message)	The leading bits of each message are coded as a (16, 7) Reed-Solomon code-word that provides 35 bits of information and 45 bits of associated forward error correction code. (System Segment Specification for JTIDS/MIDS Class 2 Terminal)

Information Symbol	A 5-bit data element comprising both information and error detection code (inner parity) bits, or a combination of both. The information bits may represent either Reed-Solomon generated information or non-error-coded information. (System Segment Specification for JTIDS Class 2 Terminal)
Initial Entry	The procedure by which a subscriber terminal becomes a system participant initially and may achieve coarse synchronization with system time. (System Segment Specification for JTIDS/MIDS Class 2 Terminal)
Initial Entry JTIDS Unit (IEJU)	Any JTIDS/MIDS unit that transmits the Initial Entry message in the appropriate time slot.
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.
Intelligence	The product resulting from the collection, processing, integration, analysis, evaluation, and interpretation of available information concerning foreign countries or areas. (Joint Pub 1-02)
Interface	A boundary or point common to two or more similar or dissimilar command and control systems, subsystems, or other entities against which or at which necessary information flow takes place. (Joint Pub 1-02)
Interface Operating Procedures (IOP)	A document used to provide a functional understanding of data exchange on a Tactical Data Link (TDL) and to describe operator initiated actions and their effect on the exchange of data.
Interface Unit (IU)	A JU, PU, or RU communicating directly or indirectly (i.e., identified as a data source) on the interface.

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. (System Segment Specification for JTIDS Class 2 Terminal)
Interoperability	(1) The ability of systems, units or forces to provide services to and accept services from other systems, units or forces and to use the services so exchanged to enable them to operate effectively together. (Joint Pub 1-02) (2) The condition achieved among communications-electronics systems or items of communications-electronics equipment when information or services can be exchanged directly and satisfactorily between them and/or their users. The degree of interoperability should be defined when referring to specific cases. (Joint Pub 1-02) (3) The ability to exchange data in a prescribed manner and the processing of such data to extract intelligible information which can be used to control/coordinate operations.
Jam Strobe	A line projecting from a jammed radar on the approximate azimuth of the jamming source. (MIL-STD-6011)
Joint	Connotes activities, operations, organization, etc., in which elements of more than one Service of the same nation participate. (Joint Pub 1-02)

JTIDS	Joint Tactical Information Distribution System. The JTIDS/ MIDS is a joint-service system which provides an Integrated Communications, Navigation, and Identification (ICNI) capability. The JTIDS/MIDS 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. (Derived from System Segment Specification for JTIDS/ MIDS Class 2 Terminal)
JTIDS/MIDS Net	One of 128 time-division structures comprising a JTIDS/MIDS 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/MIDS Network	The JTIDS/MIDS structure (usable only with Mode 1 communications) 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/MIDS Unit (JU)	A unit communicating directly on Link 16.
Local Data	Data derived from organic sensors and/or the IU's own capabilities to process, analyze, and classify track data, including data received from a remote source on a local track and accepted into the IU's database.

Local Track	A track established within an interface unit based on local positional data. Amplifying data associated with the track may be derived locally, from supporting units, or from data links. (MIL-STD-6011)
Machine Receipt	See Automatic Acknowledgement.
Message	Any thought or idea expressed briefly in a plain, coded, or secret language, prepared in a form suitable for transmission by any means of communications. (Joint Pub 1-02)
Message Standard	A set of protocols consisting of rules, procedures, formats, data element definitions, or other conventions for information exchange and related interactions agreed upon between cooperating systems to ensure interoperability.
Message Translation	The process by which a message or sequence of messages received on one data link is transformed to the appropriate message or message sequence required for transmission on another data link.
Minimum Implementation	The statement of minimum data exchange requirements that must be implemented by Service/Agency systems participating on the Joint Tactical Data Link (TDL) 16 Interface to ensure the continued flow of information. This is defined in terms of requirements that must be met at seven different levels: Functional, Related Function, Message, Related Message, Word, Data Element, and Data Item.
Minimum Information Exchange Requirements	Those categories of information that must be exchanged between operational facilities in order to provide commanders with essential information for decision making.

Mode 1 Communications	Mode 1 JTIDS/MIDS transmissions consist of a sequence of wide-band transmission symbol packets (single pulse, 13-microsecond packets and double-pulse, 26-microsecond packets), the pulses of which are formed by continuous phase shift modulation (CPSM) of the carrier frequency. The signal processing required to transform base-band data to the JTIDS signal waveforms for transmission includes base-band data encryption, forward error correction encoding, error detection encoding, cyclic code shift keying (CCSK) encoding, data symbol interleaving, and the selection of a variable start time.
Mode 2 Communications	Mode 2 JTIDS/MIDS transmissions are identical to Mode 1, except that Mode 2 operates in the narrow-band mode.
Mode 4 Communications	Mode 4 JTIDS/MIDS transmissions have signal waveform characteristics identical to Mode 2, except that Mode 4 does not employ base-band data encryption signal processing.
Navigation Controller	The Navigation Controller establishes the origin and North orientation of the U, V relative grid for the Relative Navigation function. (System Segment Specification for JTIDS/MIDS Class 2 Terminal)
Needline Participation Group	A unique list of netted subscribers compiled without regard to the specific messages they exchange with each other. This list is a means of transmitting any message to a common set of users.
Net	See "JTIDS/MIDS Net."
Net Number	A 7-bit code that identifies each net as a decimal number (0 through127). (System Segment Specification for JTIDS/MIDS Class 2 Terminal)
Network	See "JTIDS/MIDS Network."

Network Management Concepts	A set of operational concepts that deals with the allocation and assignment of JTIDS/MIDS 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/MIDS message transmission capacity.
Network Manager	A JTIDS/MIDS unit that is designated to employ the required tools to allocate, assign, and manage the JTIDS/MIDS network resources.
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 (NTR)	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 (nonC^2 JU)	A JU without command and control capability.
Normal Mode	The standard mode of terminal operation with respect to receipt and transmission of messages. (System Segment Specification for JTIDS/MIDS Class 2 Terminal)

Normal Range	The shorter of two range options for a JTIDS/MIDS terminal, providing a line-of-sight coverage capability of 0-300 nautical miles with respect to the allocated propagation for message transmission. (Derived from System Segment Specification for JTIDS/MIDS Class 2 Terminal)
Order	A communications which is written, oral, or by signal, that conveys instructions from a superior to a subordinate. (DOD IADB) In a broad sense, the terms "order" and "command" are synonymous. However, an order implies discretion as to the details of execution whereas a command does not. (Joint Pub 1-02)
Pairing	The establishment of an operational relationship (other than an engagement) between a friendly track and another track or point.
Parity Symbol	A 5-bit error-correction code data element generated by the Reed-Solomon encoding process. (System Segment Specification for JTIDS/ MIDS Class 2 Terminal)
Participating Unit (PU)	A unit communicating directly on Link 11. (MIL-STD-6011)
Participation Group Community (PGC)	The set of JUs assigned to participate as transmitters and/or receivers in the corresponding participation group.
Participation Group Pool	One or more time slot blocks assigned to a given participation group to satisfy participation group needs, priorities, and functional characteristics.
Passive Synchronization	A procedure used by a terminal to effect and maintain fine synchronization with system time by passive observations of Position and Status messages transmitted by other terminals. The synchronizing terminal is not required to transmit any information. (System Segment Specification for JTIDS/ MIDS Class 2 Terminal)

Perimeter Engagement	The unit is initiating multiple simultaneous engagements with no capability to perform independent kill assessment. However, W/ES values of Firing and Engagement Broken will be automatically transmitted for each missile/target pair.
Polling Mode	A mode of terminal operation whereby the terminal can receive messages but does not transmit any fixed format messages except to transmit automatic message acknowledgments, RTT interrogations, or other messages in response to special interrogations. (System Segment Specification for JTIDS/MIDS Class 2 Terminal)
Pool	One or more time slot blocks that can be used to satisfy a particular functional requirement or the total JTIDS/MIDS capacity that can be divided into pools to satisfy all functional requirements.
Position Reference	One or more JUs designated as a network reference. Such a JU has maintained a geodetic position accuracy of 50 feet, one sigma (standard deviation) over a long period of time.
Primary User	A subscriber terminal that utilizes the active synchronization (RTT) procedure and serves as a high-quality source for synchronization by the general Relative Navigation community. (System Segment Specification for JTIDS/MIDS Class 2 Terminal)
Pulse (JTIDS/MIDS)	A 6.4-microsecond burst of carrier frequency continuous phase shift modulated at a 5-megabit-per-second rate by the transmission symbol. (System Segment Specification for JTIDS/MIDS Class 2 Terminal)
Purge	Removal from database in response to internal system criteria.

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. (System Segment Specification for JTIDS/MIDS Class 2 Terminal)
Radio Silence Mode	A mode of terminal operation where the terminal receives but does not transmit fixed word format or variable message format messages. (Derived from System Segment Specification for JTIDS/MIDS Class 2 Terminal)
Receive Block	A time slot block assigned for message reception.
Receipt/Compliance	The acknowledgment of a message and/ or an indication of intent to respond to a message, either by machine acknowledgment or operator action.
Recurrence Rate	The total number of time slots per epoch assigned (or deleted) in a single time block assignment, specified as an integer, R = 0 to 15 where 2 = the number of time slots. (System Segment Specification for JTIDS/MIDS Class 2 Terminal)
Recurrence Rate Number (RNN)	An integer R, O < R < 15, where 2^R is the recurrence rate of the block assignment.
Reed-Solomon Code	As applied to JTIDS/MIDS, a forward error correction encoding scheme using a 32-ary cyclic block code in the class of generalized Bose-Chaudhuri-Hocquenguem (BCH) codes where the basic block codeword is a (31, 15)codeword, i.e., 31 5-bit data symbols per codeword, of which 15 are information symbols and 16 are parity symbols. Message headers are (16,7) codewords which are shortened (31,15) codewords where 7 are information symbols and 9 are parity symbols. (System Segment Specification for JTIDS/ MIDS Class 2 Terminal)

Relative Azimuth Quality (Qar)	A measure of the quality of a terminal's estimate of the orientation of the U,V grid with respect to grid North. Relative Azimuth Quality is reported in the terminal's Position and Status Reports as an integer from 0-7, where the higher numbers correspond to the higher qualities, i.e., lower errors in angular orientation. (System Segment Specification for JTIDS/MIDS Class 2 Terminal)
Relative Common Grid	A rectilinear planar grid tangent to the Earth surface at the grid origin whose coordinates are U, V Cartesian coordinates, where the V-axis is the North-South axis and the U-axis is the East-West axis. (System Segment Specification for JTIDS/MIDS Class 2 Terminal)
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. (System Segment Specification for JTIDS/MIDS Class 2 Terminal)
Relative Position Quality (Q_{pr})	A measure of the quality of a terminal's relative position with respect to the U, V relative grid. Relative Position Quality is reported in the terminal's Position and Status Reports as an integer from 0-15, where the higher qualities, i.e., less error in position. (System Segment Specification for JTIDS/MIDS Class 2 Terminal)
Relay	An automatic function of the JTIDS/ MIDS 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 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. (MIL-STD-6011)
Reporting Responsibility (R^2)	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 on a point-to-point data link (e.g., Link 11B) which can be identified as a data source (MIL-STD-6011)
Repromulgation	The rebroadcast of a specified message or messages. The repromulgation request field specifies the number of times the message should be relayed and the time slot in which it is to be broadcast.
Response Time End-to-End Response Time	The time from new information availability at the source JU to reception of the message at the destination JU.
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 JTIDS TIDP-TE.
Terminal Response Time	The time from new information availability at the terminal to the transmission of the information on the link. This time is part of the JU response time.

Round-Trip-Timing (RTT)	The process used by a JTIDS/MIDS terminal to directly determine the offset between its clock and that of another JTIDS/MIDS 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. (System Segment Specification for JTIDS/ MIDS Class 2 Terminal)
Secondary User	The general category for the majority of system subscriber terminals. Secondary user terminals generally utilize the Passive synchronization procedures for synchronizing in the Relative Navigation community. (System Segment Specification for JTIDS/ MIDS 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/MIDS network by different communities of users.
Static Network Management	Management of the 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. (System Segment Specification for JTIDS/MIDS Class 2 Terminal)
Supporting Unit (SU)	A unit supporting an IU and providing data for the interface, but not identified as a data source. (Derived from MIL-STD-6011)

Symbol Packet	A signal element containing either one (single-pulse symbol packet) or two (double-pulse symbol packet) 6.4-microsecond pulses. The single- pulse packet (13 microseconds) consists of a 6.4-microsecond pulse followed by a 6.6-microsecond interval of dead time; the double pulse packet (26 microseconds) consists of two 6.4-microsecond pulses separated and followed by 6.6-microsecond interval of dead time. (System Segment Specification for JTIDS/ MIDS Class 2 Terminal)
Synchronization Preamble	Sixteen symbol packets that preface each transmitted message to allow for the detection of the beginning of each message and the subsequent decoding of the entire message. (System Segment Specification for JTIDS/MIDS Class 2 Terminal)
Systematic Code	A code having the characteristic that each information block is encoded into a codeword comprised of "n" symbols in such a way that the first "k" symbols of the codeword are exactly the same as the information block and last "n-k" symbols of the codeword are redundant symbols which are functions of the information symbols. (System Segment Specification for JTIDS/MIDS Class 2 Terminal)
Tactical Command and Control	The exercise of authority and direction by a properly designated commander over assigned forces in the accomplishment of his mission. Tactical command and control functions are performed through an arrangement of personnel, equipment, communications, and procedures which are employed by a commander in planning, directing, coordinating, and controlling forces and operations in the accomplishment of his mission. (Joint Pub 1-02)

Tactical Command and Control System	The facilities, equipment, communications, procedures, and personnel essential to Theater-Level and commanders Below-Theater-Level for planning, directing, and controlling operations of assigned and attached forces pursuant to the missions assigned and which provide for the conveyance and/or exchange of data and information from one person or force to another. (Joint Pub 1-02)
Automated Tactical Command and Control System	A command and control system or part thereof which fully manipulates the movement of information from source to user without human intervention. (Automated execution of a decision without human intervention is not mandatory.) (Joint Pub 1-02)
Semiautomated Tactical Command and Control System	A machine-aided command and control system wherein human intervention is required in varying degrees to operate the system. (Joint Pub 1-02)
Manual Tactical Command and Control System	A command and control system that acquires, processes, and passes information generated by man at the source and is received, processed, and acted upon by manual means. (Joint Pub 1-02)
Tactical Digital Information Link (TADIL)	A JCS approved standardized communications link suitable for transmission of digital information. A data link is characterized by its standardized message formats and transmission characteristics.
TADIL A	A secure, netted data link utilizing parallel transmission frame characteristics and standard message formats at either 2250 or 1364 bits per second. Transmission characteristics and standards for Link 11 are set forth in MIL-STD-6011 and MIL-STD-188-203-1A.

TADIL B	A secure, point-to-point data link utilizing serial transmission frame characteristics and standard message formats at a basic speed of 600 or of 1200 bits per second. This data link interconnects tactical air defense and air control units. Transmission characteristics and standards for Link 11 are set forth in MIL-STD-6011 and MIL-STD-188-212. Message formats are the same for Link 11B and Link 11.
TADIL C	A time division data transmission link between control station and controlled aircraft. It provides the capability for automatic transmission of orders, status, and other information. Data exchange is accomplished on a fully automatic link at 5000 bits per second, using serial transmission. Transmission characteristics and standards for Link 4A are set forth in MIL-STD-6004 and MIL-STD-188-203-3.
TADIL J	A secure, jam-resistant, nodeless data link which utilizes the Joint Tactical Information Distribution System, and the protocols, conventions and fixed word message formats defined by the MIL-STD-6016.
Link 16 Interface	The tactical data exchange interface comprised of three basic components: participating JUs, the Link 16 Message Standard, and Voice Coordination Nets/Circuits. The interface may be connected via data forwarder(s) to a JTAO interface (i.e., Link 11 and/or Link 11B).
Link 16 Message	A functionally oriented, variable length string of one or more 70-bit words in either fixed word format or variable message format.

Technical Interface Concepts (TIC)	A document used to establish the conceptual foundation for the design, implementation, and test documentation for the general development of the Joint Chiefs of Staff (JCS) program for ensuring compatibility, interoperability, and operational effectiveness of tactical command and control operational facilities/systems. A TIC identifies: (a) tactical command and control systems and operational facilities of the Services/Agencies. (b) joint interface points, either manual or digital; and (c) inter-Service/Agency information to be exchanged among automated and manual tactical command and control systems.
Technical Interface Design Plan (TIDP)	An engineering implementation plan that specifies the technical standards required to achieve compatibility and interoperability as specified in the Technical Interface Concepts. The plan includes a comprehensive technical description of the operational interface, message implementation, methods, and rules for processing data between operational facilities and a final list of effective Service/Agency facilities/systems.
Terminal (JTIDS/MIDS)	The integrated equipment comprised of hardware, firmware, and software elements used as the means for participating as a system subscriber. (System Segment Specification for JTIDS/MIDS Class 2 Terminal)
Test Mode	A mode of terminal operation whereby a terminal is required to transmit Test messages. (System Segment Specification for JTIDS/ MIDS Class 2 Terminal)

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/MIDS 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. (System Segment Specification for JTIDS/ MIDS Class 2 Terminal)

Time Quality (Q_t) — A measure of the quality of a terminal's state of synchronization with system time reported in the terminal's Position and Status Report. Time Quality is reported as an integer from 0-15 where the higher numbers correspond to the higher levels of quality, i.e., lower errors in timing. (System Segment Specification for JTIDS/ MIDS Class 2 Terminal)

Time Refinement Symbols — Four transmission symbols added to each message after the synchronization preamble symbols to provide for measuring accurate time-of-arrival of messages. (System Segment Specification for JTIDS/MIDS Class 2 Terminal)

Time Slot — A 7.8125-millisecond time interval during which messages may be transmitted. (System Segment Specification for JTIDS/MIDS Class 2 Terminal)

Time Slot Assignment — The designation to the terminal of the specific time slot block in which it will transmit or receive messages.

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 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 15-bit slot field representing the decimal numbers zero to 32,767. (System Segment Specification for JTIDS/MIDS Class 2 Terminal)
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 messages from other participants.
Time Slot Reuse	A method to increase the JTIDS/MIDS network capacity by allowing more than one terminal to transmit in a single time slot on a single net number. This is appropriate for JUs in proximity to each other that have information to exchange; receivers will lock onto the message with the shortest time of arrival.
Time Slot Separation	The interval between time slots in an epoch assigned to a block expressed in terms of R (R = RRN), where the separation between time slots = 3 x 2^{15-R}.
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. (MIL-STD-6011) (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. (MIL-STD-6011).
Track Quality	A measure of the reliability of the positional information of a reported track.

Transmit Block	A time slot block assigned for the transmission of messages.
Transmission Symbol	A 32-bit sequence, one of 32 possible sequences generated by cyclic code shift keying, having a direct correlation with a 5-bit data symbol for the purpose of direct sequence spectrum spreading. (System Segment Specification for JTIDS/MIDS Class 2 Terminal)
Variable Message Format (VMF)	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.
Variable Message Format Message	A Link 16 message utilizing variable message format.
Word Format	The type of Link 16 word construction. There are four such types: initial, extension, continuation, and variable message format.

3.3 JTIDS/MIDS TECHNICAL CHARACTERISTICS

JTIDS/MIDS is a high-capacity, digital information distribution system providing integrated communications, navigation and identification capabilities. It provides secure, flexible, and jam-resistant information transfer in real time among the dispersed and mobile units characteristic of modern armed forces. JTIDS/MIDS combines characteristics designed to overcome many of the limitations common to existing systems by providing for increased system capacity and coverage, improved connectivity, survivability, jamming resistance, and reduced danger of data loss and data obsolescence.

The following discussion focuses on the JTIDS/MIDS Time Division Multiple Access (TDMA) architecture (nets and time slots) and the basic features of the JTIDS/MIDS TDMA communication network, including network protocol, transmission procedures, participation groups and messages.

3.3.1 JTIDS/MIDS TDMA ARCHITECTURE

The TDMA architecture's basic element is a single communication circuit or net that is shared by many users. The net is subdivided into time slots that can be assigned to individual JTIDS/MIDS participants (called JTIDS Units (JUs))for transmitting messages. Capacity can be expanded further by simultaneous operation on several nets. In general, a JU operates only on a single net at a time but it can switch nets on a time-slot-by-time-slot basis.

All JUs are required to operate in the TDMA network and to process the "Standard Double Pulse (DP)", "Packed-2 Single Pulse (SP)", "Packed-2 DP", "Packed-4 SP" and "Round-Trip-Timing (RTT)" message packing structures (see paragraph 3.3.9).

Any JU can transmit Standard DP, Packed-2 SP, Packed-2 DP, Packed-4 SP or RTT message packages in each time slot. The distinction between the five packing structures lies in the number of pulses transmitted, whether one or two pulses represents a data symbol and, consequently, how much data are transmitted in a time slot. JUs can transmit messages in an error correction codeword format in which error correction coding is used by receivers to correct errors caused by noise or jamming. All data in correctable codewords are error free. All data in uncorrectable codewords are rejected. Link 16 information is transmitted error correction coded. Messages also may be transmitted in a non-error coded message packing structure.

A JU can transmit or receive one Standard DP, Packed-2 SP, Packed-2 DP, or Packed-4 SP message packing structure in a time slot. A JU can alternatively transmit one RTT interrogation message in a time slot and then receive an RTT reply to that message in the same time slot. If a JU receives an RTT interrogation message for which it is a valid responder, it will then transmit an RTT reply message in the same time slot. A JU can switch between transmit and receive modes on a time-slot-by-time-slot basis in accordance with its time slot assignments.

3.3.1.1 SINGLE-NET ARCHITECTURE

Figure 3.3-1 illustrates the single-net architecture. System operation divides time into 12.8-minute intervals, called epochs, with 112.5 epochs per 24-hour day. Each epoch is further divided into 7.8125-millisecond intervals, referred to as time slots (or slots) so that there are 98,304 slots per epoch. The time slots are organized into three sets (A, B, and C) of 32,768 slots per set. The slots in each set are numbered from 0 to 32,767 so that each slot is identified by its slot number and set, e.g., OA. The slots are distributed in time within each epoch so that time slot "n" of Set A follows time slot "n-1" of Set C and precedes time slot "n" of Set B, where "n" is the set of integers in the sequence 0 to 32,767.

3.3.1.2 MULTINET ARCHITECTURE

JTIDS/MIDS system capacity can be expanded by simultaneous operation on several nets. Multiple-net operation (see paragraph 3.3.6) is accomplished by assigning independent frequency-hopping patterns for each net to the pulses used to convey Link 16 information. A JU can operate on only one net in a single time slot, but it can switch nets on a time-slot-by-time-slot basis.

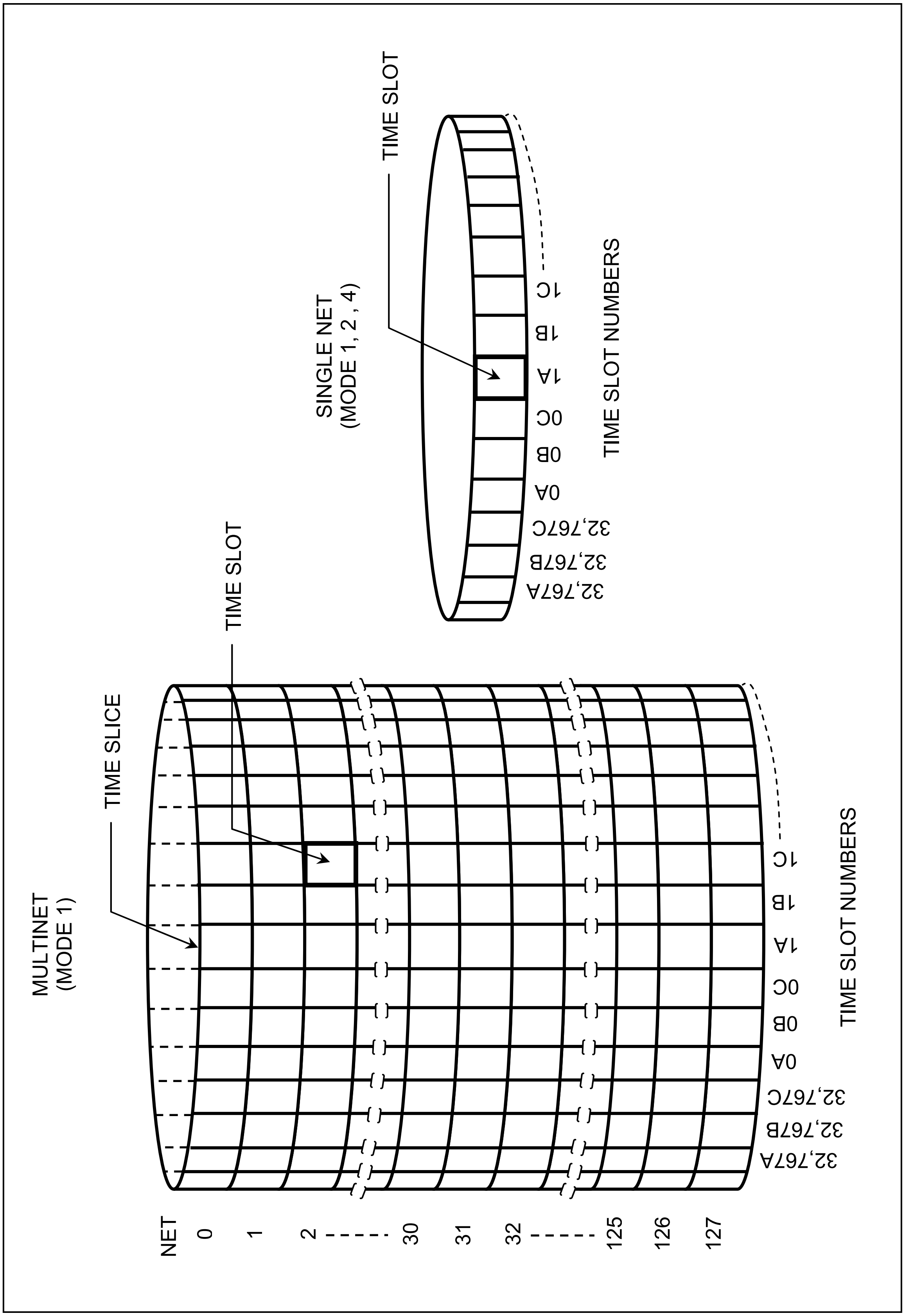


FIGURE 3.3-1. JTIDS/MIDS TDMA Architecture

3.3.2 JTIDS TDMA COMMUNICATIONS NETWORK

Functionally, the TDMA architecture is configured to provide a communication structure or network composed of multiple participation groups for network maintenance and information exchange. Appropriate protocols are provided for establishment and maintenance of the network and the protocols for control of information exchange on the network.

3.3.2.1 SYSTEM TIMING AND SYNCHRONIZATION

To maintain the TDMA discipline, JUs must be synchronized with a common network time. Network time is that time maintained by a particular JU designated as the Network Time Reference (NTR) and is the common time reference with which all other JUs synchronize. Synchronization consists of making corrections to the clock maintained in each JU and is performed in four steps; (1) initial net entry, (2) coarse synchronization, (3) fine synchronization, and (4) synchronization maintenance. These steps are performed automatically and depend only on the exchange of messages directly with the NTR or with other JUs that have synchronized with network time.

Any JU is capable of operating as the NTR. When designated as the NTR, a JU assumes its clock is correct and does not adjust its clock based on network operation (i.e., fine synchronization). There are provisions for an operator-initiated adjustment to system time by the NTR. Such an adjustment is a coordinated operation that involves the simultaneous adjustment of the clocks in the NTR and all other JUs. When a JU is not operating as the NTR, it is designated as a primary or secondary user. Primary users use the active mode and secondary users use the passive mode for achieving fine synchronization. A secondary user may use the active mode for achieving fine synchronization under certain circumstances. The steps involved in synchronization are discussed below.

3.3.2.2 NET ENTRY

To achieve initial net entry, a JU searches for and receives a valid net entry message. In communication modes 1 and 2, the terminal searches for a net entry message during a time interval that is determined by its amount of uncertainty of the estimate of system time. If the terminal fails to receive a valid net entry message during that interval, it repeats the process, expanding the uncertainty window by a predetermined method. In communication mode 4, net entry is completed upon the reception of any valid JTIDS/MIDS message.

3.3.2.3 COARSE SYNCHRONIZATION

To achieve coarse synchronization, a JU must adjust its clock so that it can identify time slots (set and number) and identify the start of time slots with sufficient accuracy to receive any message and perform the active mode of fine synchronization. Except for RTT Interrogation messages, a JU is not permitted to transmit until it has achieved fine synchronization. Coarse synchronization is performed by receiving an error-free Initial Entry message and using the time of arrival of the Initial Entry message to adjust the JU's clock. When operating in communication mode 4 (refer to paragraph 3.3.6), the Initial Entry message includes information identifying the time slot in which it was transmitted. When operating in communication mode 1 or 2, a JU is able only to decrypt the Initial Entry message received in a predefined time slot. When operating in communication modes 1 or 2, a JU must be initialized with the following parameters:

a. Code of the day.

b. Estimate of system time and an indication of the uncertainty in the estimate of time.

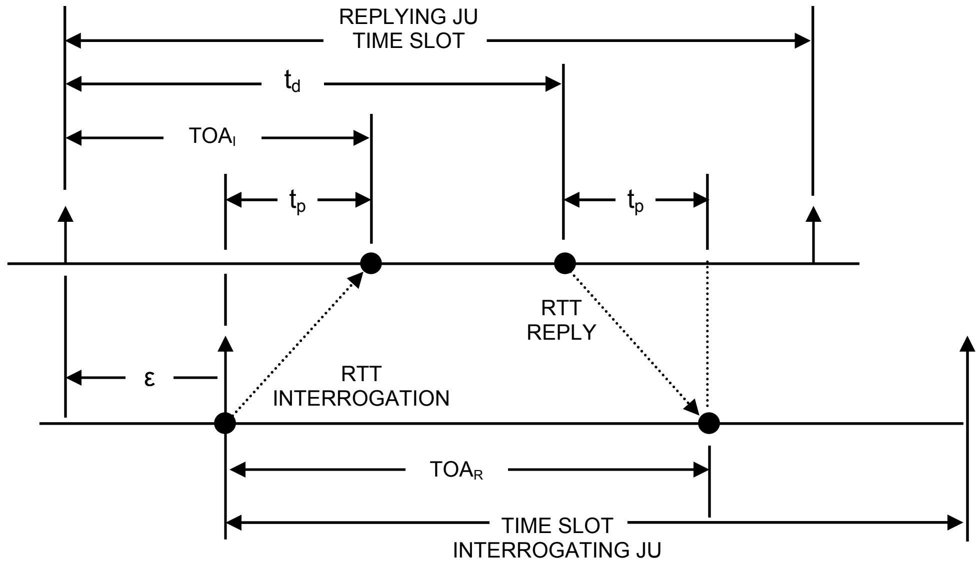
c. Source track number.

3.3.2.4 FINE SYNCHRONIZATION

Upon achieving coarse synchronization, a JU automatically begins the fine synchronization process, either actively or passively. This process is completed when a JU can predict system time with a specified accuracy. Upon achieving fine synchronization, a JU begins receiving and transmitting messages subject only to the constraints imposed by its assigned transmit mode and participation groups. The active and passive modes for achieving fine synchronization are discussed below.

3.3.2.4.1 ACTIVE MODE

The active mode uses RTT based on the RTT Interrogation and Reply messages (discussed in paragraph 3.3.10). Figure 3.3-2 illustrates the RTT process. The interrogating JU transmits an RTT Interrogation message and determines the associated RTT Reply message's Time Of Arrival (TOA_R). The interrogating JU then computes its clock correction based on the measured value of TOA_R and the value of TOA_I included in the RTT Reply message. This process is independent of the JTIDS/MIDS relative navigation function since own-position data are not required.



TOA_I = Time of arrival of the RTT Interrogation message as determined by the responding JU.

TOA_R = Time of arrival of the RTT Reply message as determined by the interrogating JU.

t_d = 4275 microseconds.

t_p = Propagation time of the RTT messages (considered to be equal for both messages since t_d is small).

ε = Initial clock offset between the two JUs, i.e., the error to be corrected by the interrogating JU.

$t_p = TOA_I - \varepsilon$ (RTT Interrogation)

$t_p = TOA_R + \varepsilon - t_d$ (RTT Reply)

$$\varepsilon = \frac{TOA_I - TOA_R + t_d}{2}$$

FIGURE 3.3-2. General RTT Algorithm

The RTT Interrogation message may be addressed to a specific JU (RTT-A Interrogation message) or unaddressed (RTT-B Interrogation message). In the latter case, a JU determines from received position reports that other units exist with time quality exceeding own-unit time quality. An interrogation message is transmitted on the net whose net number is equal to the highest time quality contained in any received position report. JUs with a time quality equal to the time quality specified in the RTT Interrogation message respond with an RTT Reply message on the net number equal to the time quality.

3.3.2.4.2 PASSIVE MODE

In the passive mode a JU simultaneously adjusts its clock and its estimate of own position (see paragraph 3.3.8) until it determines that its clock is operating within the required tolerance. The JU measures the Time Of Arrival (TOA) of error-free PPLI messages from selected JUs and combines multiple TOA measurements through a recursive filter process to determine corrections for its clock and adjustment to its own-position estimate. An estimate of own position and an estimate of position quality are required for the passive mode. A JU selects the JUs to be used in the passive mode on the basis of the time and position quality values in received PPLI messages.

3.3.2.4.3 SYNCHRONIZATION MAINTENANCE

After achieving fine synchronization JUs continue to monitor clock performance through the outputs of the filter process and perform the fine synchronization process (active or passive) as necessary to maintain synchronization with system time. If clock errors exceed predefined limits, a JU inhibits message transmission (except RTT Interrogation messages) and initiates the fine synchronization process.

3.3.3 TRANSMISSION PROCEDURES

The following paragraphs discuss the format of JTIDS/MIDS transmissions and the steps involved in preparing messages for transmission.

3.3.3.1 TRANSMISSION STRUCTURE

Figure 3.3-3 illustrates the basic JTIDS/MIDS transmission structure for RTT messages and data messages. The structure consists of the following parts:

a. Jitter. A variable time delay in the start of transmission in a time slot. Jitter is not employed when operating in communication mode 4; when RTT messages are transmitted or when transmitting messages in the Packed-2 DP or Packed-4 message packing structures (see paragraph 3.3.9.1).

b. Synchronization. A pattern of 16 DP symbol packets that allows receiving JUs to synchronize to the transmission. The pattern is changed from time slot to time slot, and within a time slot the pattern is different among nets.

c. Time Refinement (TR). A fixed pattern of four DP symbol packets used for TR.

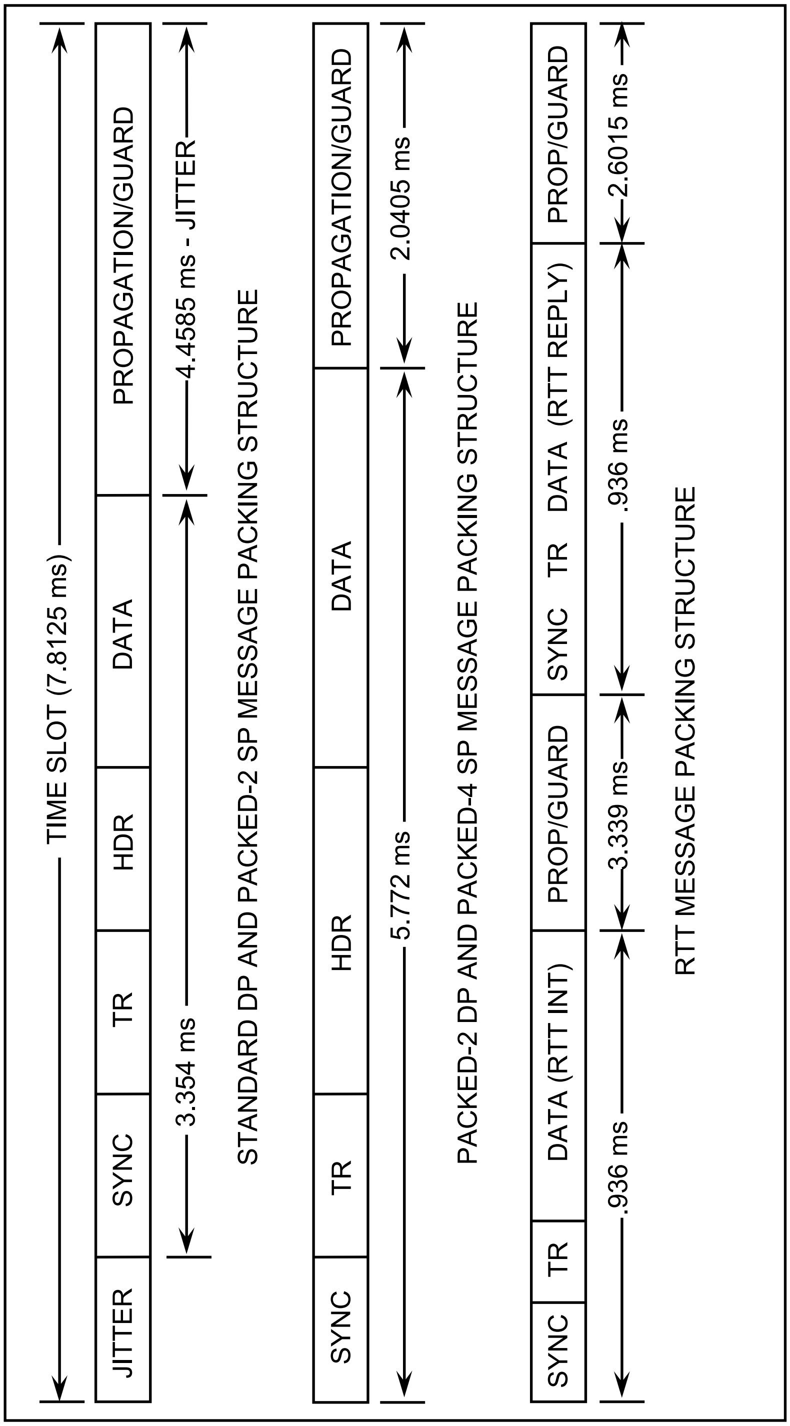
d. Header (HDR). A header word (see paragraph 3.3.9.3) that provides information concerning the message(s) transmitted in a time slot.

e. Data. Message(s) transmitted in the time slot (see paragraph 3.3.9).

f. Propagation/Guard. A time period that allows for the propagation of the signal to the maximum range and time for JUs to prepare for transmissions in the next time slot. The propagation/guard time is selectable for a maximum range of 300 nautical miles (normal) or 500 nautical miles (extended).

3.3.3.2 TRANSMISSION SIGNAL GENERATION

The steps involved in preparing a message for transmission are illustrated in Figure 3.3-3 and discussed in the following paragraphs.



Legend:
HDR - Header
INT - Interrogation
PROP - Propagation
ms - Millisecond
SYNC - Synchronization
TR - Time Refinement

FIGURE 3.3-3. JTIDS/MIDS TDMA Message Packing Structure

3.3.3.2.1 ERROR DETECTION ENCODING

For fixed and variable format messages, prior to Reed-Solomon encoding, twelve error detection parity bits are to be generated for each block of 210 data bits. This is done by using a (237, 225) polynomial code having the generating polynomial $G(X) = 1 + X^{12}$ where the "+" indicates module-2 addition over each block of 225 bits. The 225 bits include the 15 bits constituting the Track Number, Source field in the header word and the 210 data bits. The 12 parity bits are divided into three groups of four bits and a zero bit is added to the beginning of each four bits to fill the parity byte. The bytes are then combined with 70 data bits to create 75-bit words. The parity byte appears in bit positions 70 through 74 of each word.

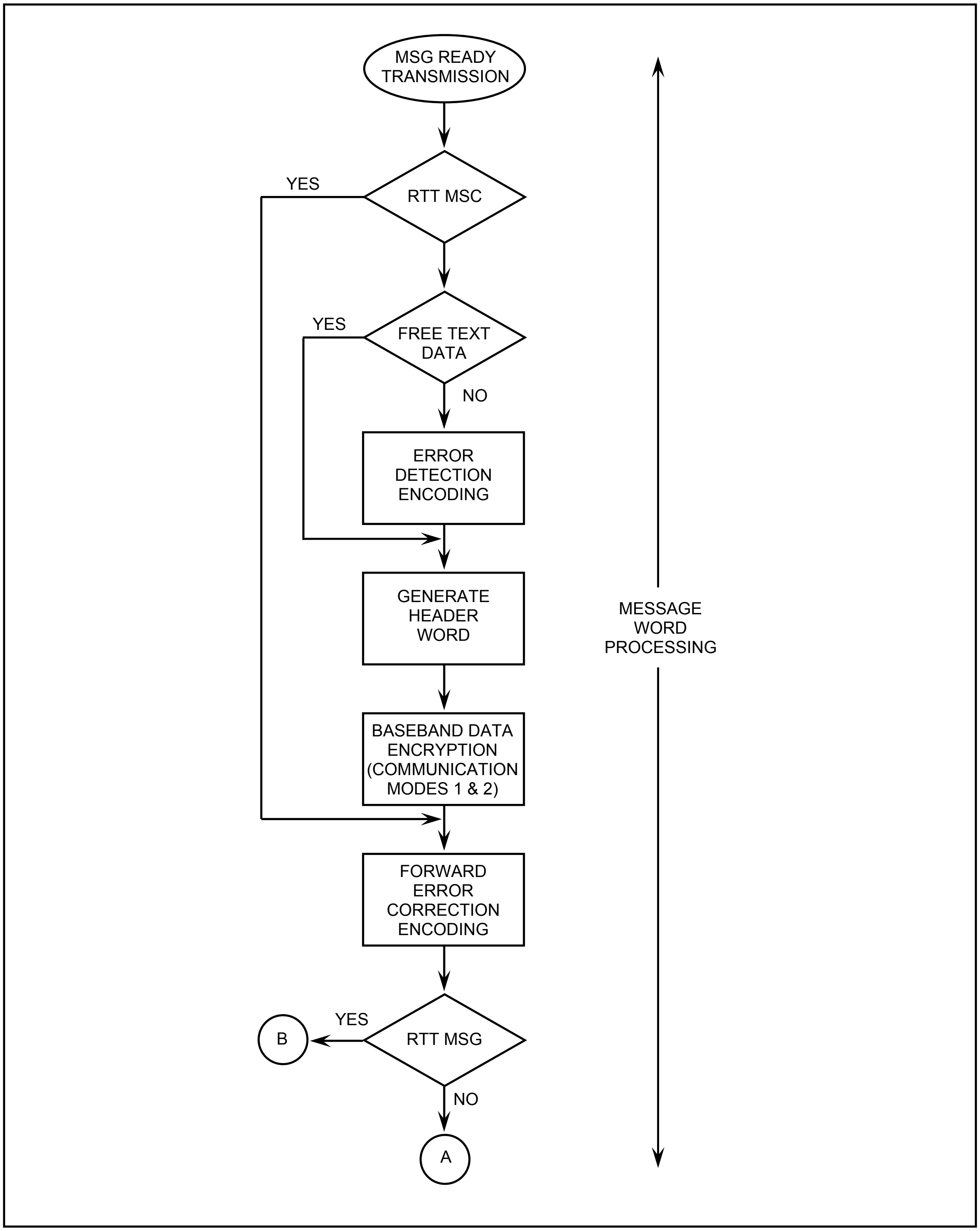


FIGURE 3.3-4. Transmission Signal Generation (Sheet 1 of 2)

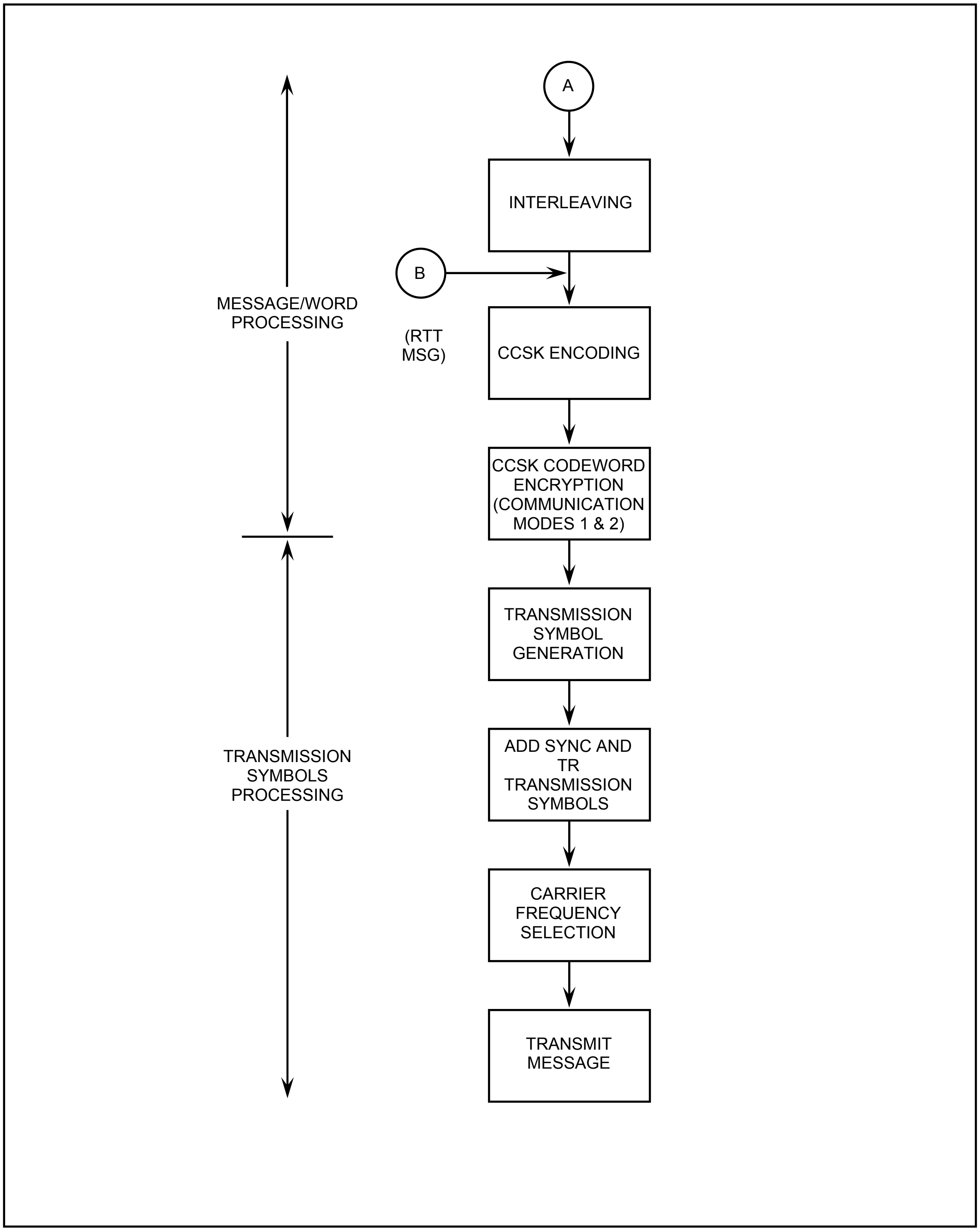


FIGURE 3.3-4. Transmission Signal Generation (Sheet 2 of 2)

3.3.3.2.2 ENCRYPTION

In communication modes 1 and 2 baseband data and cyclic code shift keying (CCSK) codewords are encrypted.

3.3.3.2.3 FORWARD ERROR CORRECTION ENCODING

The header word, fixed and variable format messages, and selected free-text messages are encoded using a Reed-Solomon code. The Reed-Solomon code is a 32-ary cyclic block code in the class of generalized Bose-Chaudhuri-Hocquenguem (BCH) codes. The Reed-Solomon encoding process converts the 35-bit header word into a (16, 7) Reed-Solomon codeword. The (16, 7) codeword contains 16 five-bit bytes, of which seven bytes contain data (35 bits of header) and nine bytes contain parity bits. The 75-bit words comprising messages are individually encoded as (31, 15) Reed-Solomon codewords. The (31, 15) codeword contains 31 five-bit bytes, of which 15 bytes contain data and 16 bytes contain parity bits. The (31, 15) and (16, 7) codewords can be encoded and decoded by the same logic.

3.3.3.2.4 INTERLEAVING

In communication modes 1 and 2, the sequence of five-bit symbols comprising the Reed-Solomon encoded header word and the five-bit symbols comprising the data of the Standard DP and Packed-2 SP message packing structure is transmitted in a predetermined random order. The header symbols are interleaved among the data symbols. The header and data symbols of the Packed-2 DP and Packed-4 SP message packing structures are also transmitted in a predetermined random order. In all four message packing structures, the header symbols are transmitted in the same pulse position.

3.3.3.2.5 CYCLIC CODE SHIFT KEYING ENCODING

CCSK encoding is applied to the five-bit bytes comprising the Reed-Solomon encoded header word and message(s) after the bytes have been interleaved (if required). Table 3.3-1 illustrates the relationship between the five-bit bytes and the CCSK codewords. The 32-bit CCSK codeword for a byte is generated by left-cyclic shifting the initial CCSK codeword (S_o) n times, where n equals the value (0-31) of the byte being encoded.

TABLE 3.3-1. Cyclic Code Shift Keying Codewords

Five-Bit Byte	CCSK Codeword (32 Bits)
00000	S_0 = 01111100111010010000101011101100
00001	S_1 = 11111001110100100001010111011000
00010	S_2 = 11110011101001000010101110110001
.	.
.	.
.	.
11111	S_{31} = 00111110011101001000010101110110

3.3.3.2.6 TRANSMISSION SYMBOL PACKET GENERATION

The CCSK codewords are converted to one of two types (DP or SP) of transmission symbol packets (also called symbol packets) illustrated in Figure 3.3-5. In the DP symbol packet the same CCSK codeword is applied to both pulses. For communication modes 1 and 2, each pulse of every symbol is transmission encrypted: the 32-bit CCSK sequence is modified in a way known by all receivers enabling them to recover the CCSK sequence and; therefore, the five data bits it represents. There is no symbol packet encryption for mode 4. DP symbol packets are used for the four TR symbols following the synchronization preamble, header words of all transmissions, all symbols of the RTT Interrogation/Reply message, and all data symbols of the Standard DP and Packed-2 DP message packing structures. The SP symbol is used for the data symbols of the Packed-2 SP and Packed-4 SP message packing structures. The JU may be initialized to transmit only DP message packing structures for any participation group. The header word indicates the type of message packing structure; therefore, the receiving JU can receive any message without prior knowledge of the message packing structure transmitted.

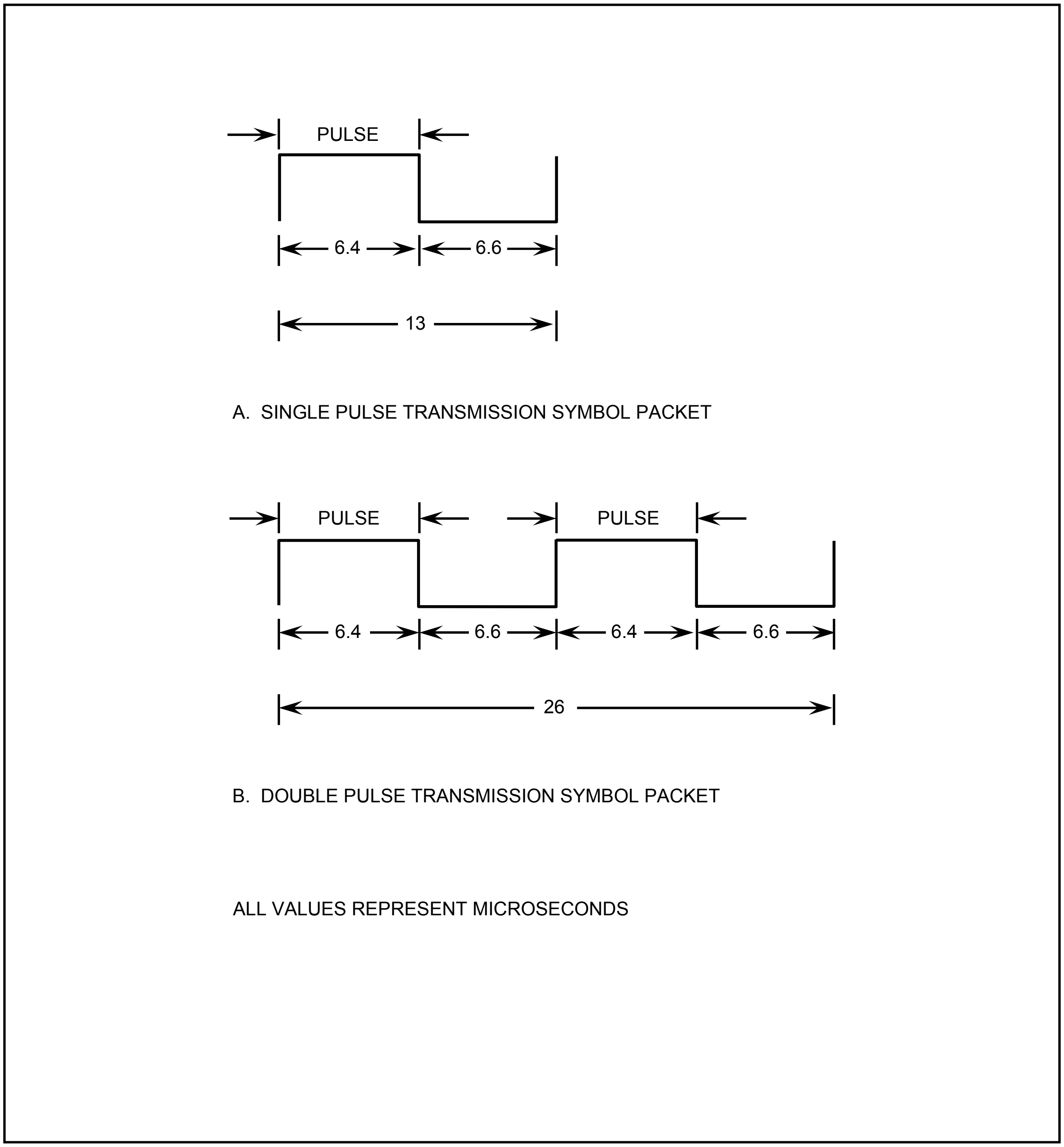


FIGURE 3.3-5. JTIDS/MIDS Transmission Symbol Packets

Each transmitted pulse consists of a burst of carrier frequency. The frequency is hopped from pulse to pulse in communication mode 1 only. The transmitted pulse is formed by continuous phase shift modulation (CPSM) of the carrier frequency at a 5-megabit-per-second rate using the 32-bit pulse sequence as the modulating signal. CPSM, also known as minimum frequency shift keying, can be viewed as phase coherent Frequency Shift Keying (FSK) modulation. Viewed as an FSK modulation, CPSM is represented by a phase coherent binary FSK signal between two frequencies, F_1 and F_2, with separation between them equal to 1/2T, where T = the digit duration of 200 nanoseconds, as illustrated in Figure 3.3-6. The nth digit is transmitted as the lower frequency if it is the same as the (n-1)st digit. The higher frequency is transmitted if it differs. Since noncoherent detection must be employed in the receiver, the frequency transmitted for the first digit of any pulse is arbitrary.

3.3.3.2.7 CARRIER FREQUENCY SELECTION

JTIDS/MIDS transmissions occur in the frequency band between 960 and 1,215 MHZ. In communication modes 2 and 4, all transmissions are made at 969 MHZ. In communication mode 1, spread spectrum modulation is employed to spread the JTIDS/MIDS energy across the band in the 51 discrete frequencies shown in Table 3.3-2. To prevent interference with the IFF system that also occupies the frequency band, frequencies are excluded in guard regions around the IFF frequencies at 1030 and 1090 MHZ. The TACAN system also occupies this band, and interference with it is prevented by the spread spectrum modulation that produces JTIDS/MIDS transmissions having low duty cycle and different pulse spacing with respect to any particular TACAN channel.

3.3.4 PARTICIPATION GROUPS

Messages are sorted into participation groups (PGs)* and are transmitted in time slots assigned to the PG into which the message has been sorted. The following paragraphs discuss PG types, time slot and net assignments, and message exchange and PG protocols.

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* Each PG may be thought of as a discrete digital communication channel operating independently from other PGs, except that the PGs do not have independent logic for initializing and maintaining communications.

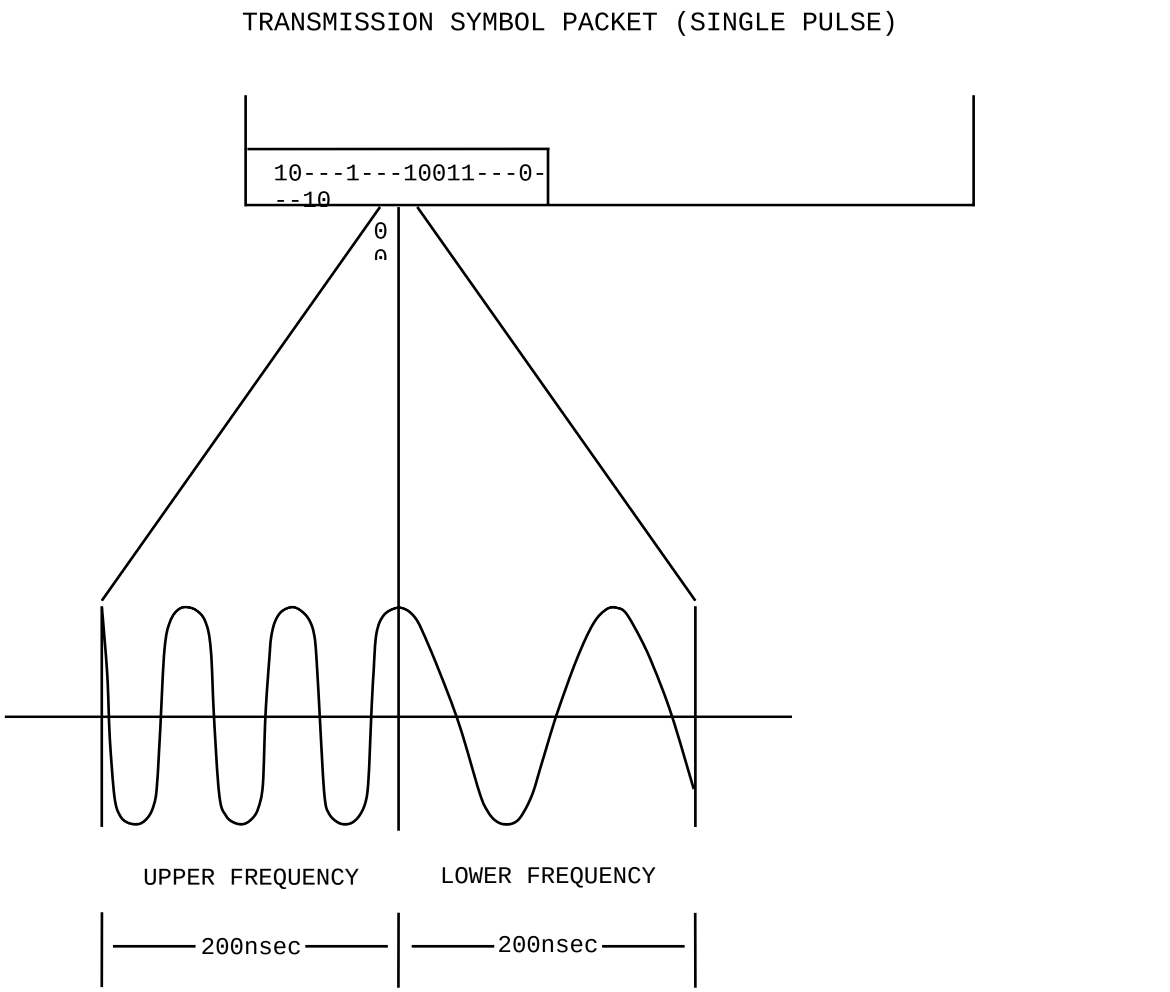

FIGURE 3.3-6. JTIDS/MIDS Waveform (Continuous Phase Shift Modulation)

TABLE 3.3-2. Carrier Frequencies (Communication Mode 1)

Frequency Number (F_n)	Frequency (MHZ)	Frequency Number (F_n)	Frequency (MHZ)	Frequency Number (F_n)	Frequency (MHZ)
0	969	17	1062	34	1158
1	972	18	1065	35	1161
2	975	19	1113	36	1164
3	978	20	1116	37	1167
4	981	21	1119	38	1170
5	984	22	1122	39	1173
6	987	23	1125	40	1176
7	990	24	1128	41	1179
8	993	25	1131	42	1182
9	996	26	1134	43	1185
10	999	27	1137	44	1188
11	1002	28	1140	45	1191
12	1005	29	1143	46	1194
13	1008	30	1146	47	1197
14	1053	31	1149	48	1200
15	1056	32	1152	49	1203
16	1059	33	1155	50	1206

3.3.4.1 PARTICIPATION GROUP TYPES

The two types of PGs are network and needline. A network PG has a function name (e.g., RTT, PPLI, Surveillance) and is defined by a list of Link 16 labels and sublabels, as specified in the JTIDS TIDP. A message designated for transmission in a network PG is sorted by its label and sublabel into the applicable PG and transmitted in a time slot assigned to that PG. Each needline PG is defined by a list of subscriber addresses. A message designated for transmission in a needline PG is assigned a destination address and sorted by its address into the applicable PG. It is transmitted in a time slot assigned to that PG.

Table 3.3-3 lists some of the defined JTIDS/MIDS network PGs and identifies their purposes and the messages that can be exchanged on them. As a minimum, a JTIDS/MIDS communications network must include the PGs identified in Table 3.3-3 (marked by *), and all JUs in an active status must participate on these PGs.

3.3.4.2 TIME SLOT AND NET ASSIGNMENTS

The capacity of a JTIDS/MIDS PG is determined by the number of time slots assigned to the PG. The time slots are assigned in blocks where each block is defined by the set and slot number of the first time slot in the block and a Recurrence Rate Number (RRN), where 2^{RRN} is the total number of time slots per epoch in the block assignment (see Table 3.3-4). The time slots in a block are equally spaced in time throughout an epoch. The net number for a PG may be predefined or selected during operation. In the latter case, the network will include multiple PGs of the same type (e.g., voice) operating in parallel.

TABLE 3.3-3. JTIDS/MIDS Network Participation Groups

PG		Purpose	Messages	Type
Index No.	Function			
0.	No Statement*			
1.	Initial Entry*	Coarse Synchronization	Network Entry	Common
2/3.	RTT-A/RTT-B*	Active Fine Synchronization	RTT Interrogation/Reply	Common
4.	Network Management*	Network Management	Network Management	Common
5/6.	PPLI and Status*	Passive Fine Synchronization	PPLI and Status Relative Navigation, JU Tactical Information Reports	Common
7.	Surveillance	Tactical Information Exchange	Surveillance and Information Management	Common/ Limited
8.	Mission Management/ Weapons Coordination	Tactical Information Exchange	Mission Management, Weapons Coordination, and Weapons Management	Limited
9.	Control	Tactical Information Exchange	Control	Limited
12/13.	Voice A/B*	Tactical Information Exchange	Free Text	Common/ Limited

* JTIDS/MIDS Terminal requirement: MANDATORY (Index No. i.a.w. the JTIDS/MIDS System Segment Specification)

TABLE 3.3-4. Time Slot Block Size and Interval

RRN*	Block Size (Time Slots/Epoch)	Time Slot Interval Time Slots	Time	
0	1	98,304	12.8	min
1	2	49,152	6.4	min
2	4	24,576	3.2	min
3	8	12,288	1.6	min
4	16	6,144	48	sec
5	32	3,072	24	sec
6	64	1,536	12	sec
7	128	768	6	sec
8	256	384	3	sec
9	512	192	1.5	sec
10	1,024	96	750	ms
11	2,048	48	375	ms
12	4,096	24	187.5	ms
13	8,192	12	93.75	ms
14	16,384	6	46.875	ms
15	32,768	3	23.4375	ms

*RRN - recurrence rate number.

3.3.4.3 MESSAGE EXCHANGE PROTOCOL

The message exchange protocol defines the conditions under which each Link 16 message will be exchanged and the procedures for exchanging each message. Some of the areas addressed in the message exchange protocol are:

a. Transmit/Receive Rules. Defines specific conditions under which a message and the individual words comprising the message are transmitted. Also defines the special rules governing the receipt of the message.

b. Message Exchange Procedures. Defines how information is exchanged and managed using the Link 16 messages. For discussion purposes (see Section 4) the message exchange procedures are grouped into technical functions, e.g., Air Surveillance.

c. Minimum Implementation. Defines the minimum amount of information that must be exchanged by a JU to interoperate using Link 16. Minimum implementation is defined at the network, functional, message, word, data element and data item levels (see Appendix A).

3.3.4.4 PARTICIPATION GROUP PROTOCOL

The PG protocol defines the rules and procedures for exchanging any message on a PG. The PG protocol includes the time slot assignment methods, access mode, and relay mode (if required).

3.3.4.4.1 TIME SLOT ASSIGNMENT METHODS

The nets and time slots are assigned to PGs by one or both of the following time slot assignment methods. The parameters involved in a time slot block assignment are listed in Table 3.3-5.

a. In the static time slot assignment method, PG nets and time slot blocks are assigned during JU initialization or by operator action during operation. Other communications media (e.g., voice) must be used for operator coordination in this assignment method.

b. In the dynamic time slot assignment method, PG nets and time slot blocks are assigned dynamically via the network management messages. One or more JUs are designated to manage the capacity of JTIDS/MIDS PGs. The designated JUs allocate/reallocate time slots between the PGs for which they are responsible in response to changing communication needs or requests from PG participants.

TABLE 3.3-5. Time Slot Block Assignment Parameters

1.	PG designation.
2.	Access mode assigned to time slot block.
3.	Indication that JU is to add or delete the specified time slot block.
4.	Time slot block designation; initial time slot number (0-32,767), time slot set (A, B, or C), and recurrence rate number (see Table 3.3-4).
5.	Time to execute assignment (epoch, time slot number) (for dynamic time slot assignment method only).
6.	Indication that JU is to use the specified time slot block for message reception or transmission.
7.	Net number (0-127) if prespecified.
8.	Access rate (for contention access mode only).
9.	Reallocation Pool Number (for time slot reallocation access mode only).
10.	KGV-8/TSEC Secure Data Unit (SDU) cryptovariables.

3.3.4.4.2 ACCESS MODES

The access modes define how time slots assigned to a JU for transmission of messages of a PG are selected. One or more of the following modes is used for each JTIDS/MIDS PG:

a. Dedicated Access Mode. In this mode, time slots assigned for transmission of a PG's messages are used as needed in order of their occurrence.

b. Contention Access Mode. In this mode, time slots are assigned to multiple JUs for transmission. A contention access rate is assigned to define intervals of time having the same rate. Once each interval, each terminal transmits in one time slot. The time slot used is selected randomly from all assigned slots that occur during the interval. The contention access mode can be used only when communication mode 1 is selected.

c. Time Slot Reallocation Access Mode. In this mode, JUs in a PGC periodically reallocate a shared pool of time slots such that a JU assigns itself time slots according to its demand and the announced demands of other JUs. If the aggregate JU demand for time slots exceeds the capacity of the pool, the JUs assign themselves slots in proportion to their demands but scaled down by a common factor such that the total allocation is within the pool capacity. The mode can be used only when Communication Mode 1 is selected.

d. Call-Up Access Mode. In this mode, time slots are allocated dynamically to JUs for transmission. The PG participants are interrogated sequentially under centralized control (roll call mode) or decentralized control (round robin mode). Upon interrogation, a JU transmits all available messages applicable to the PG, using the next n assigned time slots.

3.3.5 TRANSMIT MODES

Three operator selectable transmit modes are available to a JU. The selected transmit mode determines the conditions under which the JU may transmit messages and is set independently for each JU. The transmit modes are discussed in the following paragraphs.

3.3.5.1 NORMAL MODE

In the normal mode, a JU achieves and maintains fine synchronization, either passively or actively, and then transmits messages unconditionally, subject only to the constraints of its assigned transmit time slots and message exchange protocol.

3.3.5.2 POLLING MODE

In the polling mode, a JU achieves and maintains fine synchronization either passively or actively. A JU in the polling mode transmits fixed and variable format messages only when required to transmit (1) a message in response to a received Communication Control message addressed to the JU, and (2) an operator or machine acknowledgment message. JUs do not transmit RTT Reply messages when in the polling mode. JUs can transmit free text digital voice and RTT Interrogation messages while in the polling mode.

3.3.5.3 RADIO SILENCE MODE

In this mode, a JU achieves and maintains fine synchronization using the passive mode. A JU does not transmit any fixed or variable format messages in the radio silence mode except when it is initially set to the radio silence mode. If already in the state of fine synchronization at that time, a terminal transmits a J2 message to indicate its intent to go Conditional Radio Silence and that it cannot be used as an active synchronization source. A JU can transmit free text digital voice messages while in the radio silence mode.

3.3.6 COMMUNICATION MODES

There are three operator selectable communication modes for a JTIDS/MIDS network. The selected communication mode determines whether or not the network can operate on multiple nets (by employing frequency hopping) and the transmitted data are encrypted. All JUs in a JTIDS/MIDS network must select the same communication mode. In communication modes 2 and 4, all transmissions are made at 969 MHZ. The communication modes are:

Communication Mode	Multiple Nets	Data Encrypted
1	Yes	Yes
2	No	Yes
3	Mode Not Used	Mode Not Used
4	No	No

3.3.7 RELAY FUNCTIONS

JTIDS/MIDS employs radio relay techniques in order to extend communications coverage beyond line of sight. The relay techniques that are selectable on an individual PG basis are paired time slot and repromulgation. They are discussed below.

3.3.7.1 PAIRED TIME SLOT RELAY

In this technique, paired sets of relay receive and relay transmit time slots are assigned to a JU. The JU automatically retransmits any valid message(s) received in a relay receive time slot in the corresponding relay transmit time slot. Each paired block assigned to a JU is labeled with one of six relay functions or the PG number of the transmit assignment whose messages it is relaying. All paired blocks having the same relay function name or PG number as a label comprise the assignments for that relay function.

a. Main Net Relay Function. Messages of one or more PGs are relayed by the main net relay function when paired blocks labeled "Main Net Relay" have their relay receive blocks corresponding to the transmit blocks of those PGs. When active as a main net relay, a terminal sets the Active Relay Indicator, Wide Area Network in its PPLI messages to "active" and transmits its PPLI messages in both the Common and Special PPLI Pools. A terminal may operate in either the conditional or unconditional mode for this type of relay function.

b. Voice Relay Function. Messages of the voice PG are relayed by the voice relay function when paired blocks labeled "Voice Net Relay" have their relay receive blocks corresponding to the transmit block(s) of the voice PG assignments. If the net number of the voice PG assignments and voice relay assignments is specified as "No Statement," the voice relay net is selected by the operator for voice channel operation. A terminal in the active state of the voice relay function sets the Active Relay Indicator, Voice Channel in its PPLI message to "active." The net number also is reported in the PPLI message. A terminal may operate in either the conditional or unconditional mode for this type of relay function.

c. Control Relay Function. Messages of the control PG are relayed by the control relay function when paired blocks labeled "Control Relay" have their relay blocks corresponding to the transmit blocks of the control PG assignments. If the net number of the control PG assignments is specified as "No Statement," the control relay net is selected by the operator for control channel operation. A terminal in the active state of the voice relay function sets the Active Relay Indicator, Control Channel in its PPLI message to "active." A terminal may operate in either the conditional or unconditional mode for this type of relay function.

d. Zoom Relay Function. The paired blocks of a zoom relay function are identical with those of the main net relay function. In the main net relay function, the relay receive and relay transmit net numbers are identical. In the zoom relay assignment, the relay transmit net number is different from the transmit net number assigned the main net relay function. A JU may be assigned to operate either as a main net or zoom relay function, but not both concurrently. A JU performs the zoom relay function in the unconditional mode.

e. Directed Relay Function. The JTIDS/MIDS terminal performs a directed relay function in the unconditional relay mode (see paragraph 3.3.7.3). The "receive" and "transmit" time slots and net numbers are those paired blocks assigned to the terminal, by initialization host control or Radio Relay Control message, as directed relay blocks.

The JTIDS/MIDS terminal is capable of accepting and operating at least 16 directed relay assignments, each assignment labeled in the range 0-15.

f. Participation Group Relay Function. For this relay function, the paired block assignments are designated to be PG relay functions and are labeled with the index number of the PG whose message they are relaying.

3.3.7.2 <u>REPROMULGATION RELAY</u>

In this technique, the JU that originates a message indicates in the Repromulgation Relay message how many times a message is to be retransmitted. Then each JU assigned to relay messages on the subject PG will decrease by one the number of retransmissions indicated in the relay message and will retransmit the message once. The procedure for selecting relay transmit time slots depends on the access mode employed by the subject PG. The maximum radius of the communication coverage is the sum of the line of sight ranges of the JU that originated a message and all JUs (in one direction) that relayed the message.

3.3.7.3 RELAY MODES

All paired blocks having the same label (e.g., main net relay, voice, etc.) respond collectively to a relay control action having that label. A relay control action may be given a terminal by transmitting the initial word of the Radio Relay Control message or via initialization entry. One relay action, Delete, removes the assignments for that function from the memory of the terminal so that relay of messages in that function is no longer permitted. Four other nondelete relay control actions can be specified.

a. Suspend. A relay function of a terminal placed in the suspended mode has its assignments held in memory by the terminal; relay of messages in the function is suspended.

b. Conditional. A relay function of a JU placed in the conditional mode becomes active when it provides better communication coverage than other JUs assigned the same relay function. Only the main net, voice and control relay functions may be placed in the conditional mode.

c. Unconditional. A relay function of a JU placed in the unconditional mode relays all valid messages received in assigned relay receive time slots. In this method the maximum radius of the communication coverage is the sum of the line of sight ranges of the JU that originated a message and the JU that relayed the message.

d. Message Directed. A PG relay function may be assigned Message Directed 0 or Message Directed 1 action. If the message directed relay bit in a Variable Message Format (VMF) message is present and is the same as the assignment, the message is relayed. If not, the message is not relayed. If the message directed field is not present in a VMF message or the message is a fixed word format message, the message is relayed unconditionally.

3.3.8 RELATIVE NAVIGATION

The synchronous nature of JTIDS/MIDS provides the basis for individual JUs to determine their location relative to the other JUs. When two or more JUs have an accurate, independently derived knowledge of their geodetic position, the relative navigation function provides all JUs with accurate geodetic position data.

The relative navigation function is based on the multilateration techniques illustrated in Figure 3.3-7. A JU could determine its position in three dimensions based on the measured Time of Arrival (TOA) of PPLI messages from three JUs and the positions of the transmitting JUs (included in the PPLI messages). However, the accuracy of the multilateration technique is affected by relative JU clock errors and the fact that the TOA measurements are not made simultaneously. Therefore, the TOA measurements are combined through a recursive filter process to determine own unit position, movement, and clock corrections. For mobile JUs, dead reckoning data are used to extrapolate position data between filter operations. In addition, the dead reckoning data are supplied to the filter for optimum mixing with the movement data derived from successive position estimates. A JU selects the TOA measurements to be used in the filter process based on the estimated accuracy (quality) of its own position and time data and that of other JUs as reported in their PPLI messages.

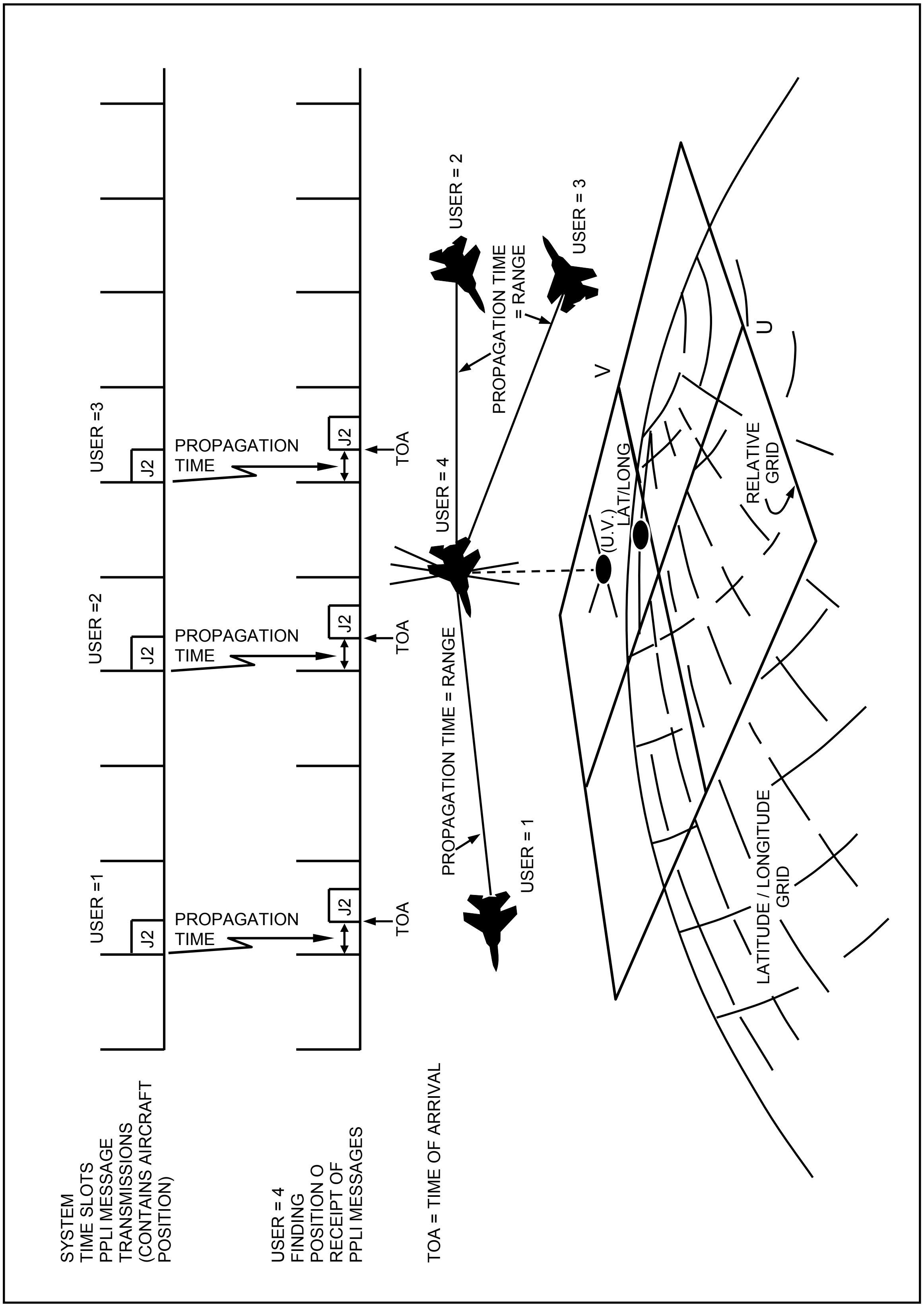

Figure 3.3-7. Position Location Using Time-of-Arrival Data

3.3.9 DATA MESSAGES

JTIDS/MIDS data messages convey information (i.e., a transfer of bits or symbols representing data) among the JUs. JTIDS/MIDS data messages convey Link 16 messages and free text information. Most JTIDS/MIDS messages fall within this category. Data messages include those being originated at the transmitting terminal and those being relayed by the transmitting terminal.

In addition to the synchronization preamble and time refinement/pulses, data messages contain a header plus the information bearing portion of the message. These data messages are further distinguished by packing structures and data formats as indicated in Figure 3.3-3. The packing structures define the amount and symbol redundancy of information that can be conveyed in a message transmission, while the data formats define the structure or formatting of the data themselves. The following paragraphs discuss the packing structures, data formats, and headers of JTIDS/MIDS data messages.

3.3.9.1 DATA MESSAGE PACKING STRUCTURES FORMATS

Data messages are transmitted in one of four message packing structures: Standard DP, Packed-2 SP, Packed-2 DP, and Packed-4 SP. In each of these formats, the header word (described more fully in paragraph 3.3.9.3) is sent as a 16-symbol, double pulse per symbol Reed-Solomon codeword. The distinction between the four structures lies in the number of data symbols transmitted to convey information and whether the symbols are SP or DP (see paragraph 3.3.3.2.6). The following paragraphs describe the four message packing structures in more detail.

3.3.9.1.1 STANDARD DP MESSAGE PACKING STRUCTURE

The information bearing portion of Standard DP JTIDS/MIDS message packing structures consists of 93 symbols. These symbols can convey three (31, 15) Reed-Solomon codewords representing 225 bits of coded information or, alternatively, 465 bits of uncoded data. Thus, the Standard DP message packing structure contains 32 pulses in the synchronization preamble, 8 pulses in the TR segment, and 218 pulses corresponding to 109 DP symbols used to convey the header plus data. The total message transmission time is 3.354 milliseconds, based on 13.0 microseconds separation between successive pulses. The Standard message packing structure can be jittered as described in paragraph 3.3.3.1.

3.3.9.1.2 PACKED-2 MESSAGE PACKING STRUCTURE

The information bearing portion of Packed-2 message packing structure consists of 186 SP symbols. These symbols can convey six (31, 15) Reed-Solomon codewords representing 450 bits of coded information or, alternatively, 930 bits of uncoded data. The data portion of the Packed-2 SP message packing structure again consists of 218 pulses, as with the Standard DP message packing structure, of which 32 pulses are used to represent the 16-symbol, double pulse per symbol header, and the remaining 186 information bearing symbols. As with the Standard DP message packing structure, the Packed-2 SP message packing structure requires 3.354 milliseconds of transmission time and can be jittered.

3.3.9.1.3 PACKED-2 DP MESSAGE PACKING STRUCTURE

The information bearing portion of Packed-2 DP JTIDS/MIDS message packing structures consists of 186 DP symbols. The Packed-2 DP message packing structure is identical to the Standard DP message packing structure, except that it contains an extra 93 DP data symbols, which are appended to the Standard message packing structure. The 186 DP symbols can convey six (31, 15) Reed-Solomon codewords representing 450 bits of coded information or, alternatively, 930 bits of uncoded data. Since the Packed-2 DP message packing structure contains 186 more pulses than Standard DP or Packed-2 SP message packing structures, the TDMA message transmission time is 5.772 milliseconds for the Packed-2 DP message packing structure. Packed-2 DP message packing structure is not jittered.

3.3.9.1.4 PACKED-4 SP MESSAGE PACKING STRUCTURE

The information bearing portion of Packed-4 SP JTIDS/MIDS message packing structure consists of 372 SP symbols. Packed-4 message packing structure is identical to the Packed-2 SP message packing structure, except that it contains an extra 186 SP data symbols, which are appended to the Packed-2 SP message packing structure. The 372 SP symbols can convey twelve (31, 15) Reed-Solomon codewords representing 900 bits of coded information or, alternatively, 1860 bits of uncoded data. As with Packed-2 DP message packing structures, the Packed-4 SP message packing structure requires 5.772 milliseconds of transmission time and cannot be jittered.

3.3.9.2 MESSAGE TYPES

JTIDS/MIDS data messages are further characterized by whether the underlying information transmitted is arranged in a fixed, predefined format (fixed format); a variable, but predefined format (variable format); or in a nonpredefined format (free text format). These message types are described in the following paragraphs.

3.3.9.2.1 FIXED FORMAT MESSAGES

A fixed format message includes up to three, six, or twelve 75-bit words (70 data bits/word), depending on the packing format and whether the DP or SP transmission symbol packet is used. The format and sequence of data fields in each word are predefined (see section 5). A message is composed of an initial word and may include extension and/or continuation words. The availability of data and the applicable message exchange protocol define the combination of extension and/or continuation words included in a message. The basic functions of these words are:

a. Initial Word. The initial word identifies the message and the sum of the extension and continuation words following the initial word, and it contains the basic data included in the message.

b. Extension Words. The extension words contain additional data that are normally included in the message. Extension words need not be transmitted in a message, but, if they are transmitted, they must be transmitted in serial order following the initial word.

c. Continuation Words. The continuation words contain amplifying (e.g., optional) data that are included in the message as required by the message exchange protocol and the availability of information. If extension words are transmitted, continuation words must be transmitted following all extension words.

A JU can transmit one or more Link 16 initial words in a single Standard DP, Packed-2 SP, Packed-2 DP, and Packed-4 SP message packing structure.

All words comprising a fixed format message must be transmitted in proper sequence in a single time slot. Multiple fixed format messages may be transmitted in a time slot.

3.3.9.2.2 VARIABLE MESSAGE FORMAT

A VMF consists of a variable length string of fields formatted into 75-bit words (70 data bits/word) for transmission. The content of individual words in a message may vary since fields can be repeated and those fields not required for a message are not transmitted. Several time slots may be required to transmit a variable message. The VMF includes word and field accountability data interspersed between or among the data fields. The order of fields in a VMF may be predefined, except that fields may be repeated, deleted, or random. In the latter case, the field accountability data consist of unique field identifiers.

3.3.9.2.3 FREE TEXT MESSAGE

Free text messages are used for the transmission of voice data and other data not in a predefined format. Only one free text message may be transmitted in a time slot. The maximum size of the message depends on whether or not the message is Reed-Solomon encoded and what message packing format is used.

3.3.9.3 HEADER WORD

A 35-bit header word is included once in each transmission (except those time slots used for RTT messages) to provide information concerning all messages transmitted in the time slot. Table 3.3-6 contains the information found in the header word. The header word is always encoded into a (16, 7) Reed-Solomon codeword (see paragraph 3.3.3.2.3).

3.3.10 ROUND TRIP TIMING MESSAGE PACKING STRUCTURE

RTT messages are used only to establish and maintain fine synchronization (see paragraph 3.3.2.4). The RTT Interrogation message and RTT Reply message contain 32 pulses in the synchronization preamble, 8 pulses in the TR segment, and 32 pulses in the data portion. The header word associated with data messages (see paragraph 3.3.9.3) is not transmitted with RTT messages. Instead, necessary header type information (e.g., SDU serial number) is included in the RTT message. The data portion of an RTT Interrogation message and an RTT Reply message consists of 16 symbols. These symbols convey (16,7) Reed-Solomon codeword representing 35 bits of coded information. The three types of RTT messages are characterized in Table 3.3-8 and are discussed below.

a. RTT-A Interrogation Message. This message is addressed to a specific unit and requests that the addressed unit respond with an RTT Reply message.

b. RTT-B Interrogation Message. This message is unaddressed and those active units with clock accuracy (Q_t) equal to the clock accuracy specified in the RTT-B message respond with an RTT Reply message. An interrogating JU specifies, in its Interrogation message, a time quality that exceeds its own time quality. The Interrogation message and Reply message are transmitted on the net having a number equal to the time quality specified in the Interrogation message.

c. RTT Reply Message. This message is transmitted in response to RTT-A and RTT-B Interrogation messages to complete the active fine synchronization process.

TABLE 3.3-6. Header Word Format

34 — 19	18 — 4	3	2 — 0
SECURE DATA UNIT SERIAL NUMBER	TRACK NUMBER, SOURCE	RI/TM	TIME SLOT TYPE

FIELD	NO. BITS	DESCRIPTION
Time Slot Type	3	Identifies message packing format, message type, and whether or not a free text message is error correction (Reed-Solomon) encoded. Details are summarized further in Table 3.3-7.
Relayed Transmission Indicator (RI)/Type Modification (TM)	1	Free Text Message. When the Time Slot Type field identifies a free text message, this field indicates whether the transmission symbol packet is double pulse (RI/TM IND = 0) or single pulse (RI/TM = 1). Fixed or Variable Format Message. When the Time Slot Type field identifies a fixed or variable format message, this field indicates whether the message(s) in the time slot were relayed (RI/TM = 1) or not relayed (RI/TM = 0).
Track Number, Source	15	Identifies the originator of the messages(s) in a time slot.
Secure Data Unit Serial Number	16	These data used in the message decryption process.

TABLE 3.3-7. Data Message Type Codes

TYPE CODE	PACKING STRUCTURE	MESSAGE TYPE	REED-SOLOMON CODING	DATA BITS CONVEYED
0(0)	STD DP	FT	NO	465
0(1)	PKD-2 SP	FT	NO	930
1(0)	PKD-2 DP	FT	NO	930
1(1)	PKD-4 SP	FT	NO	1860
2(0)	PKD-2 DP	FT	YES	450
2(1)	PKD-4 SP	FT	YES	900
3	PKD-2 SP	FF*	YES	450
4	STD DP	FF*	YES	225
5	PKD-2 DP	FF*	YES	450
6(0)	STD DP	FT	YES	225
6(1)	PKD-2 SP	FT	YES	450
7	PKD-4 SP	FF*	YES	900

DP = Double Pulse
SP = Single Pulse
PKD = Packed
FT = Free Text Messages
FF = Fixed Format Messages

* This also includes VMFs. The distinction between fixed format and VMFs is made in the 2-bit Word Format field of every word other than the header word.

TABLE 3.3-8. RTT Message Format

<table>
<tr><td></td><td>34 19</td><td colspan="2">18 4</td><td>3</td><td>2 0</td></tr>
<tr><td>RTT-A
Interrogation Msg</td><td>Secure Data Unit
Serial Number</td><td colspan="2">TN
Addressee</td><td>RTT
Type</td><td>Time
Slot
Type</td></tr>
<tr><td></td><td>34 19</td><td>18 15</td><td>14 4</td><td>3</td><td>2 0</td></tr>
<tr><td>RTT-B
Interrogation Msg</td><td>Secure Data Unit
Serial Number</td><td>Q_t</td><td>SP</td><td>RTT
Type</td><td>Time
Slot
Type</td></tr>
<tr><td></td><td>34 19</td><td colspan="4">18 0</td></tr>
<tr><td>RTT Reply Msg</td><td>Interrogator's
Secure Data Unit
Serial Number</td><td colspan="4">RTT
TOA</td></tr>
</table>

FIELD	NO. BITS	DESCRIPTION
Time Slot Type	3	Type = 2
RTT Type	1	RTT-A. RI/TM = 0 RTT-B. RI/TM = 1
TN, Addressee	15	Identifies unit that is requested to respond to this RTT Interrogation message.
SP	11	Spare.
Q_t	4	Indicates the time quality value a unit must have in order to respond to this RTT Interrogation message.
Secure Data Unit Serial Number	16	These data used in the message decryption process.
TOA	19	Time of arrival of RTT Interrogation Message measured by unit transmitting the RTT Reply message.

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SECTION 4

4. GENERAL REQUIREMENTS

4.1 GENERAL

This section describes the general requirements for exchange of digital data within the interface. This interface consists of participating Link 16 units and includes the forwarding Link 11/11B Units. The requirements for the individual messages and their transmit/receive (T/R) rules are contained in Section 5. Minimum implementation requirements for the messages are contained in Appendix A. Appendix B is the Data Element Dictionary. Data forwarding rules for the interface are provided in Appendix C. Message, data element, and data item implementation by system are provided in Appendix D and the Classified Supplement. Appendix E is the ICP repository for those ICPs that are approved by the CCB for inclusion in MIL-STD-6016.

4.1.1 MESSAGE STANDARD FUNCTIONAL AREAS

The Link 16 interface has been divided into functional areas as follows:

a. System Information Exchange and Network Management.

b. Precise Participant Location and Identification (PPLI).

c. Air Surveillance.

d. Surface (Maritime) Surveillance.

e. Subsurface (Maritime) Surveillance.

f. Land (Ground) Surveillance.

g. Space Surveillance

h. Electronic Surveillance.

i. Electronic Warfare (EW)/Intelligence.

j. Mission Management.

k. Weapons Coordination and Management.

l. Control.

m. Information Management.

The relationship of these Link 16 functional areas to the warfare tasks is shown in Table 4.1-1. Relationships among the functions may be used to group them logically for making maximum use of the Joint Tactical Information Distribution System (JTIDS) netting and system capacity.

The functions are strongly interdependent because most tasks require the use of several functions. The System Information Exchange and Network Management, PPLI, and Information Management functions are essential to the successful employment of almost all of the other functions. The Surveillance functions all require the same set of supporting functions, while broader functions such as Mission Management, Weapons Coordination and Management, and Control require varying degrees of support from most of the other functions.

Participation in each functional area includes adherence to required JTIDS Unit (JU) Response Times (Tables 4.1-2 and 4.1-3), message update rates (Table 4.1-3), priorities of message transmission, T/R rules, and the minimum implementation. JU Response Time is defined as the time from new information availability at the JU to the transmission of the information on the link. JU Response Times will vary with the criticality of the information being transmitted. As an example, Automatic Carrier Landing System (ACLS) Control information is more critical than Surface (Maritime) Surveillance information. Message update rate is defined as the periodicity of a message transmission on the link. A message update rate of not applicable (NA) in Table 4.1-3 indicates that the message will be updated when new information is available instead of on a periodic basis.

Table 4.1-1. JTIDS/MIDS User Technical Functions Versus Warfare Tasks

FUNCTION	AIRBORNE OPERATIONS	AD/AAW (A/C) OPERATIONS	AIR DEFENSE SAM OPS	AIR RECON/ SURV OPS	AIRSPACE CONTROL	AIR STRIKE INTERDIC OPS	ASW OPERATIONS	CAS OPERATIONS	FIRE SUPPORT OPERATIONS	LAND COMBAT OPERATIONS	SEARCH & RESCUE OPS	SHIP-TO-SHORE MOVEMENT
SYSTEM INFO & NETWORK MGT	X	X	X	X	X	X	X	X	X	X	X	X
PPLI	X	X	X	X	X	X	X	X	X	X	X	X
AIR SURV	X	X	X	X	X	X	X	X	X	X	X	X
SURF (MARITME) SURV		X	X	X		X	X		X		X	X
SUBSURF (MARITME) SURV				X			X				X	X
LAND (GROUND) SURV	X	X	X	X		X		X	X	X	X	X
SPACE SURV			X									
ELEC SURV		X	X	X		X	X	X	X	X	X	X
EW/INTELL	X	X	X	X		X	X	X	X	X	X	X
MISSION MGT	X	X	X	X	X	X	X	X	X	X	X	X
WEAPONS COORD & MGT	X	X	X	X	X	X	X	X	X	X	X	X
CONTROL	X	X	X	X	X	X	X	X			X	
INFO MGT	X	X	X	X	X	X	X	X	X	X	X	X

TABLE 4.1-2. JTIDS/MIDS Unit Response Time

FUNCTION	RESPONSE TIME
SYSTEM INFORMATION	
TEST REQUIREMENTS	10 SEC.
INTRA-SYSTEM REQUIREMENTS	10 SEC.
TERMINAL NET MAINTENANCE	10 SEC.
NETWORK MANAGEMENT	10 SEC.
NAVIGATION SYSTEM ALIGNMENT	1 SEC.
PPLI	10 SEC.
AIR SURVEILLANCE	10 SEC.
SURFACE (MARITIME) SURVEILLANCE	30 SEC.
SUBSURFACE (MARITIME) SURVEILLANCE	30 SEC.
LAND (GROUND) SURVEILLANCE	30 SEC.
SPACE SURVEILLANCE	10 SEC.
ELECTRONIC SURVEILLANCE	12 SEC.
INTELLIGENCE THREAT WARNING	1 TO 60 SEC.[1]
MISSION MANAGEMENT	TO BE DETERMINED
WEAPONS COORDINATION AND MANAGEMENT	10 SEC.
AIR TRAFFIC CONTROL	2 SEC.
SEARCH AND RESCUE	2 SEC.
RECONNAISSANCE	2 SEC.
RENDEZVOUS	2 SEC.
REFUEL/TANKER	2 SEC.
ASW AIR CONTROL	2 SEC.
AIR INTERCEPT CONTROL	
SINGLE ENGAGE CAPABILITY	2 SEC.
MULTIPLE ENGAGE CAPABILITY	2 SEC.
AIR SUPPORT OPERATIONS	2 SEC.
CLOSE AIR SUPPORT	2 SEC.
BEACON BOMBING	2 SEC.
INTERDICTION	2 SEC.
PRECISION BOMBING	10 SEC./0.1 SEC.[2]
LASER TARGETING	2 SEC.
AIR CARGO DELIVERY	2 SEC.
ACLS/ALS (PRECISION DIRECTION)	10 SEC./0.1 SEC.[2]
CAINS	NONE
MISSILE/RPV CONTROL	
OVER THE HORIZON TARGETING	1 SEC.
PRECISION DIRECTIONS (RPV)	0.1 SEC.
HANDOVER (UNMANNED)	1 SEC.

NOTES

1. THREAT WARNING MAXIMUM RESPONSE TIME = 1 SECOND; INTELLIGENCE IS TIME DEPENDENT ON MESSAGE CONTENT.

2. 0.1-SECOND RESPONSE TIME REQUIRED DURING FINAL CONTROL MODE.

TABLE 4.1-3. JTIDS/MIDS Unit Response Time and Update Rate by Message
(Sheet 1 of 2)

MESSAGE NUMBER	MESSAGE TITLE	RESPONSE TIME (SECS)	MESSAGE UPDATE RATE
J0.0	INITIAL ENTRY	10	12, 8-20 SECONDS
J0.1	TEST	10	SEE J0.1 T/R RULES
J0.2	NETWORK TIME UPDATE	10	SEE J0.2 T/R RULES
J0.3	TIME SLOT ASSIGNMENT	10	NA
J0.4	RADIO RELAY CONTROL	10	NA
J0.5	REPROMULGATION RELAY	10	NA
J0.6	COMMUNICATIONS CONTROL	10	NA
J0.7	TIME SLOT REALLOCATION	6	12, 6-48 SECONDS (EXCLUDING 42 SECONDS)
J1.0	CONNECTIVITY INTERROGATION	10	NA
J1.1	CONNECTIVITY STATUS	10	NA
J1.2	ROUTE ESTABLISHMENT	10	NA
J1.3	ACKNOWLEDGEMENT	10	NA
J1.4	COMMUNICANT STATUS	10	SEE J1.4 T/R RULES
J1.5	NET CONTROL INITIALIZATION	10	NA
J1.6	NEEDLINE PARTICIPATION GROUP ASSIGNMENT	10	NA
J2.0	INDIRECT INTERFACE UNIT PPLI	10	12, 8-20 SECONDS
J2.2	AIR PPLI	10	SEE J2.2 T/R RULES
J2.3	SURFACE (MARITIME) PPLI	10	SEE J2.3 T/R RULES
J2.4	SUBSURFACE (MARITIME) PPLI	10	TBD
J2.5	LAND (GROUND) POINT PPLI	10	SEE J2.5 T/R RULES
J2.6	LAND (GROUND) TRACK PPLI	10	SEE J2.6 T/R RULES
J3.0	REFERENCE POINT	10	SEE J3.0 T/R RULES
J3.1	EMERGENCY POINT	10	1.6, 1.2-2 MINUTES
J3.2	AIR TRACK	10	SEE J3.2 T/R RULES
J3.3	SURFACE (MARITIME) TRACK	30	SEE J3.3 T/R RULES
J3.4	SUBSURFACE (MARITIME) TRACK	30	SEE J3.4 T/R RULES
J3.5	LAND (GROUND) POINT/TRACK	30	SEE J3.5 T/R RULES
J3.6	SPACE TRACK	10	SEE J3.6 T/R RULES
J3.7	ELECTRONIC WARFARE PRODUCT INFORMATION	12	12, 8-20 SECONDS
J5.4	ACOUSTIC BEARING/RANGE	30	SEE J5.4 T/R RULES
J6.0	AMPLIFICATION	1-60	SEE J6.0 T/R RULES
J7.0	TRACK MANAGEMENT	10	SEE J7.0 T/R RULES
J7.1	DATA UPDATE REQUEST	10	NA
J7.2	CORRELATION	10	750, 500-1000 MSECS
J7.3	POINTER	10	NA
J7.4	TRACK IDENTIFIER	10	SEE J7.4 T/R RULES
J7.5	IFF/SIF MANAGEMENT	10	SEE J7.5 T/R RULES
J7.6	FILTER MANAGEMENT	10	NA
J7.7	ASSOCIATION	10	SEE J7.7 T/R RULES
J8.0	UNIT DESIGNATOR	TBD	NA
J8.1	MISSION CORRELATOR CHANGE	10	NA
J9.0	COMMAND	10	SEE J9.0 T/R RULES
J9.1	ENGAGEMENT COORDINATION	10	SEE J9.1 T/R RULES

LEGEND
TBD = TO BE DETERMINED
NA = NOT APPLICABLE

TABLE 4.1-3. JTIDS/MIDS Unit Response Time and Update Rate by Message
(Sheet 2 of 2)

MESSAGE NUMBER	MESSAGE TITLE	RESPONSE TIME (SECS)	MESSAGE UPDATE RATE
J10.2	ENGAGEMENT STATUS	10	SEE J10.2 T/R RULES
J10.3	HANDOVER	10	NA
J10.5	CONTROLLING UNIT REPORT	10	SEE J10.5 T/R RULES
J10.6	PAIRING	10	SEE J10.6 T/R RULES
J12.0	MISSION ASSIGNMENT	2	SEE J12.0 T/R RULES
J12.1	VECTOR	2	SEE J12.1 T/R RULES
J12.2	PRECISION AIRCRAFT DIRECTION	TBD	SEE J12.2 T/R RULES
J12.3	FLIGHT PATH	2	SEE J12.3 T/R RULES
J12.4	CONTROLLING UNIT CHANGE	2	NA
J12.5	TARGET/TRACK CORRELATION	TBD	SEE J12.5 T/R RULES
J12.6	TARGET SORTING	TBD	SEE J12.6 T/R RULES
J12.7	TARGET BEARING	TBD	SEE J12.7 T/R RULES
J13.0	AIRFIELD STATUS	TBD	SEE J13.0 T/R RULES
J13.2	AIR PLATFORM AND SYSTEM STATUS	TBD	SEE J13.2 T/R RULES
J13.3	SURFACE (MARITIME) PLATFORM AND SYSTEM STATUS	TBD	SEE J13.3 T/R RULES
J13.4	SUBSURFACE (MARITIME) PLATFORM AND SYSTEM STATUS	TBD	TBD
J13.5	LAND (GROUND) PLATFORM AND SYSTEM STATUS	TBD	SEE J13.5 T/R RULES
J14.0	PARAMETRIC INFORMATION	12	TBD
J14.2	ELECTRONIC WARFARE CONTROL/ COORDINATION	12	SEE J14.2 T/R RULES
J15.0	THREAT WARNING	1	SEE J15.0 T/R RULES
J17.0	WEATHER OVER TARGET	TBD	SEE J17.0 T/R RULES
J28.0	U.S. NATIONAL 1 (ARMY)	TBD	TBD
J28.1	U.S. NATIONAL 2 (NAVY)	TBD	TBD SEE J28.1 T/R RULES
J28.2	U.S. NATIONAL 3 (AIR FORCE)	TBD	TBD
J28.20	TEXT MESSAGE	TBD	NA
J28.3	U.S. NATIONAL 4 (MARINE CORPS)	TBD	TBD
J28.4	FR NATIONAL 1	TBD	TBD
J28.5	FR NATIONAL 2	TBD	TBD
J28.6	U.S. NATIONAL 5 (NSA)	TBD	TBD
J28.7	UK NATIONAL 1	TBD	TBD
J29.0	RESERVED	TBD	TBD
J29.1	UK NATIONAL 2	TBD	TBD
J29.3	SP NATIONAL 1	TBD	TBD
J29.4	SP NATIONAL 2	TBD	TBD
J29.5	CA NATIONAL	TBD	TBD
J29.7	AU NATIONAL MESSAGE	TBD	TBD
J30.0	GE NATIONAL 1	TBD	TBD
J30.1	GE NATIONAL 2	TBD	TBD
J30.2	IT NATIONAL 1	TBD	TBD
J30.3	IT NATIONAL 2	TBD	TBD
J30.4	IT NATIONAL 3	TBD	TBD
J30.5	FR NATIONAL 3 (ARMY)	TBD	TBD
J30.6	FR NATIONAL 4 (AIR FORCE)	TBD	TBD
J30.7	FR NATIONAL 5 (NAVY)	TBD	TBD
J31.0	OVER-THE-AIR REKEYING MANAGEMENT	TBD	TBD
J31.1	OVER-THE-AIR REKEYING	TBD	TBD
J31.7	NO STATEMENT	--	SEE J31.7 T/R RULES
RTT-A	RTT INTERROGATION-ADDRESSED	10	SEE RTT-A T/R RULES
RTT-B	RTT INTERROGATION-BROADCAST	10	SEE RTT-B T/R RULES
RTT-REP	RTT REPLY	--	SEE RTT-REP T/R RULES

4.1.2 DESCRIPTION OF INTERFACE UNITS

Units are specified by the communication function they accomplish; the following definitions for units apply throughout this document:

a. Interface Unit (IU). A generic term that applies to JTIDS Units (JUs), Participating Units (PUs), and Reporting Units (RUs) providing information to the interface.

b. JTIDS Unit (JU). A unit communicating directly on Link 16.

c. Command and Control JTIDS Unit (C^2 JU). A JTIDS unit with command and control (C^2) capability communicating directly on Link 16.

d. Noncommand and Control JTIDS Unit (nonC^2 JU). A JTIDS unit other than a C^2 JU communicating directly on Link 16.

e. Participating Unit (PU). A unit communicating directly on Link 11.

f. Reporting Unit (RU). A unit taking part in the exchange or transfer of tactical data on a point-to-point data link to which data can be addressed, and from which data can be identified as to source.

g. Indirect Unit. A PU or RU that is being forwarded onto Link 16.

h. 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.

i. Forwarding JTIDS Unit (FJU). A JU that translates and forwards data among units using J-Series messages and M-Series messages. An FJU can function in one of the configurations illustrated in Figure 4.1-1. These configurations are described below:

(1) Forwarding JTIDS Unit A (FJUA). A unit communicating on both Link 11 and Link 16 while forwarding information between Link 11 and Link 16 participants.

(2) Forwarding JTIDS Unit B (FJUB). A unit communicating on both Link 11 and Link 16 while forwarding information between Link 11 and Link 16 participants.

(3) Forwarding JTIDS Unit AB (FJUAB). A unit communicating on Link 16, Link 11, and Link 11B while forwarding information among Link 16, Link 11, and Link 11B participants.

j. Forwarding Participating Unit (FPU). A PU which is forwarding data between Link 11 and one or more RUs.

k. Forwarding Reporting Unit (FRU). An RU which is forwarding data between two or more RUs.

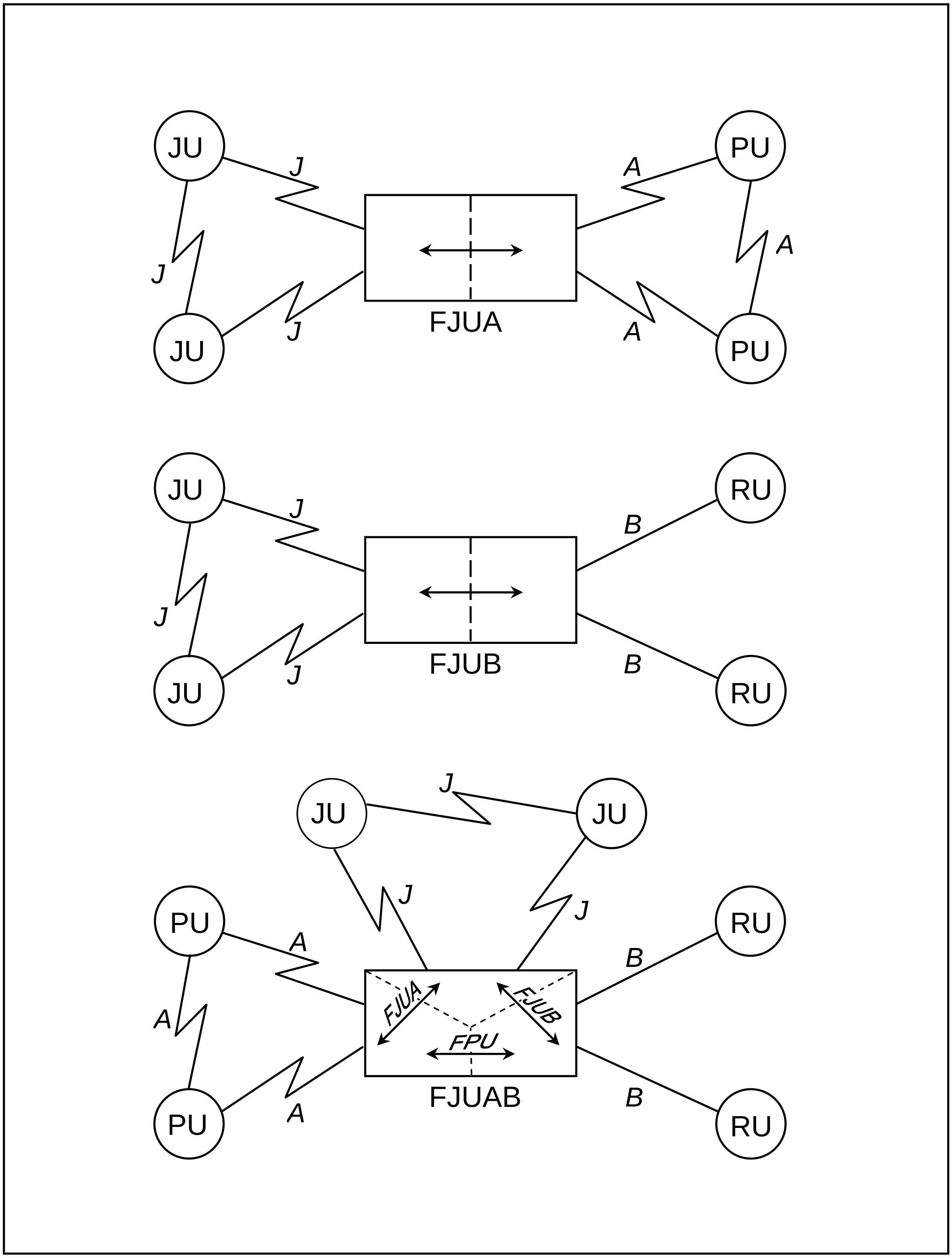


Figure 4.1-1. Representative FJU Link Configurations

4.1.3 TRACK/ADDRESS NUMBERING

A track number (TN) is used to provide a common reference number for information and directives exchanged within the interface. The reference numbers are used for both digital and voice communications to denote all IUs and/or tactical information reports, e.g., tracks. For the purpose of TN assignment, tactical information reporting includes reference numbers assigned to all tracks, strobes, bearing lines, and points exchanged on the interface. When applied to an IU, such a number is termed an address; when applied to a point, it may be an address or TN, as appropriate. In the message, the address is termed "Source TN" when used to identify the IU originating the data and is termed "Addressee TN" when used to identify the IU that is to receive the data.

4.1.3.1 TRACK NUMBER SEQUENCE AND USE

a. Whenever TNs are assigned sequentially, the sequence shall be determined by binary addition. The 19-bit Link 16 TN is composed of two 5-bit groups followed by three 3-bit groups, for a total of five characters. The 5-bit groups have a range of meaning of 0 through 7 or A through Z, less I and O. The 3-bit groups are always numeric, 0 through 7. Due to this composition, the 15-bit JU addresses are not the same as the 15 least significant bits (LSBs) of the 19-bit TN, but the 12-bit Link 11/11B TNs are the same as the 12 LSBs of the 19-bit TN. For display and database purposes, a 15-bit address is the same TN as the 19-bit TN composed of the same octal numbers. The purely numeric 5-digit Link 16 addresses and TNs are embedded between sequences containing 5-character alphanumeric TNs. By binary addition, the next 19-bit TN after the octal number 07777 is alphanumeric (octal) 0A000, not the octal number 10000. Figure 4.1-2 illustrates the composition and coding of the 19-bit TNs.

b. Table 4.1-4 specifies the complete sequence and use of Link 11, 11B, and 16 TNs. There are a total of 32,764 numeric TNs available for allocation as 15-bit addresses or 19-bit surveillance TNs (the octal numbers 00000, 00077, 00177, and 07777 cannot be allocated); and 491,520 alphanumeric TNs, each containing one or two letters, available for allocation as 19-bit surveillance TNs. Operational procedures will ensure that TNs are normally allocated in blocks which are entirely numeric or entirely alphanumeric, not a mixture. Operational procedures will further ensure that addresses are allocated from within a block or blocks which are not allocated for use as surveillance TNs to insure against the duplicate TN situation which could occur if an address is the same as a TN within an allocated block of surveillance TNs. No specific block(s) of TNs is reserved for this purpose, although testing or operational experience may dictate the need to do so. In an interface with Link 11 and/or 11B units, the block of TNs allocated as JU addresses should be below the octal number 07777 to ensure that a JU has one and only one TN throughout a Link 11/11B/16 interface. Furthermore, operational procedures will ensure that C^2 JUs which expect to exchange addressed messages with Link 11/11B units must be assigned an address below the octal number 00176.

19 18 17 16 15	14 13 12 11 10	9 8 7	6 5 4	3 2 1
0 - 7 or A - Z*	0 - 7 or A - Z*	0 - 7	0 - 7	0 - 7
5	5	3	3	3

* Except I and O

5-Bit Group

CODE	CHAR	CODE	CHAR
00000	0	10000	J
00001	1	10001	K
00010	2	10010	L
00011	3	10011	M
00100	4	00100	N
00101	5	10101	P
00110	6	10110	Q
00111	7	10111	R
01000	A	11000	S
01001	B	11001	T
01010	C	11010	U
01011	D	11011	V
01100	E	11100	W
01101	F	11101	X
01110	G	11110	Y
01111	H	11111	Z

3-Bit Group

CODE	CHAR
000	0
001	1
010	2
011	3
100	4
101	5
110	6
111	7

FIGURE 4.1-2. 19-bit Track Number Composition and Coding

TABLE 4.1-4. JTIDS/MIDS Track Number Sequence and Use [1]

TN RANGE	NO. OF TNs	TYPE[2]	USE
00000	1	N	No Statement
00001-00076	62	N	PU/FPU/FJUA/FJUAB/C^2 JU Addresses
00077	1	N	Illegal (Not Used)
00100-00175	62	N	RU/FRU/FJUB/C^2 JU Addresses
00176	1	N	Link 11/11B/16 Pseudo-Source Track Number
00177	1	N	Collective Address
00200-07776	3,967	N	Link 11/11B/16/IJMS Surveillance TNs or JU Addresses
07777	1	N	Illegal (Not Used)
0A000-0Z777	12,288	AN	Link 16 Surveillance TNs
10000-17777	4,096	N	Link 16/IJMS Surveillance TNs or JU Addresses
1A000-1Z777	12,288	AN	Link 16 Surveillance TNs
20000-27777	4,096	N	Link 16/IJMS Surveillance TNs or JU Addresses
2A000-2Z777	12,288	AN	Link 16 Surveillance TNs
. . .			
70000-77776	4,095	N	Link 16/IJMS Surveillance TNs or JU Addresses
77777	1	N	Network Manager Address
7A000-7Z777	12,288	AN	Link 16 Surveillance TNs
A0000-ZZ777	393,216	AN	Link 16 Surveillance TNs

Notes

1. All JUs shall be capable of accepting all legal track numbers described in this table. JUs that assign TNs shall also be capable of assigning all legal TNs.

2. N = Numeric (5 octal numbers, 15-bit or 19-bit; in 19-bit numeric TN, bits 19, 18, 14, and 13 must be 0).

   AN = Alphanumeric (19-bit, 5 characters; first and/or second character must be letter A-Z (less I and O), last three must be octal numbers).

4.1.3.2 ADDRESS ALLOCATION

The octal number 00000 is reserved as No Statement. The octal number 77777 is reserved as the Network Manager address. (The actual unit address for the Network Manager will not be the octal number 77777.) The octal number 00176 is reserved as the pseudo source track number address (See Appendix C, Data Forwarding). The octal number 00177 is reserved as a collective address and is not assignable as a unit address. The octal numbers 00077 and 07777 are illegal (not used) for use on the interface. Addresses for units operating on Link 11 (PUs, FPUs, FJUAs, and FJUABs) shall be assigned from the block of octal numbers 00001 through 00076. Addresses for units operating on Link 11B (RUs, FRUs, and FJUBs) shall be assigned addresses from the block of octal numbers 00100 through 00175. C^2 JU addresses shall be assigned from the blocks of octal numbers 00001 through 00076, 00100 through 00175, 00200 through 07776, and 10000 through 77776. To exchange addressed messages with Link 11/11B units, a C^2 JU must be assigned an address from the blocks of octal numbers 00001 through 00076 and 00100 through 00175. Addresses for nonC^2 JUs shall be assigned from the blocks of octal numbers 00200 through 07776 and 10000 through 77776.

4.1.3.3 TRACK NUMBER ALLOCATION

Based upon each interfacing system's requirements, blocks of contiguous numbers shall be allocated to each system for use in reporting tactical information. A system may subdivide its block(s) for allocation to subordinate units. Each unit should be allocated a larger number of TNs than its local track capacity to provide the capability to report tracks when some of its TNs are being used by other units as a result of shifts in reporting responsibility (R^2).

TN blocks are assigned to PUs, FPUs, RUs, FRUs, FJUAs, FJUBs, and FJUABs from the octal numbers 00200 through 07776. TN blocks are assigned to C^2 JUs from the octal numbers 00200 through 07776 (low TNs), 10000 through 77776 (high TNs), and alphanumeric (octal) block 0A000 through ZZ777 (high TNs). In an interface with Link 11 or Link 11B units, the block of TNs allocated to C^2 Units for the reporting of tracks, points, or lines of bearing (LOBs) should be limited (when possible) to values below the octal number 07777 so that the TN can be equated to the Link 11/11B TN. When track volume requires additional numbers, TN values greater than the octal number 07777 may be used but the equating of TNs will not be possible. In a mixed IJMS/Link 16 environment, the TN block(s) should be limited (when possible) to values below the octal number 77777 so that the TN can be equated to the Link 16/IJMS TN. If additional TNs are required, Track Numbers greater than 77777 octal may be used but the equating of TNs will not be possible. Systems operating on more than one data link shall, equate TNs between the links, such that the decimal value representation will be the same. To accomplish this, systems must be assigned track blocks among multiple links to allow for equating of TNs.

It is understood that there will be instances that will preclude limiting track numbers. It is also understood that even if track numbers are limited there will be instances where a unit will be unable to equate TNs because of a specific TN in use. In both of these cases, TNs will not be able to be equated.

C^2 JUs shall be capable of accepting a minimum of two separate noncontiguous blocks of TNs, including a low TN block and a high TN block, from any of these specified ranges. An FJU shall also be capable of accepting a Data Forwarding TN block in the range 00200-07776 for use in TN association. The Data Forwarding TN block is not required to be contiguous with or a subset of the low TN block allocated to the FJU's host IU.

Table 4.1-4 summarizes the allocation of TNs.

4.1.3.4 ADDRESS ASSIGNMENT

Each interfacing unit on Link 16 shall be assigned a specific TN for use as its address prior to joining the interface. An interfacing unit on Link 16 shall be capable of accepting any assigned address within the range of TNs allocated as addresses.

4.1.3.5 TRACK NUMBER ASSIGNMENT

Each subset of tactical information including air tracks, surface (maritime) tracks, subsurface (maritime) tracks, land (ground) tracks, bearings, fixes, and/or points, that is originated by a unit and reported within the interface shall be assigned a TN from the block(s) allocated to that system or unit. In addition, all C^2 units shall have the capability to manually assign individual TNs outside their allocated block. Each system shall ensure that two different tracks are not reported using the same TN, and that multiple TNs are not assigned to the same track. Each system may establish its own criteria for the initiation of tracks and for TN assignment and reporting within the interface. An SU shall be assigned a TN from the parent IU or unit TN allocation.

4.1.3.6 TRACK NUMBER ACCOUNTABILITY

Each C^2 IU shall be responsible for maintaining accountability of TNs. Once a TN has been assigned for reporting tactical information, that TN shall be associated with that track data for as long as the data are reported within the interface, regardless of which unit is reporting the data. Each C^2 JU shall normally assign TNs from its allocated block(s), cycling through the block(s) and skipping those numbers known to be in use. After an IU has cycled through the block(s) for the first time, TNs must be reassigned again, skipping those in current use, in such a way to preclude the confusion that can occur when the reporting of specific data is terminated and the TN is immediately reassigned. When both a low TN and a high TN block are allocated, the low TNs shall be eligible for reassignment when the upper limit of the low TN block is reached. Normally, the high TNs will be assigned only when no low TN is eligible for assignment or reassignment. Data filters, lack of correlation, or other problems may prevent a C^2 JU from recognizing that a track is being reported with a given TN. As a result, either or both of two ambiguous conditions may occur:

a. Dual Designation/Track Number Conflict. The same track is being reported by two or more units using two or more different TNs. Procedures for the prevention (i.e., correlation) and resolution of dual designations are described in paragraphs 4.4.4.3.1 and 4.7.3, respectively.

b. Duplicate TNs. The same TN is being used by two or more units to report two or more different tracks.

4.1.3.7 RESOLUTION OF DUPLICATE TRACK NUMBER

The resolution of duplicate TN reporting requires that agreement be reached via voice coordination among the conflicting units as to which track will carry the TN in use. All other tracks in question shall then be assigned their own specific TN. To minimize the probability of duplicate TNs, each unit shall assign TNs sequentially from its allocated block(s), cycling through the block(s) and skipping those numbers known to be in use.

4.1.4 DATA REGISTRATION

Data registration is a condition of correct relative alignment between local and remote track positional data. It involves measuring, computing, converting, transforming and adjusting positional data. Optimum interface data registration occurs when all the IUs hold their locally derived track positional data at the same geodetic position as the remote positional data for the same interface tracks. Geodetic position is defined in terms of latitude, longitude, and altitude in reference to an earth model.

The exchange of track positional data is fundamental to the operation of an interface. IUs which receive these reported tracks must attempt to correlate these tracks with local data. The correlation process is compounded as either the remote or local positional errors increase. The combination of remote track positional errors coupled with local track positional errors may result in dual designations.

In addition to accuracy requirements for track correlation, the use of remote data by systems using over-the-horizon targeting and remote intercept control have increased remote positional accuracy requirements.

4.1.4.1 DATA REGISTRATION ERROR SOURCES

Identified in this subsection are sources of error in data registration that occur in each of the participating IUs. The magnitude of the errors varies according to the characteristics and configuration of each IU. For example, a stationary JU which has been accurately surveyed has less potential errors in the PPLI reports than a moving JU with limited navigational capability. Each individual IU has various combinations of sensors, data processors, software techniques, etc., which comprise the total operational configuration.

The errors which impact data registration have been identified as follows:

a. Geodetic position errors.

b. Sensor errors.

c. Data processing errors.

d. Remote unit errors.

Table 4.1-5 summarizes these error sources. They are discussed in greater detail in the paragraphs that follow.

4.1.4.1.1 GEODETIC POSITION ERRORS

Geodetic position errors are associated with each JU's ability to determine its position in terms of geodetic latitude, longitude, and altitude. They are defined as the difference between the JU's reported position and the JU's position relative to the reference spheroid (normally World Geodetic System-84 (WGS-84)). Stationary JUs usually determine geodetic position through site surveys which are accomplished prior to link participation. Moving JUs derive geodetic position in real-time from the JU's navigation systems and other navigation aids (e.g., OMEGA, Tactical Air Navigation (TACAN), Global Positioning System (GPS), etc.).

TABLE 4.1-5. Summary of Data Registration Error Sources

ERROR SOURCES	CAUSE OF ERROR	COMMENT
GEODETIC POSITION	INABILITY TO LOCATE OWN UNIT'S POSITION RELATIVE TO AN EARTH MODEL (NORMALLY WGS-84).	ERROR IN GEODETIC LONGITUDE ERROR IN GEODETIC LATITUDE ERROR IN ALTITUDE
SENSOR (ALIGNMENT AND CALIBRATION)	BIAS ERRORS IN THE JU SENSOR'S AZIMUTH ORIENTATION, VERTICAL ORIENTATION (NORMAL TO TANGENT PLANE AT GEODETIC POSITION), AND RANGING MEASUREMENTS.	ERROR IN SENSOR AZIMUTH ERROR IN SENSOR ELEVATION ERROR IN SENSOR RANGE NOTE: ERRORS IN THE NORTH SEEKING DEVICE ARE INCLUDED IN THE SENSOR AZIMUTH ERROR.
DATA PROCESSING	A. COORDINATE SYSTEMS B. TRANSFORMATIONS AND CONVERSIONS C. BASIC ALGORITHMS UTILIZED D. TRACK REPORT EXTRAPOLATION	THESE ERRORS ARE RELATED TO CONSIDERATIONS SUCH AS TYPE OF DIGITAL FILTER USED, TRACKING ALGORITHMS IMPLEMENTED, ACCURACY OF TRANSFORMATION EQUATIONS, AND CONSIDERATION OF TRACK POSITIONAL-TIME RELATIONSHIPS.
REMOTE UNITS	RESIDUAL ERRORS THAT ARE ASSOCIATED WITH REMOTE UNITS.	PERFORMED ON INDIVIDUAL REMOTE UNITS WITH CORRECTION FACTORS CALCULATED IN TERMS OF MEAN TRANSLATIONAL AND MEAN ROTATIONAL PARAMETERS. THESE FACTORS ARE APPLIED TO POSITIONAL DATA RECEIVED FROM EACH INDIVIDUAL REMOTE UNIT.

Geodetic position errors affect the position reported in PPLI messages and the location of the coordinate center used for coordinate transformation equations. Coordinate transformations are performed between the JU's local tangent plane and geodetic position. If geodetic position errors are significantly large, not only are the reported tracks subjected to position errors, but also the JU's ability to correctly correlate/decorrelate local and remote tracks is seriously degraded.

Geodetic position errors are expressed as follows:

a. Delta longitude.

b. Delta latitude.

c. Delta altitude.

4.1.4.1.2 SENSOR ERRORS

Inherent in the operation of active and passive sensors are procedures required to align and calibrate the sensors' measurement systems. Normally, these procedures are accomplished prior to participation in an interface. However, due to errors in the basic alignment procedures and random measurement variables, i.e., noise drifts, index of refraction, etc., the sensor may be subjected to significant errors. These sensor errors are identified as follows:

a. Elevation errors.

b. Azimuth errors.

c. Ranging errors.

In addition, the inability of the JU to correctly sense north orientation introduces another source of error. This error, however, is compensated for when corrections are applied in the sensor's azimuth alignment during the sensor error correction process.

4.1.4.1.3 DATA PROCESSING ERRORS

Data processing errors arise from the coordinate systems utilized, the equations used with coordinate system transformations and conversions, the basic algorithms employed in the data processing, and the procedures used to extrapolate the measured data from the time of observation to the reported time.

Typical coordinate systems utilized by the JUs include the sensor oriented system that uses range, azimuth, and elevation; the rectangular coordinate system oriented in the tangent plane that uses north, east, and up; and the geodetic system which is usually modeled to WGS-84. These systems are used to transform the JU's sensor data into track position and velocity data which are used in the tracking function. The tracking function includes processes such as data smoothing, track initiation, and track updating. The equations utilized for these transformations may cause errors in excess of acceptable levels if they are not implemented to reflect accuracy requirements.

In addition, software supporting algorithms such as sine and cosine routines must also be implemented in such a manner as to minimize inaccuracies.

Extrapolation of track data must also be considered within data processing schemes. It is incumbent upon each JU to ensure that track positions accurately reflect time of observation. This is done by time tagging. Extrapolation and time tagging of tracks can ensure that the local/remote correlation and decorrelation process can account for time and position differences.

4.1.4.1.4 REMOTE IU ERRORS

All IUs which originate track positional data are subject to the errors noted above. It is anticipated that all units will attempt to minimize such errors. Under optimum conditions the results of these efforts will cause the overall data registration picture (local-to-remote differences) to be acceptable. However, under operational conditions it can happen that one or more units will have residual errors which cause unacceptable differences in local-to-remote positional data. Remote IU errors are measured by observing the positional difference between local track positions and remote track positions received from a specific remote unit. Remote IU errors are due to differences in geodetic and sensor registration between own unit and a selected remote IU.

4.1.4.2 DATA REGISTRATION MONITORING AND ADJUSTMENT PROCEDURES

Each JU which participates in the Surveillance function and has the capability to initiate or assume R^2 for surveillance tracks shall have the capability to perform data registration. These JUs shall have the capability to make periodic adjustments in accordance with the following generalized criteria:

a. JUs shall have the capability to perform monitoring and adjustment of data registration procedures using automatic or manual means.

b. Monitoring and computing of data registration should be performed with minimal interference to, or curtailment of, normal data system operation.

c. Results of data registration monitoring and adjustments shall be available for operator appreciation.

The procedures that are required to minimize the data registration errors identified in paragraph 4.1.4.1 are as follows:

a. Geodetic registration.

b. Sensor registration.

c. Data processing accuracy.

d. Remote unit registration.

Figure 4.1-3 is a simplified diagram of a typical data registration process. Figures 4.1-4 and 4.1-5 contain descriptions of the various coordinate systems used in the data registration process. The sensor system consists of range, azimuth, and elevation expressed as R, AZ, and EL respectively. R, AZ, and EL data are then transformed into an IU coordinate set defined with

X, Y, and Z where X equals east, Y equals true north and Z equals geodetic vertical. For JTIDS interface operation, the X, Y, and Z data are transformed into the Geodetic Coordinate System. This system is modeled using WGS-84 with target location expressed as ϕ for geodetic latitude, λ for geodetic longitude, and H for altitude.

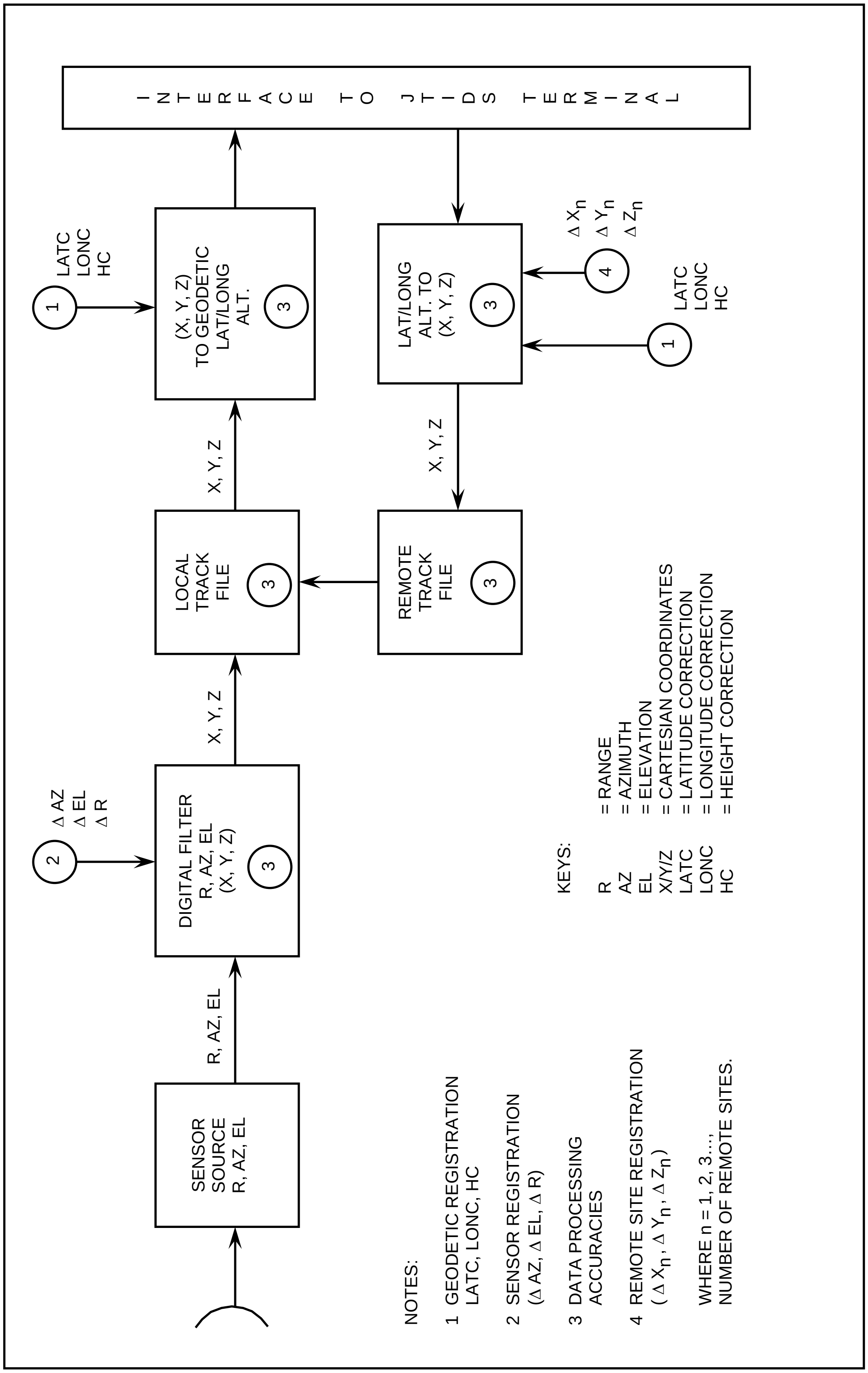
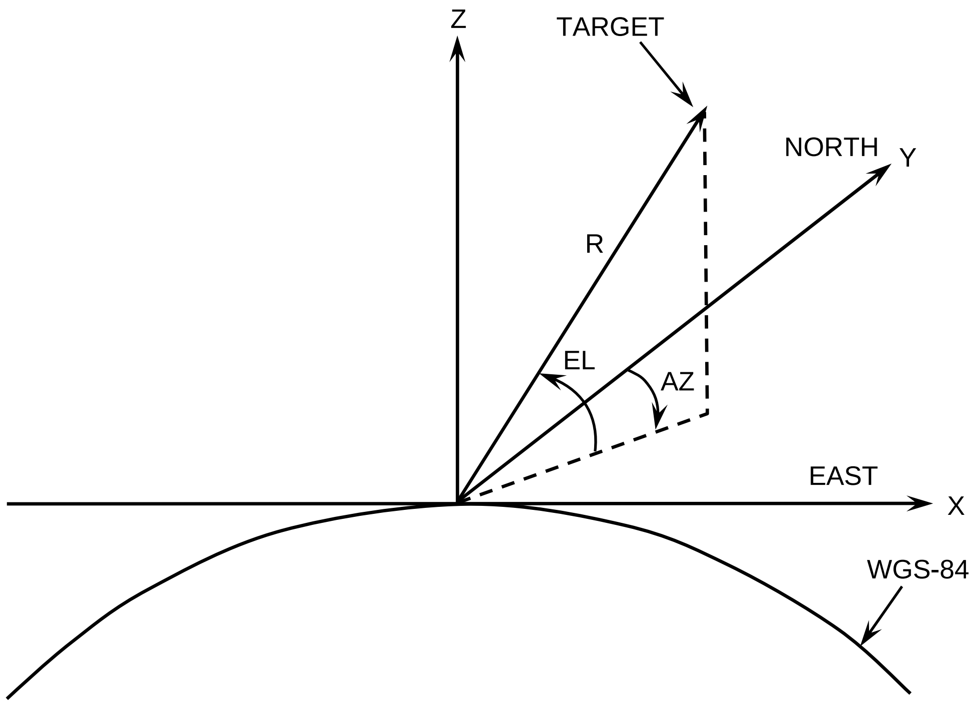


Figure 4.1-3. Simplified Diagram of Data Registration Process



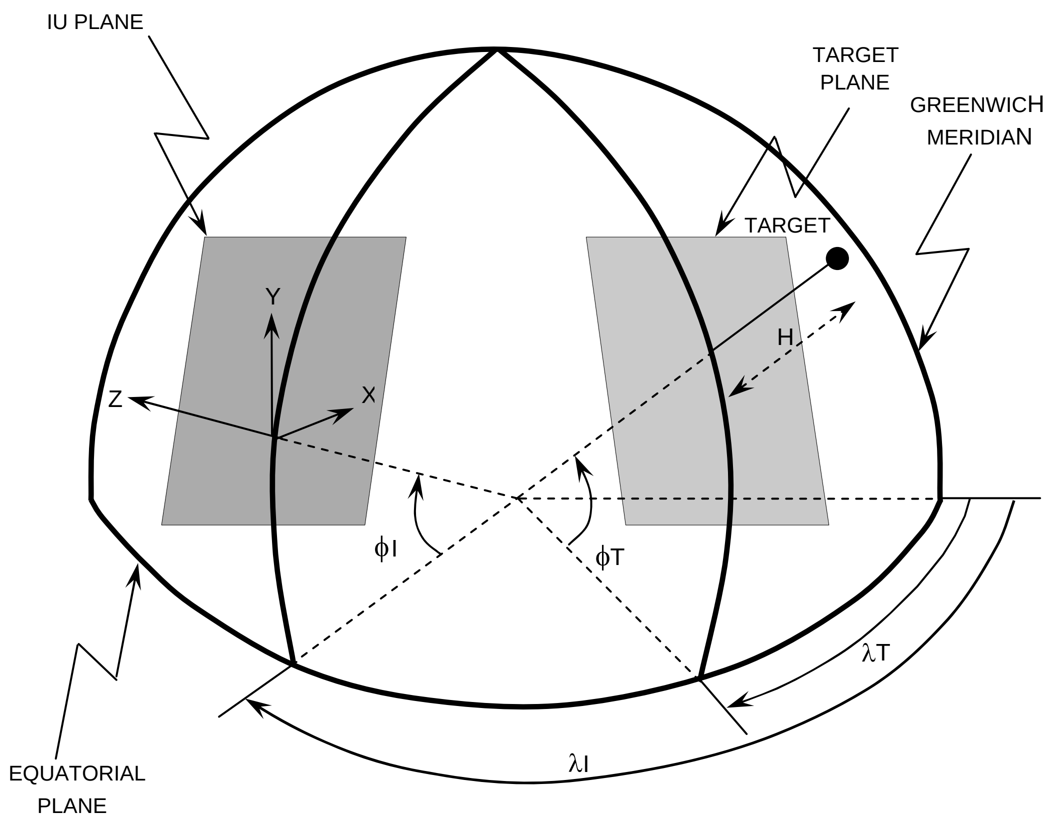
A. <u>SENSOR COORDINATE SYSTEM</u>

R = TARGET RANGE
AZ = AZIMUTH ANGLE
EL = ELEVATION ANGLE

B. <u>IU COORDINATE SYSTEM</u>

X = EAST VECTOR FROM IU
Y = TRUE NORTH FROM IU
Z = IU'S GEODETIC VERTICAL

FIGURE 4.1-4. Description of Sensor and IU Coordinate Systems



ϕ I, λ I = GEODETIC LATITUDE/LONGITUDE OF IU

ϕT, λ T = GEODETIC LATITUDE/LONGITUDE OF TARGET

H = TARGET ALTITUDE ABOVE REFERENCE SPHEROID (WGS-84)

Figure 4.1-5. Description of Geodetic Coordinate System

4.1.4.2.1 GEODETIC REGISTRATION

Geodetic registration is defined as a process in which a JU monitors its reported geodetic positional data and periodically adjusts this geodetic data with information derived from active participation in the JTIDS/MIDS Relative Navigation function. Geodetic registration begins with a capability of the JU to determine and maintain accurate positional coordinates in terms of geodetic latitude, longitude, and altitude. Monitoring of relative geodetic position is provided by active participation in the JTIDS/MIDS Relative Navigation function during netted operation. Through active participation in the JTIDS/MIDS Relative Navigation function, highly accurate adjustments to the reported geodetic position are obtainable. The JTIDS/MIDS terminal will provide Relative Navigation adjustments to the host platform in terms of latitude correction (LATC), longitude correction (LONC), and altitude correction (HC). These correction factors shall be periodically applied to the own unit's latitude, longitude, and altitude used for the coordinate transformations defined in paragraph 4.1.4.2.3.

4.1.4.2.2 SENSOR REGISTRATION

Sensor registration is the process of determining and maintaining the correct alignment of the sensor elements used for the measurement of a tracked object's position. Monitoring is accomplished by comparing the geodetic position of a remote unit reported in the PPLI messages and the remote unit's position observed through active local sensors. This procedure requires that each JU periodically monitor the remote units and, through analysis techniques, calculate the mean correction variations in terms of difference in azimuth expressed as ΔAZ, difference in elevation expressed as ΔEL, and difference in range expressed as ΔR.

Each JU which participates in the Surveillance function shall have the capability to periodically monitor sensor registration using remote unit PPLI messages and local sensor returns. Periodically, the JU shall adjust sensor registration in accordance with the following criteria:

a. Remote IUs which are used in the sensor registration process may be selected either manually or automatically.

b. The statistical method used in determining sensor errors shall consider:

(1) The sampling interval.

(2) The minimum number of remote units necessary to ensure reliable data.

(3) PPLI position, azimuth, and time quality values.

(4) Quadrant distribution of the remote IUs used.

(5) Maximum and minimum range criteria of remote units; and

(6) Altitude data availability in both the received PPLI messages and local sensor data.

c. Results of the sensor registration shall be available for operator appreciation in the form of ΔAZ, ΔEL, and ΔR.

d. It is a design goal that the sensor registration process detect and correct sensor errors so that the azimuth/elevation angle errors shall not exceed one-half degree and range errors shall not exceed 500 feet.

4.1.4.2.3 DATA PROCESSING ACCURACY

This paragraph discusses the data processing accuracies required of a participating JU when calculating, converting, and transforming local and remote track data. These accuracies are directly related to the basic equations used to perform the various conversions and transformations, the assumptions and algorithms used in this process, and the time and position relationship associated with the track information. The track data requirements specified in this paragraph apply to positional data received in J2 and J3 messages, as well as locally derived data.

Each JU must include in its local and remote track data processing the time tag associated with a track position report. JUs shall ensure that all track positions are extrapolated when local and remote correlation and decorrelation is performed.

In addition to the extrapolation requirement, the JU must insure that the equations and assumptions employed in the processing, conversion, and transformation of positional data conform to the following accuracy requirements:

a. The processing accuracy of locally input positional coordinates into geodetic latitude, longitude, and altitude coordinates shall be within plus or minus 60 feet.

b. The processing accuracy of remote data such as latitude, longitude, and altitude into local database coordinates shall be within plus or minus 60 feet.

c. When positional data are received by an FJU, the processing accuracy of the forwarded positional data shall be within plus or minus 60 feet.

d. The processing accuracy for the conversion of (X dot, Y dot) velocity coordinates into course and speed, or the conversion of course and speed into (X dot, Y dot) coordinates shall be within plus or minus .1 dm/hr for linear parameters and plus or minus .05 degrees for course.

The required data processing accuracy shall be obtainable within the following positional and geographical limits:

a. The distance of the track from the receiving or transmitting unit is less than 250 data miles.

b. The geodetic latitude of the JU is between 70° south latitude and 70° north latitude.

c. The geodetic altitude of the track is between 120,000 feet above and 1,000 feet below the reference spheroid measured along the geodetic vertical.

The above accuracy requirements are based on a comparison with exact mathematical conversions and transformations using the WGS-84 earth model as the reference spheroid with the following parameters:

a. Primary parameters are as follows:

(1) Semi-Major axis, a is equal to 6,378,137 meters (3,487.607721 data miles).

(2) Flattening, f is equal to 1/298.257223563.

b. Secondary parameters are as follows:

(1) Semi-Minor axis, b is equal to 6,356,752.3142 meters (3,475.9144 data miles).

(2) Major Eccentricity, e = 0.0818191908426.

Standard units of measure are as follows:

a. 1 nautical mile is equal to 1,852 meters, (International Nautical Mile adopted by Department of Defense (DOD), 1 July 1954).

b. 1 ft is equal to 0.3048 meters (DOD Standard 1476, 1 August 1977).

c. 1 data mile is equal to 6,000 feet (U.S.) = 1,828.8 meters.

d. 1 nautical mile is equal to 1.012685914 data miles.

To prevent any ambiguity, the geodetic latitude and longitude data exchanged in the interface are defined as WGS-84 latitude and longitude.

The exact mathematical equations depicted in Figure 4.1-6 shall be used by tactical data systems using orthogonal projections as the standard for comparison when determining a system's capability to meet the accuracy requirements of paragraph 4.1.4.2.3. Tactical data systems using other projections, e.g., stereographic, shall use equations that also meet the stated accuracy requirements.

DEFINITION OF TERMS

ϕ_s = Geodetic latitude, degrees

λ_s = Geodetic longitude, degrees

h_s = geodetic height, data miles (distance between reference spheroid and coordinate center measured along geodetic vertical, positive above spheroid).

System coordinate center position

ϕ_t = Geodetic latitude, degrees

λ_t = Geodetic longitude, degrees

h_t = geodetic height, data miles (distance between reference spheroid and track (or point) measure along the geodetic vertical, positive above spheroid).

Track or point position

X_t, Y_t, Z_t = X, Y, and Z coordinates in data miles of a track or point measured relative to an orthogonal right-handed coordinate system whose center is located at (ϕ_s, λ_s, h_s) with Y-axis aligned with true north, X-axis aligned with east, and Z-axis aligned with the geodetic vertical.

a = Semi-major axis of the reference spheroid; this will be 3,487.607721 data miles for WGS-84 earth model.

e^2 = Square of earth model eccentricity; this will be 0.00669437999013 for WGS-84 earth model.

FIGURE 4.1-6. Mathematical Equations Using Orthogonal Projections (1 of 5)

TRANSFORMATION FROM LOCAL TANGENT PLANE CARTESIAN COORDINATES EXPRESSED AS X, Y, Z, TO GEODETIC LATITUDE, LONGITUDE AND HEIGHT

Given: (X_t, Y_t, Z_t) and (ϕ_s, λ_s, h_s)

Find: (ϕ_t, λ_t, h_t)

Determine ϕ_t'

where $\phi_t' = \tan^{-1}\left[\dfrac{(E+K)\cos L}{C}\right]$ and

$$\begin{cases} E = [A_s\,(1-e^2) + h_s + Z_t]\sin\phi_s + Y_t \cos\phi_s \\ C = (A_s + h_s + Z_t)\cos\phi_s - Y_t \sin\phi_s \\ L = \tan^{-1}\left(\dfrac{X_t}{C}\right) \\ A_s = \dfrac{a}{\sqrt{1-e^2\sin^2\phi_s}} \end{cases}$$

and K is determined by iteration as follows: Set K′=0, and compute K

$$\text{where } K = \frac{k_2\,(E+K')}{\sqrt{\dfrac{R^2}{1-e^2} + (E+K')^2}} \quad \text{and} \quad \begin{cases} k_2 = \dfrac{ae^2}{\sqrt{1-e^2}} \\ R = \dfrac{C}{\cos L} \end{cases}$$

if $|K| - |K'| > 10^{-5}$, set K′ = K, and recompute K.

then

$$\boxed{\begin{array}{lll} \phi_t = \phi_t', & \text{if} & -90^\circ \le \phi_t' \le 90^\circ \\ \phi_t = \phi_t' - 180^\circ, & \text{if} & \phi_t' > 90^\circ \\ \phi_t = \phi_t' + 180^\circ, & \text{if} & \phi_t' < -90^\circ \end{array}}$$

$$\boxed{\lambda_t = \lambda_s + L}$$

$$\boxed{h_t = \left[\frac{R}{\cos\phi_t}\right] - \left[\frac{a}{\sqrt{1-e^2\sin^2\phi_t}}\right]}$$

FIGURE 4.1-6. Mathematical Equations Using Orthogonal Projections (2 of 5)

TRANSFORMATION FROM GEODETIC LATITUDE, LONGITUDE AND HEIGHT TO LOCAL TANGENT PLANE CARTESIAN COORDINATES EXPRESSED AS X, Y, Z

Given: (ϕ_t, λ_t, h_t) and (ϕ_s, λ_s, h_s)

Find (X_t, Y_t, Z_t)

$$\boxed{X_t = (A_t+h_t)\cos\phi_t \sin(\lambda_t-\lambda_s)}$$

where $A_t = \dfrac{a}{\sqrt{1-e^2\sin^2\phi_t}}$

$$\boxed{Y_t = (A_t+h_t)\left[\cos\phi_s \sin\phi_t - \sin\phi_s \cos\phi_t \cos(\lambda_t-\lambda_s)\right] - \Delta K \cos\phi_s}$$

where $\Delta K = e^2 (A_t \sin\phi_t - A_s \sin\phi_s)$

and $A_s = \dfrac{a}{\sqrt{1-e^2\sin^2\phi_s}}$

$$\boxed{Z_t = (A_t+h_t)\left[\cos\phi_s \cos\phi_t \cos(\lambda_t-\lambda_s) + \sin\phi_s \sin\phi_t\right] - A_s - h_s - \Delta K \sin\phi_s}$$

FIGURE 4.1-6. Mathematical Equations Using Orthogonal Projections (3 of 5)

CONVERSION OF TRACK COURSE AND SPEED TO LOCAL TANGENT PLANE CARTESIAN COORDINATES EXPRESSED AS $\dot{X}$ AND $\dot{Y}$

Given: (ϕ_t, λ_t, h_t) and (ϕ_s, λ_s, h_s)

where θ_t is the track course, degrees relative to true north at track position

and S_t is the track speed, data miles/hour (dm/h)

Find: $\dot{X}$ and $\dot{Y}$

Assume $\dot{h}_t = 0\ dm/hr$

then

$$\boxed{\dot{X} = S_t\ [\ (\sin\theta_t \cos\Delta\lambda) - (\cos\theta_t \sin\phi_t \sin\Delta\lambda)\ ]}$$

$$\boxed{\dot{Y} = S_t\ [\ \sin\theta_t \sin\phi_s \sin\Delta\lambda + \cos\theta_t\ (\sin\phi_s \sin\phi_t \cos\Delta\lambda + \cos\phi_s \cos\phi_t)\ ]}$$

Where $\Delta\lambda = \lambda_t - \lambda_s$

FIGURE 4.1-6. Mathematical Equations Using Orthogonal Projections (4 of 5)

CONVERSION OF LOCAL TANGENT PLANE CARTESIAN COORDINATES TO TRACK COURSE (θ_t) AND SPEED (S_t)

Given: (ϕ_t, λ_t, h_t), (ϕ_s, λ_s, h_s), and $\dot{X}$, $\dot{Y}$

Find Course (θ_t) and Speed (S_t)

Assume $\dot{h}_t = 0\ dm/hr$

then

$$\boxed{S_t = \sqrt{\dot{U}_t^2 + \dot{V}_t^2}}$$

$$\boxed{\theta_t = \sin^{-1}\left(\frac{\dot{U}_t}{S_t}\right)}$$

where

$$\dot{U}_t = \frac{\dot{X}}{\cos\Delta\lambda} - \frac{(\sin\theta_t \sin\Delta\lambda)\,(\dot{X}_t \sin\phi_s \tan\Delta\lambda - \dot{Y}_t)}{(\sin\theta_t \sin\phi_s + \cos\phi_t \cos\phi_s \cos\Delta\lambda)}$$

$$\dot{V}_t = \frac{-\dot{X}_t \sin\theta_s \sin\Delta\lambda + \dot{Y}_t \cos\Delta\lambda}{(\sin\theta_t \sin\phi_s + \cos\phi_t \cos\phi_s \cos\Delta\lambda)}$$

$$\Delta\lambda = \lambda_t - \lambda_s$$

FIGURE 4.1-6. Mathematical Equations Using Orthogonal Projections (5 of 5)

4.1.4.2.4 REMOTE IU REGISTRATION

Remote IU registration is the procedure for determining data registration corrective values by comparing remote tracks received from a selected remote IU to local data and applying corrective values to positional data received from that IU. Each IU which has a capability to initiate or assume R^2 for real-time surveillance tracks will have a capability to periodically monitor its data registration relative to a selected IU and to make periodic adjustments in accordance with the following criteria:

a. Either automatic or manual selection of remote IUs for monitoring and adjustment of data registration shall be used.

b. The periodic performance of the remote IU registration procedure for selected units shall be automatically conducted at least once per monitor interval as specified in Table 4.1-6.

TABLE 4.1-6. Maximum Monitor Intervals

OWN UNIT / REMOTE IU		JU WITH $Q_{pr} \le 3$ OR INDIRECT UNIT			IU $Q_{pr} \ge 4$
		AIR	ALL OTHERS	FIXED LAND	
IU $Q_{ar} \le 3$ OR $Q_{pr} \le 3$	AIR	5 MINS.	10 MINS.	15 MINS.	15 MINS.
	ALL OTHERS	10 MINS.	1 HR.	1 HR.	1 HR.
	FIXED LAND	15 MINS.	1 HR.	4 HRS.	4 HRS.
IU $Q_{ar} \ge 4$ AND $Q_{pr} \ge 4$		15 MINS.	1 HR.	4 HRS.	4 HRS.

LEGEND (U)
(U) Q_{pr} - RELATIVE POSITION QUALITY
(U) Q_{pr} - RELATIVE POSITION QUALITY

c. The mean translational and rotational registration errors and correction values shall be computed automatically using a minimum of 3 common tracks with track quality (TQ) greater than or equal to 4 for at least six update cycles. Azimuth separation should be at least 45°.

d. The execution of the remote IU registration should be performed without interference or curtailment of normal data system operations.

e. Results of remote IU registration shall be available for operator appreciation in the form of the most recently computed mean translational error/difference in X and Y (data miles) and the mean rotational error/difference (degrees of azimuth) for each remote IU designated for remote IU registration.

f. It is a design goal that the remote IU registration function will detect and adjust registration errors before they exceed two data miles for X and Y, and one-half degree of azimuth.

4.1.5 IDENTIFICATION OF DATA SOURCE

Identification of the source of data on the interface is provided by the Source TN field. The Source TN field is a discrete address assigned to each IU.

4.1.6 SPECIAL PROCESSING

Certain national systems provide surveillance and warning information of a particularly sensitive nature. Link 16 makes provision for the protection of the source of such information through the use of the Special Processing Indicator (SPI). The SPI shall not be used for any other purpose. In particular, setting the SPI to value 1 shall not permit any other field of the message to be encoded differently from that defined by the message standard. The setting of the SPI by units originating data shall be in accordance with national requirements. When the SPI is set to value 1, it indicates that the information in the message in which it appears requires special handling and processing as defined in the following paragraphs.

4.1.6.1 DATA CONSTRAINTS

a. All surveillance, warning and amplification data in messages in which the SPI is set to value 1 shall be classified SECRET, and on reception shall be afforded the protection commensurate with that classification.

b. Data protected by the SPI set to value 1 shall be transmitted on Link 16 only if the terminal or other communication path is operating in a secure mode.

c. Data protected by the SPI set to value 1 shall not be transmitted on Link 16 if there are any units on the interface which are unable to protect the data according to its classification.

4.1.6.2 FORWARDING OF DATA PROTECTED BY THE SPI

Data which is protected by the SPI set to value 1 shall not be forwarded onto unsecured links or voice circuit. A unit which is forwarding Link 16 to Link 11 shall adhere to the constraints for data protected by the SPI, in accordance with the procedures in MIL-STD 6016, Appendix C.

4.1.6.3 SECURITY FILTERING

All units which are capable of transmitting data protected by the SPI shall also implement a security transmit filter to inhibit such transmissions. The security filter shall be overridden by an Emergency or Force Tell alert on a reported entity.

4.1.6.4 CHANGE OF REPORTING RESPONSIBILITY FOR A SPI TRACK

If a C^2 unit assumes R^2 for a track which was previously reported with the SPI set to value 1, the unit shall have the option of retaining the original value or of clearing it to value 0, in accordance with national requirements.

4.1.6.5 SPECIAL PROCESSING OF EW DATA

The SPI in the J3.7 and J14.0 is used to indicate the security processing status of LOBs, AOPs, and fixes reported in those messages. The value of the SPI shall be set at the discretion of the reporting unit, in accordance with national requirements and independent of the setting of the SPI in contributing LOBs, AOPs, or fixes. However, if all contributions have their SPI set to value 1, the AOP or fix shall be reported with the SPI set to value 1.

4.1.7 RECEIPT/COMPLIANCE

Link 16 messages that are not generated in response to another message are called original messages (OMs) or original orders. Some addressed OMs have a receipt/compliance (R/C) field and require response messages to be transmitted by the receiving unit to indicate that the OM has been received and, if desired, also to indicate whether the receiving unit will accomplish the action identified in the OM. Response messages contain an R/C field which indicates the response being returned.

The receipt/compliance procedures for the messages used for Link 16 network management are different than those for operational messages. "Network management messages" as used herein refers to J0, J1, J8, and J31 series messages containing an R/C field. "Operational messages" as used herein refers to J9, J10, J12, and J14 series messages containing an R/C field. Table 4.1-7 provides the data item names, data item code values, and data item explanations for the R/C field. Table 4.1-8 specifies the applicability of the various R/C data items to the J series messages for transmission of original messages and receipt of original messages. Table 4.1-8.1 specifies the applicability of the various R/C data items to the J series messages for response to original messages and receipt of responses to original messages. Table 4.1-9 describes examples of the interchange when original and response messages are exchanged between JUs.

4.1.7.1 ORIGINAL MESSAGE

An R/C field in the OM specifies whether a response message is to be returned to the originator. If the R/C field is set to value 0, then a response message is required. If the R/C field is set to value 5, then only a machine receipt (MR) message and/or automatic computer generated response is required. If the R/C field is set to value 1, then no response message is required. The R/C field of an OM addressed to more than one unit shall be set to value 1.

4.1.7.2 MACHINE RECEIPT

A machine receipt message has the R/C field set to value 2 and shall be transmitted once by an addressed terminal upon receipt of either a valid OM with the R/C field set to value 0 or 5 or upon receipt of a response message with the R/C field set to a value greater than 2. In the network management messages, the machine receipt is equivalent to a WILCO message. Therefore, a machine receipt for a network management OM shall only be sent if the addressed terminal can accept and execute the actions specified in the OM. The machine receipt message shall be transmitted in the time slot specified by the Recurrence Rate, Receipt/Compliance field of the message it is responding to. The machine receipt message shall be identical to the message it is responding to except in the Source TN; Relayed Transmission Indicator; Message Length Indicator; Addressee TN; R/C; and Recurrence Rate, Receipt/Compliance fields. The Recurrence Rate, Receipt Compliance field shall be set to the No Statement value in all machine receipt messages. A response message with the R/C field set to a value greater than 2 may be transmitted in lieu of the machine receipt message. A CANTPRO message must be transmitted in lieu of a machine receipt message if the addressed terminal cannot accept and execute the action specified in a network management OM.

4.1.7.3 CANNOT PROCESS RESPONSE

An appropriate CANTPRO response message shall be transmitted automatically by an addressed unit upon receipt of an OM with the R/C field set to value 0 or value 5 if the message cannot be processed. The R/C field of the CANTPRO response message shall indicate the reason the message cannot be processed. This is an automatic computer generated response and the operator need not be aware that any order has been received or that the CANTPRO response has been generated. The CANTPRO response message shall be identical to the OM it is responding to except in the Source TN; Relayed Transmission Indicator; Addressee TN; R/C; and Recurrence Rate, Receipt/Compliance fields.

TABLE 4.1-7. Receipt/Compliance (Sheet 1 of 2)

DATA ITEM	DI CODE	DUI/DI EXPLANATION
ORIGINAL ORDER	0	RECEIPT/COMPLIANCE RESPONSE REQUIRED.
ORIGINAL ORDER	1	RECEIPT/COMPLIANCE RESPONSE NOT REQUIRED. MUST BE USED IN ORIGINAL ORDER MESSAGES ADDRESSED TO COLLECTIVE ADDRESSES. THE ORIGINAL ORDER SHALL BE TRANSMITTED 3 TIMES.
MACHINE RECEIPT	2	MESSAGE RECEIVED ERROR FREE.
WILCO	3	THE SYSTEM COMPONENT REQUIRED TO TAKE ACTION UNDER THIS ORDER WILL COMPLY. IN THIS USAGE, THE SYSTEM COMPONENT IS HUMAN OPERATOR OR (UNMANNED VEHICLE ONLY) A MACHINE.
HAVCO	4	THE SYSTEM COMPONENT REQUIRED TO TAKE ACTION UNDER THIS ORDER HAS COMPLIED. IN THIS USAGE, THE SYSTEM COMPONENT MAY BE A HUMAN OPERATOR OR A MACHINE.
ORIGINAL ORDER	5	RECEIPT/COMPLIANCE RESPONSE (MR AND/OR CANTPRO ONLY) REQUIRED.
CANTCO	6	THE SYSTEM COMPONENT REQUIRED TO TAKE ACTION UNDER THIS ORDER CANNOT COMPLY. IN THIS USAGE THE SYSTEM COMPONENT IS A HUMAN OPERATOR OR (UNMANNED VEHICLE ONLY) A MACHINE.
CANTPRO	7	NON-SPECIFIC SYSTEM LIMITATION OR CONFLICT[1].
CANTPRO	8	TIME SLOT ASSIGNMENT CONFLICT DETECTED[1].
CANTPRO	9	CRYPTOVARIABLE NOT HELD[1].
CANTPRO	10	PARTICIPATION GROUP NOT DEFINED[1].

NOTE

[1] THIS IS AN AUTOMATIC COMPUTER GENERATED RESPONSE AND THE OPERATOR NEED NOT BE AWARE THAT ANY ORDER HAS BEEN RECEIVED OR THAT THE CANTPRO RESPONSE HAS BEEN GENERATED.

TABLE 4.1-7. Receipt/Compliance (Sheet 2 of 2)

DATA ITEM	DI CODE	DUI/DI EXPLANATION
CANTPRO	11	APPLICABLE ASSIGNMENT TABLE FULL[1].
CANTPRO	12	RELAY FUNCTION SPECIFIED ALREADY HAS ASSIGNED TIME SLOT BLOCKS FOR WHICH A DIFFERENT RELAY MODE/NET NUMBER HAS BEEN SPECIFIED[1].
CANTPRO	13	INTERFERENCE PROTECTION FEATURES WOULD BE VIOLATED BY ACCEPTANCE OF ASSIGNMENT[1].
CANTPRO	14	HOST SUBSCRIBER INTERFACE IS INACTIVE AND MESSAGE IS NOT PROCESSED BY THE TERMINAL[1].
CANTPRO	15	TN, ADDRESSEE DOES NOT IMPLEMENT THE ACTION REQUESTED[1].
CANTPRO	16	ONE OR MORE TNs IN THE OM NOT HELD[1].
CANTPRO	17	TN, REFERENCE OR TN, FRIENDLY WEAPON IS UNDER OWN UNIT CONTROL[1].
CANTPRO	18	UNIT NOT EXERCISING AIR CONTROL CAPABILITY[1].
CANTPRO	19	UNACCEPTABLE IDENTITY[1].
CANTPRO	20	ADDRESSEE TRACK NUMBER IS INACTIVE[1].
CANTPRO	21	THE FORWARDING UNIT DID NOT RECEIVE A MACHINE RECEIPT FROM THE ADDRESSEE TRACK NUMBER[1].
CANTPRO	22	TN REFERENCE OR TN, FRIENDLY WEAPON IS NOT UNDER THIS UNIT'S CONTROL[1].
UNDEFINED	23-30	
NO STATEMENT	31	

NOTE

[1] THIS IS AN AUTOMATIC COMPUTER GENERATED RESPONSE AND THE OPERATOR NEED NOT BE AWARE THAT ANY ORDER HAS BEEN RECEIVED OR THAT THE CANTPRO RESPONSE HAS BEEN GENERATED.

TABLE 4.1-8. Applicability of Receipt/Compliance Values for Transmission of Original Message and Receipt of Original Message

<table>
<tr><th rowspan="2" colspan="2"></th><th colspan="5">R/C VALUE</th></tr>
<tr><th>0</th><th>1</th><th>2</th><th>5</th><th>3-4, 6-31</th></tr>
<tr><td rowspan="17">MESSAGE</td><td>J0.3</td><td>O</td><td></td><td>M</td><td></td><td rowspan="17">NOT APPLICABLE</td></tr>
<tr><td>J0.4</td><td>O</td><td></td><td>M</td><td></td></tr>
<tr><td>J0.6</td><td>O</td><td>O</td><td>M</td><td></td></tr>
<tr><td>J1.4</td><td colspan="4">TBD</td></tr>
<tr><td>J1.5</td><td colspan="4">TBD</td></tr>
<tr><td>J1.6</td><td colspan="4">TBD</td></tr>
<tr><td>J8.0</td><td colspan="4">TBD</td></tr>
<tr><td>J9.0</td><td>O</td><td>(1)</td><td>M</td><td></td></tr>
<tr><td>J9.1</td><td></td><td>O</td><td>M</td><td>O</td></tr>
<tr><td>J9.2</td><td colspan="4">TBD</td></tr>
<tr><td>J10.3</td><td>O</td><td></td><td>M</td><td></td></tr>
<tr><td>J12.0</td><td>(2)</td><td>(2)</td><td>M</td><td>(2)</td></tr>
<tr><td>J12.1</td><td>O</td><td></td><td>M</td><td>O</td></tr>
<tr><td>J12.4</td><td>O</td><td></td><td>M</td><td></td></tr>
<tr><td>J14.2</td><td>(3)</td><td>(4)</td><td>M</td><td></td></tr>
<tr><td>J31.0</td><td>O</td><td></td><td>M</td><td></td></tr>
<tr><td>J31.1</td><td>O</td><td></td><td>M</td><td></td></tr>
</table>

LEGEND
O = value eligible to be transmitted by originator of Original Message.
M = value eligible to be transmitted as a Machine Receipt by unit in receipt of Original Message.

NOTES
(1) Not applicable when Command = 2-4, 7, 9, 12-15, or 18-25.
(2) See Table J12-2 in Section 5 for applicability by MAD for originator of Original Message.
(3) Not applicable when EWAC = 7-12 or 26.
(4) Not applicable when EWAC = 0, 2, 3, 17, 19, 21, or 22.

TABLE 4.1-8.1. Applicability of Receipt/Compliance Values for Transmission of Response to Original Message and Receipt of Response to Original Message

MESSAGE	R/C VALUE																				
	2	3	4	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	0,1,5,23-31
J0.3	R				T	T	T	T	T		T		T								NOT APPLICABLE
J0.4	R				T	T	T	T	T	T	T		T								
J0.6	R				T		T	T				T	T								
J1.4	TBD																				
J1.5	TBD																				
J1.6	TBD																				
J8.0	TBD																				
J9.0	R	T	T	T	T								T	T	T	T	T	(1)	(1)	T	
J9.1	R				T								T	T							
J9.2	TBD																				
J10.3	R	T		T	T								T	T	T	T	T	(1)	(1)	T	
J12.0	R	T	T	T	T								T	T							
J12.1	R	T	T	T	T								T								
J12.4	R	(2)	(2)	(2)	(2)								T								
J14.2	R	(3)	(3)	(3)	T								T					(1)	(1)		
J31.0	R				T		T						T								
J31.1	R		T		T		T						T								

LEGEND
T = value eligible to be transmitted in response to an Original Message.
R = value eligible to be transmitted by unit in receipt of response to Original Message (i.e. the originator of the Original Message).

NOTES
(1) Applicable only in response message originated by FJU.
(2) Not Applicable when Control Change Indicator = 2.
(3) Not applicable when EWAC = 7-12 or 26.

TABLE 4.1-9. Message Transfer Sequence for Receipt/Compliance (Sheet 1 of 6)

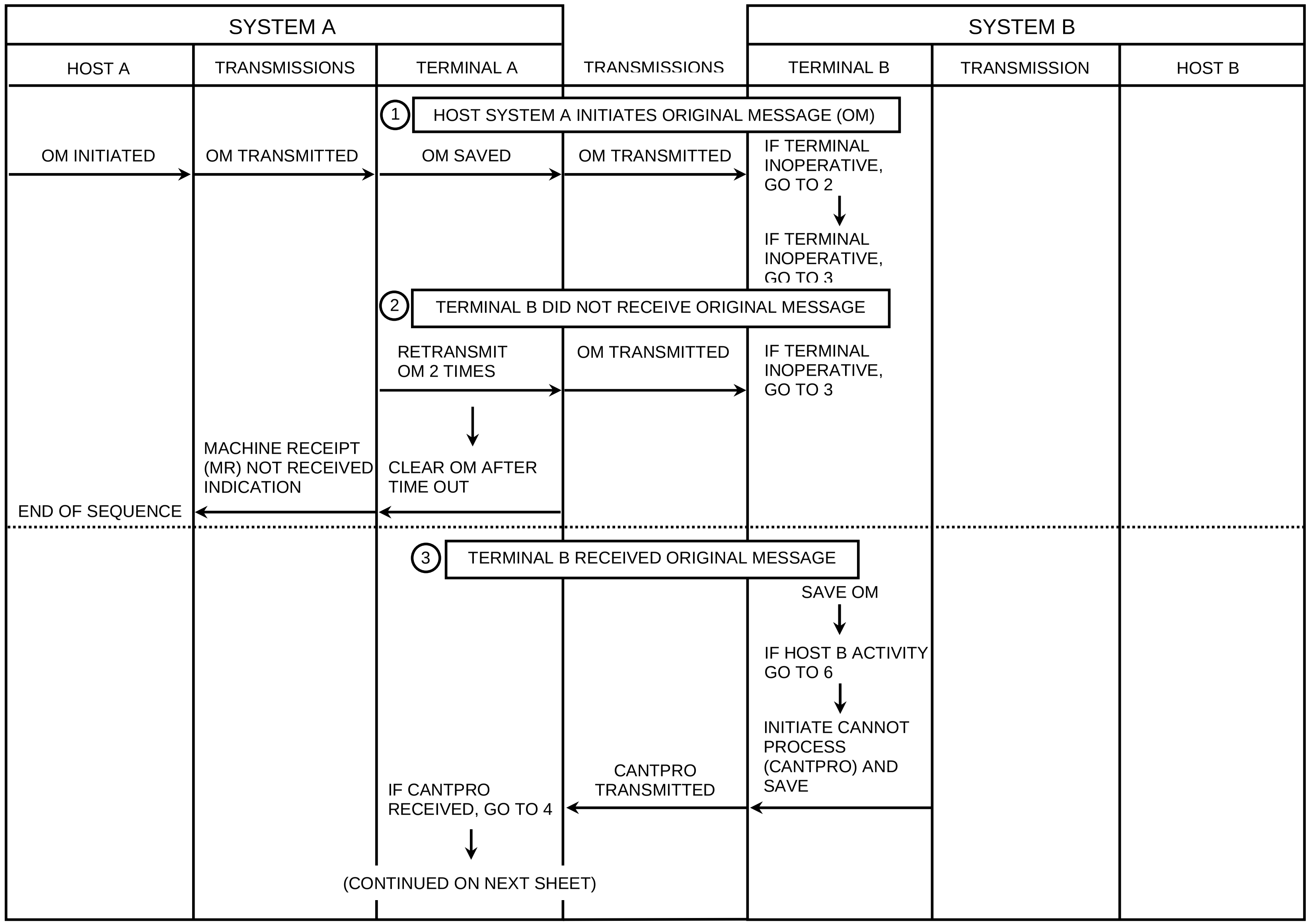


TABLE 4.1-9. Message Transfer Sequence for Receipt/Compliance (Sheet 2 of 6)

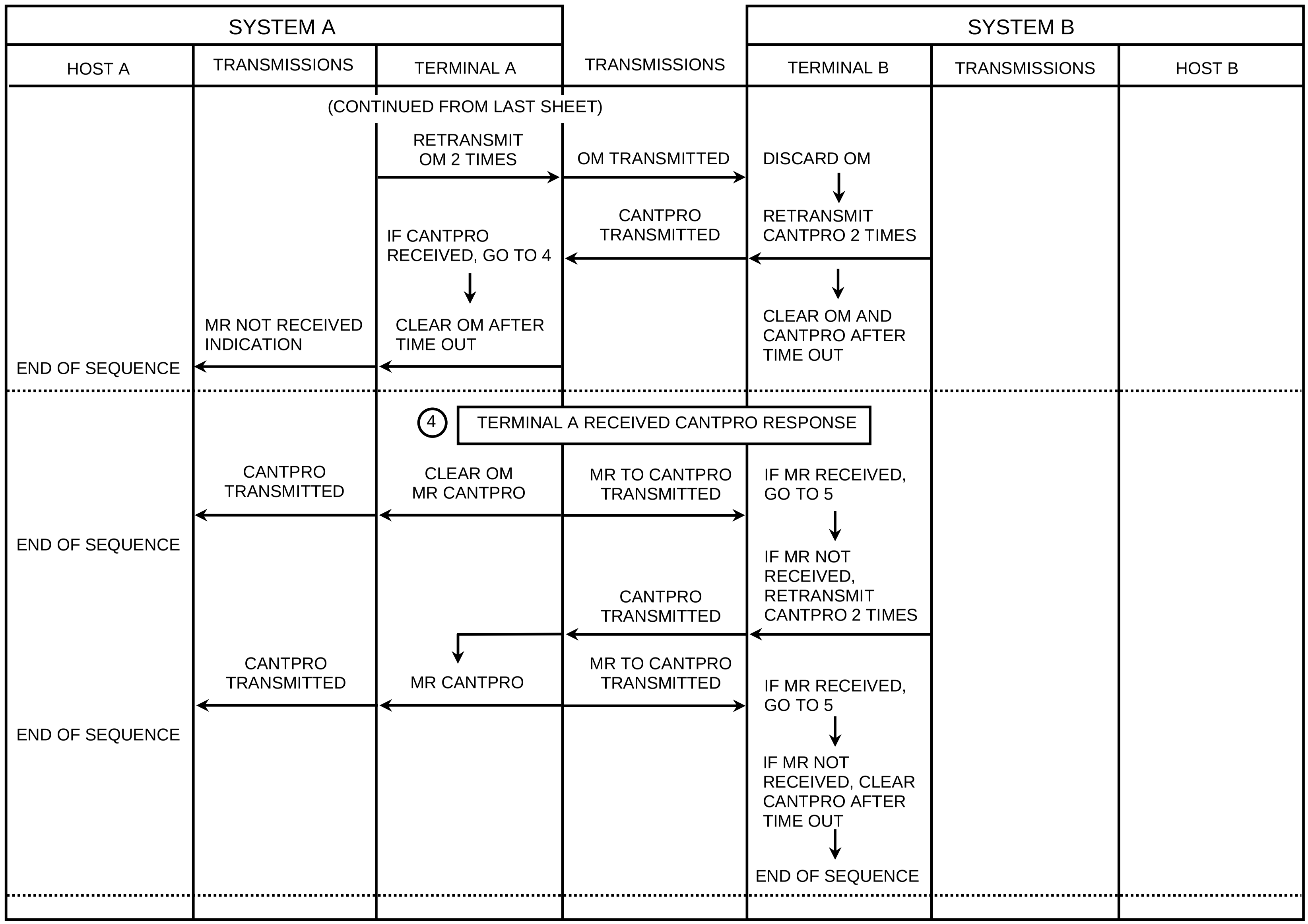


TABLE 4.1-9. Message Transfer Sequence for Receipt/Compliance (Sheet 3 of 6)

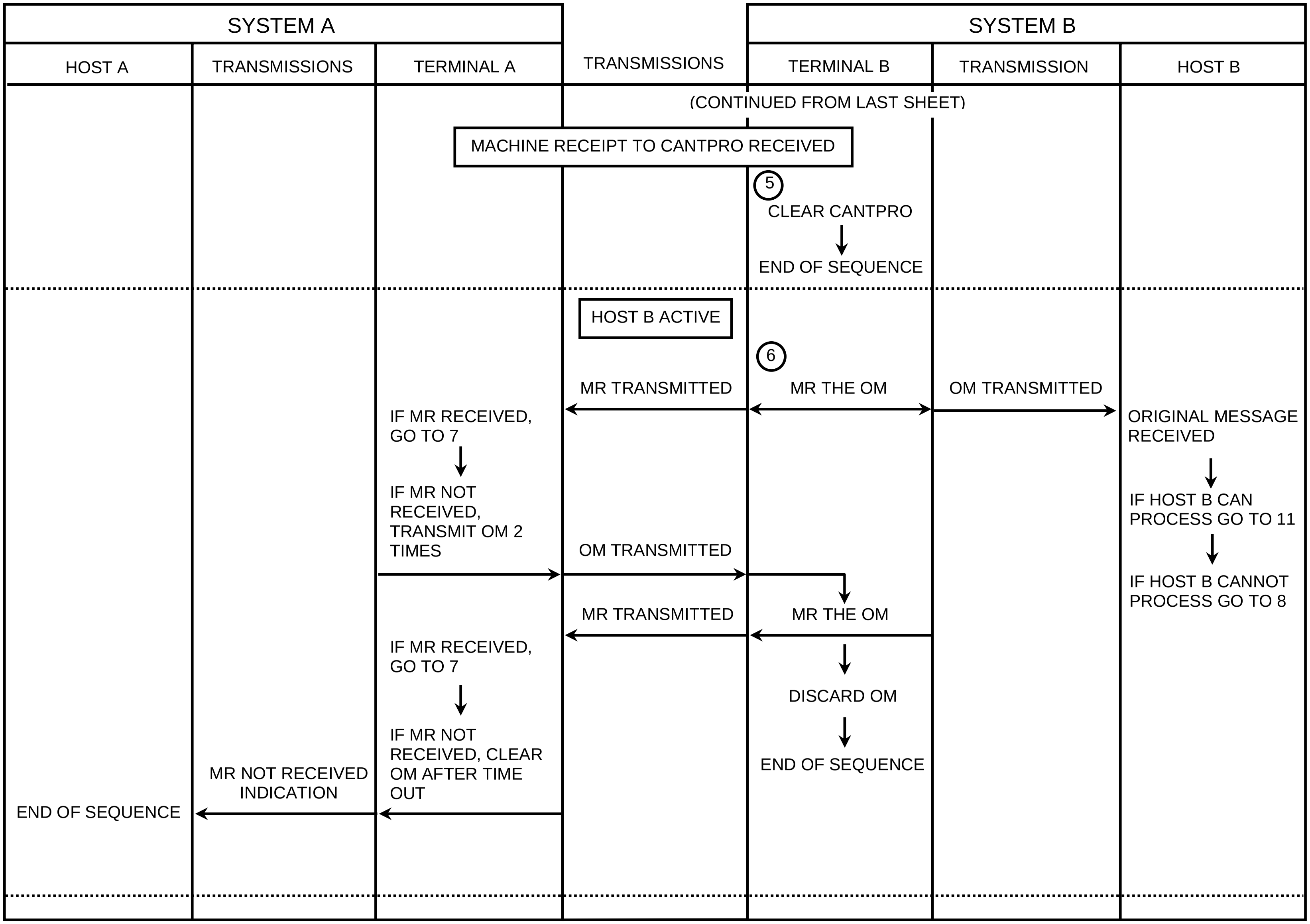


TABLE 4.1-9. Message Transfer Sequence for Receipt/Compliance (Sheet 4 of 6)

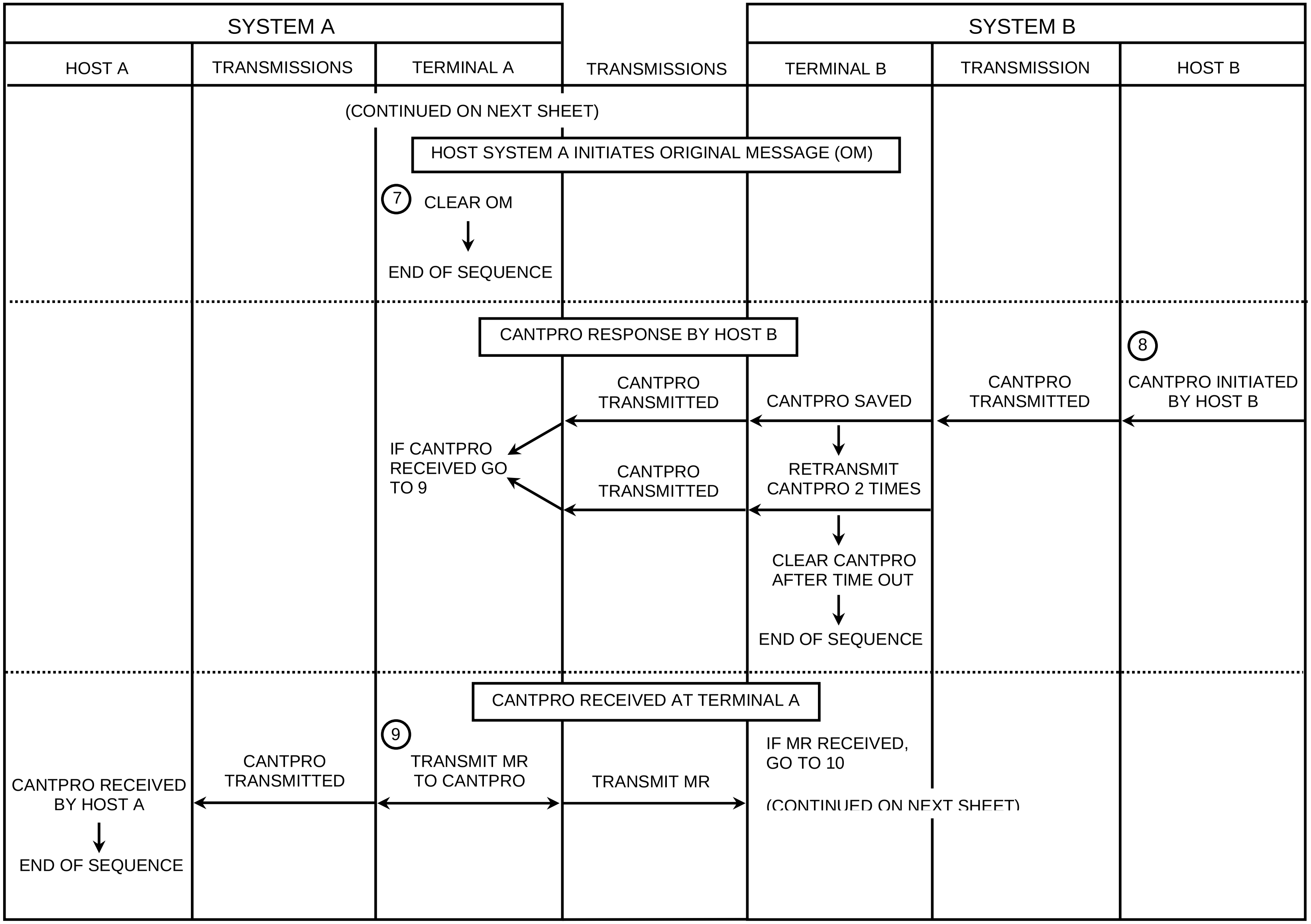


TABLE 4.1-9. Message Transfer Sequence for Receipt/Compliance (Sheet 5 of 6)

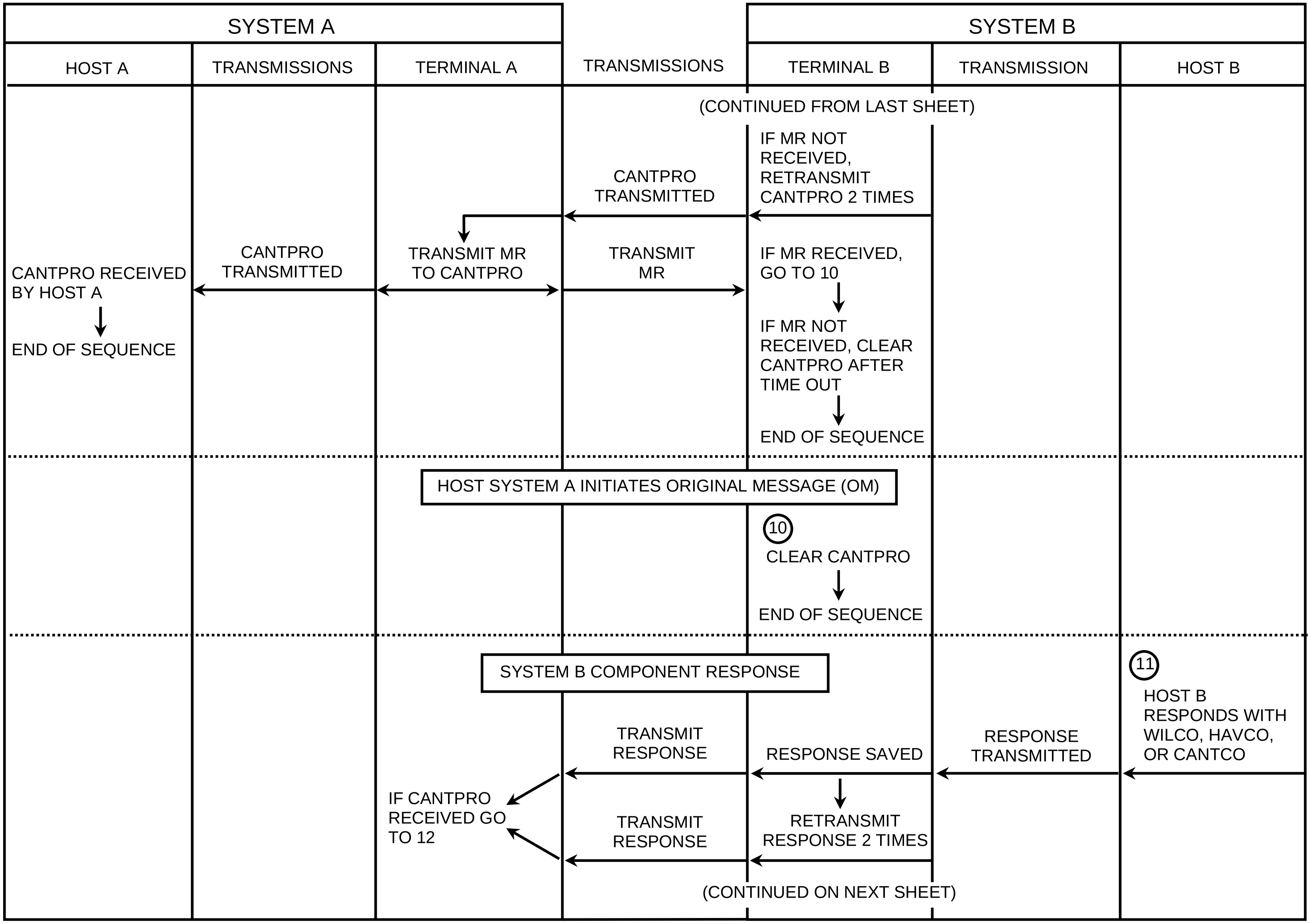
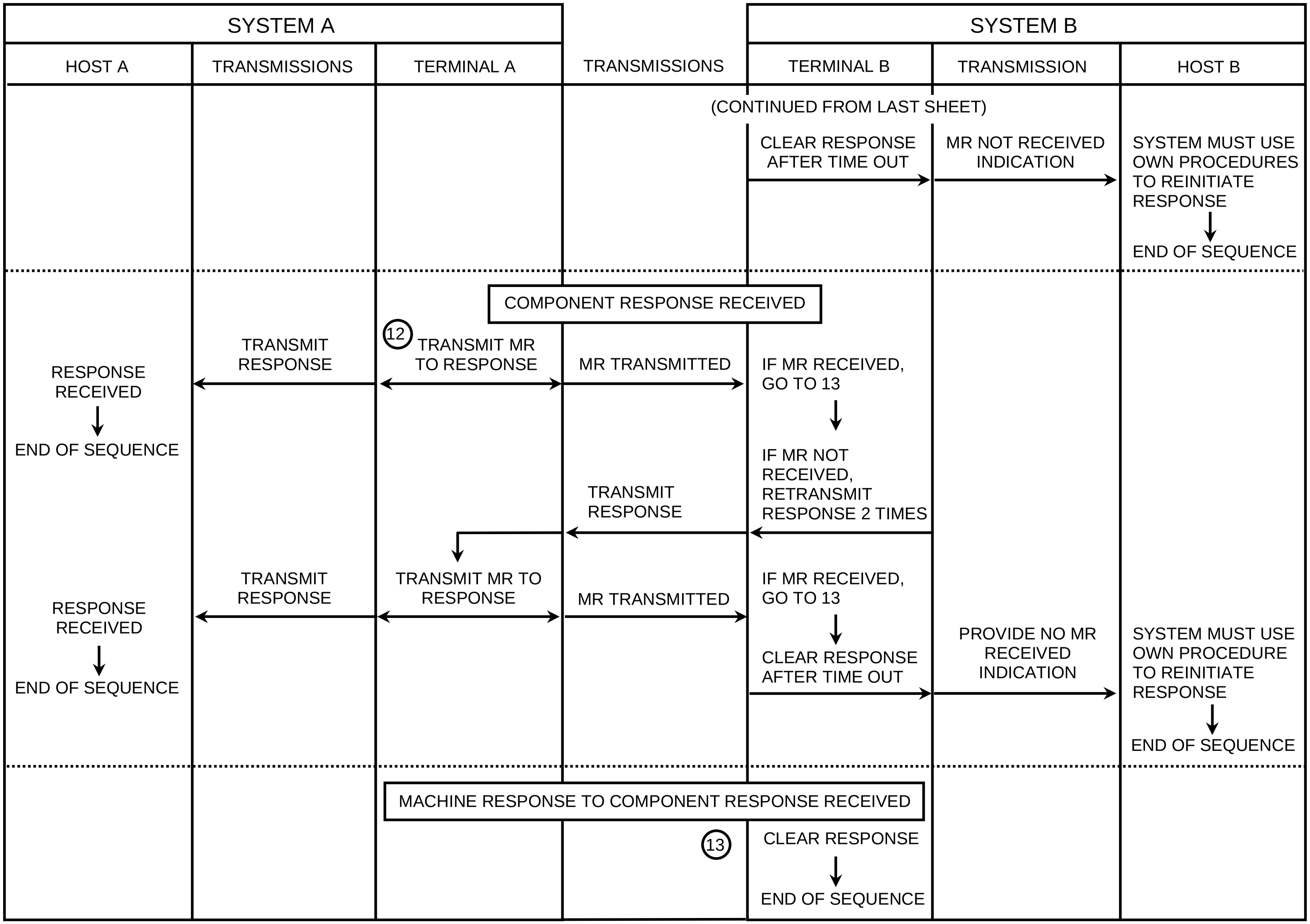


TABLE 4.1-9. Message Transfer Sequence for Receipt/Compliance (Sheet 6 of 6)



4.1.7.4 SYSTEM COMPONENT RESPONSE

System component response messages of WILCO, HAVCO, or CANTCO are normally initiated in response to OMs with the R/C field set to value 0. For HAVCO a system component may be a human or a machine. For WILCO and CANTCO the system component is a human or (unmanned vehicle only) a machine. The system component response message shall mirror the OM to which it is responding but with the following modifications:

a. The Source TN; Relayed Transmission Indicator; Addressee TN; R/C; and Recurrence Rate, Receipt/Compliance fields.

b. For message words/data fields, which shall be added/deleted when required by the individual message transmit rules.

4.1.7.5 RETRANSMISSION OF ORIGINAL MESSAGES

When an OM with the R/C field set to value 0 or value 5 is sent, a copy of the message shall be saved by the initiating terminal. When the Recurrence Rate, Receipt/Compliance field in the OM is set to the value 0, No Statement, the terminal shall automatically retransmit the OM if a machine receipt message or response message that serves as a machine receipt message is not received after 64 time slots from the transmission of the OM. The retransmission process is performed twice. When the Recurrence Rate, Receipt/Compliance field is set to a value other than 0, the terminal shall retransmit the OM if a response message is not received in the donated time slot. The retransmission process is performed twice. If a response message has not been received after the completion of either of the two conditions described, the terminal shall provide an operator alert.

An OM with the R/C field set to value 1 shall be transmitted 3 times with a Recurrence Rate Number (RRN) equal to 6(12 seconds, 8-20 second interval) and shall not require any response message.

4.1.7.6 RETRANSMISSION OF RESPONSE MESSAGES

Response messages with the R/C field not equal to value 2 shall be saved by the terminal initiating the response message until the expected machine receipt message is received. When the Recurrence Rate, Receipt/Compliance field is set to value 0, No Statement, the terminal shall automatically retransmit the response message if a machine receipt message is not received after 64 time slots from transmission of the OM. The retransmission process is performed twice. When the Recurrence Rate, Receipt/Compliance field is set to a value other than 0, the terminal shall retransmit the response message if a machine receipt message is not received in the donated time slot. The retransmission process is performed twice. JUs may provide an operator alert if, after the completion of this process, a machine receipt message has not been received for WILCO, HAVCO, or CANTCO response messages. For those response messages that are not operator initiated, no alert shall be generated.

4.1.7.7 RELAY OF RECEIPT/COMPLIANCE MESSAGES

A terminal functioning as an active relay shall relay messages that require receipt/compliance, but it shall not receipt messages for which it is not the addressee.

4.1.7.8 SUPPRESSION OF REDUNDANT ORIGINAL MESSAGES OR RESPONSE MESSAGES

Transmission of a redundant original message or response message may be suppressed if the addressed unit in the original or response message becomes inactive prior to completion of the redundant transmissions.

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4.2 SYSTEM INFORMATION EXCHANGE AND NETWORK MANAGEMENT

This technical function provides for the exchange of information required to establish and maintain an interface via Link 16. This information shall be exchanged via messages that enable network synchronization, timing, dynamic capacity assignments and reassignments, network control, cryptovariable management, designation of relays, reassignment of relays and Net Control Stations (NCSs), and other actions required to ensure interoperability of the interfacing tactical data systems (TDSs).

The following discussion is divided into two parts: a general overview of the Network Management process, and detailed technical considerations and specific procedures. The general overview is presented first.

4.2.1 THE NETWORK MANAGEMENT PROCESS

The responsibilities associated with the Network Management process may be broken into three primary activities:

a. Network Structure Design.

b. Resource Allocation.

c. Network Initialization and Maintenance.

These activities are described briefly in this section and are covered in greater depth beginning with paragraph 4.2.2. JUs that are equipped with appropriate facilities shall be appointed as Network Managers to perform these activities. JUs that are designated as Network Managers may be assigned all or part of the above activities (including Cryptonet Management) either for an entire network or for a subset of the network limited by the C^2 structure or geographic area. The personnel and equipment needed for a facility to support Network Management will depend both on the activities to be performed and on the size, complexity, and dynamics of the network. The degree of automation required for Network Management will also depend on these factors.

Cryptonet Management is required to minimize the exposure of sensitive operational information; access should be based on risk and need-to-know. Risk and need-to-know are the factors used to limit the adverse impact on operations of a known or unknown compromise and to facilitate actions to recover from a known compromise. Compromise of a network's information can result from theft or capture of a network's cryptovariable(s). Cryptonet Managers can limit operational impact from a known or unknown compromise by assigning separate cryptovariables to Participation Groups (PGs) based on their need-to-know and the risk of compromise of the data transferred within the PG.

4.2.1.1 NETWORK STRUCTURE DESIGN

In configuring a Link 16 network, the first step is to establish a skeletal structure for the network based on the community's communications and communications security requirements. This process involves determining communities of interest, i.e., Participation Groups, for each information exchange category and establishing connectivity within these communities.

4.2.1.1.1 PARTICIPATION GROUPS

The Time Division Multiple Access (TDMA) network structure is organized around Participation Groups made up of Network PGs and Needline PGs (described in paragraph 4.2.3.1). A Network Manager responsible for configuring the network structure shall first establish a set of Participation Group Communities (PGCs) fitting the communications requirements of the general community for which he has responsibility. To do so, the Network Manager must be informed as to the message types to be exchanged by JUs in the general community, the communications security requirements, and the sources and destinations (specific or general) associated with each message type.

The communications security requirements of a PGC define the allowable message security connectivity for the PGC. The security requirements of all PGCs dictate to the Network Manager which PGCs can belong to the same cryptonet. A cryptonet is the set of all JUs holding the same cryptovariable for message security. In the JTIDS/MIDS system, messages can be transmitted in one of two security modes, the Common Variable mode or the Partitioned Variable mode.

4.2.1.1.2 SECURITY MODES

The JTIDS/MIDS system provides both transmission security (TRANSEC) and message security (MSEC). In the Common Variable mode there is one cryptovariable used for both TRANSEC and MSEC. In the Partitioned Variable mode there are two cryptovariables, one for TRANSEC and one for MSEC. Each JTIDS/MIDS net is defined by a net number and a TRANSEC cryptovariable. Each time slot assignment on a net can be designated to operate in the Common Variable or Partitioned Variable mode. In the Common Variable mode all net members can receive and read the messages transmitted, thereby operating as a single cryptonet. In the Partitioned Variable mode the nets can be divided into multiple cryptonets using different MSEC variables. In order to receive and read the messages transmitted, a JU must be a net member and a cryptonet member. However, in the Partitioned Variable mode any net member can relay any J-Series message even though the net member does not hold the same MSEC variable.

4.2.1.1.3 MULTINETTING AND STACKED NETS

When the PGCs have been established, sets of PGCs that are suitable for multinetting or stacked netting shall be identified to allow for multinet operations without loss of operationally required connectivity if multinet operation is necessitated by capacity demands (See paragraph 4.2.4.1.1.). A set of PGs may be multinetted if their associated PGCs have no JUs in common. A set of PGs may be stacked if their associated PGCs have no JUs in common, and their capacity requirements are identical.

4.2.1.1.4 RELAY

Once the PGCs are established, measures shall be taken to provide for connectivity among the JUs in each PGC. Because of line of sight (LOS) limitations or enemy jamming, some JUs may not be able to communicate directly with other JUs in their PGC. Where direct links between all JUs in a PGC do not exist or are unreliable, connectivity shall be established through the use of relays. JUs that are suitably located during the course of their normal operations shall serve as relays of opportunity.

A JU designated to relay a message shall be provided with capacity in which to transmit the relayed message. Three relay modes are available: Paired Slot Relay mode, Repromulgation Relay mode, and Addressed Relay mode. Relay assignments can be Unconditional or Conditional. An Unconditional Relay is activated upon assignment. A Conditional Relay is activated and deactivated automatically as a terminal function based on the location and relative distance of the JU from other active relays.

a. Paired Slot Relay Mode. In the Paired Slot Relay mode, any message received in a given time slot block X shall be relayed in the next occurring time slot of an associated time slot block Y. Multiple sets of paired time slots may be strung together to handle multihop relays. However, the use of relays, particularly multihop paired slot relays, is very costly in terms of system capacity. Single-hop paired slot relay requires twice the time slots needed for the original transmissions. More generally, N-hop Paired Slot Relay increases the time slot requirement by a factor of N plus 1. Paired Slot Relay assignments may be either Conditional or Unconditional.

b. Repromulgation Relay Mode. The Repromulgation Relay mode is an alternative relay mode designed to conserve capacity in a multihop relay environment. It is also designed to provide a way of distributing information in a multihop relay environment without depending on a terminal knowing direct or indirect connectivity, relay address, or externally supplied routing information. Thus, it is a distributed capability that does not depend on a central control function for its normal operation. It is suited to communications where a high throughput rate must be sustained or where messages have multiple destinations. Repromulgation Relay assignments are Unconditional only.

Using the Repromulgation Relay mode, relay time slots are donated from the originating JU's time slot block. A message designated for the Repromulgation Relay mode must be preceded by a Repromulgation Relay message which must be the first message in the time slot. The Repromulgation Relay message will specify the number of times the message should be relayed and the exact delay between the receipt of the message and the relay transmission. This delay corresponds to the Recurrence Rate of the time slot block (or subblock) in which the message originated. The originating JU may transmit its next message in the third slot of the time slot block following the previous transmission.

When the time slot requirements are driven by a throughput requirement, the Repromulgation Relay mode increases the time slot requirement at most by a factor of three, regardless of the number of relay hops required. The main drawback of this technique is that the first word of each message is required as overhead.

c. Addressed Relay Mode. The Addressed Relay mode can be used where multihops are required to achieve the desired physical and functional connectivity. Terminals participating in communications according to specific needlines must be controllable not only by relay time slot assignments and Repromulgation Counters, but also by addressing techniques. The Addressed Relay mode involves transmitting the information in a time slot along an established route that is specified in the first message in the time slot. Addressed Relay mode assignments are Unconditional only.

4.2.1.2 RESOURCE ALLOCATION

While a JTIDS/MIDS network has a large capacity for the exchange of tactical information, especially when formatted messages are transmitted, the total capacity of a single net is finite.

One net has a total usable capacity of 98,304 time slots during each 12.8 minute epoch. There are 128 assignable net numbers. Each net number can be associated with any available TRANSEC cryptovariable. Each net is characterized by a net number and a TRANSEC cryptovariable. However, approximately 15 to 20 of these nets can operate at the same time in geographic proximity without excessive mutual interference. Each time slot block assignment on a net can be operated in the Common or Partitioned Variable mode. In the Common Variable mode the net TRANSEC variable is also used for MSEC. In the Partitioned Variable mode, a separate variable (MSEC variable) is used for MSEC.

The primary task of the Network Manager is to allocate the total network capacity within communications security guidelines among users who have information to exchange. If the number of users is small, the task of capacity and cryptovariable allocation is relatively simple. With a large number of users, the task becomes more complex because user demands quickly reduce the remaining, available network capacity. Therefore, the Network Manager needs to know how many participants there will be and their security requirements so this information can be factored into the Network Management scheme.

The task of the Cryptonet Manager is to provide sound Cryptonet Management practices by:

a. Establishing procedures that are consistent with established Communications Security (COMSEC) doctrine to minimize the exposure of sensitive operational information.

b. Establishing procedures that provide for the most effective and secure use of the finite number of cryptovariables that are available.

c. Establishing procedures that establish and maintain a relationship of cryptovariables to cryptovariable logical labels by using the short titles.

d. Establishing procedures that provide effective methods of recovery from a security compromise that has resulted from a loss of a cryptovariable such as a keyed terminal or a cryptovariable device.

e. Establishing a method of dynamically rekeying JTIDS/MIDS terminals after loss, suspected loss, or a change of cryptovariables due to operational considerations.

f. Providing for the partitioning of available information into separate cryptonets based on the operational need-to-know and risk.

The specific resource allocation is highly dependent on the operational situation, the proximity of one JU to another, and the flexibility of sectioning various information exchanges into mutually exclusive groups. For example, in situations involving the exchange of Land (Ground) and Subsurface (Maritime) Surveillance messages, these two functions are definable as two multinetted PGs. In some operational situations, however, Surface (Maritime) forces may have to operate close to shore, making them vulnerable to attack by mobile artillery as well as submarines. In this situation, Surface (Maritime) forces will require access to Land (Ground) and Subsurface (Maritime) Surveillance messages.

4.2.1.2.1 ACCESS MODES

When the PGCs and their associated relay requirements have been determined, system capacity for the corresponding PG must be allocated to meet the established requirements. First, a preliminary choice of the access mode to be used must be made. The choices available include Dedicated Access mode, Contention Access mode, Time Slot Reallocation (TSR) Access mode, and Call-Up Access mode.

a. Dedicated Access Mode. The Dedicated Access mode is the assignment of specific time slots to specific JUs within a PGC. JUs have unlimited access to their assigned time slots within the PG. The Dedicated Access mode has the advantage of guaranteeing that a JU has time slots available for transmissions and that receiving JUs have no message conflict on a time slot. However, this access mode wastes capacity if message traffic is bursty, since only a small subset of the assigned time slots may actually be used for transmissions.

b. Contention Access Mode. The Contention Access mode allows JUs in a PGC to compete for the available capacity of the PG by pseudorandomly choosing transmission time slots from a common pool according to the requirements of each JU. This method conserves capacity, especially when message traffic is bursty or is driven by response time. However, this method decreases the probability that any given message will reach its intended destination(s) due to the possibility that more than one JU within LOS of the receiver may choose to transmit in the same time slot.

c. Time Slot Reallocation Access Mode. The Time Slot Reallocation Access mode allows JUs in a PGC to reallocate a shared pool of time slots periodically so that each JU assigns itself time slots according to its expected demand and the announced demands of other JUs. The shared pool of time slots assigned to and shared by a number of JUs for exchanging messages in a particular PGC is known as the reallocation pool. If the aggregate JU demand for time slots exceeds the capacity of the reallocation pool, the JUs assign themselves time slots in proportion to their demands, but scaled down by a common factor so that the total allocation is within the reallocation pool capacity.

This access mode conserves capacity by allowing the reallocation pool to be sized according to the expected aggregate requirement rather than as the sum of the peak capacity requirements of all participating JUs. The reallocation period can be set to the expected rate of demand fluctuations with a minimum reallocation period of 6 seconds and a maximum reallocation period of 48 seconds. The access mode is designed to operate in conditions of poor connectivity and overload, and in these conditions it will result in graceful degradation in the probability of successful message transmission in the case of time slot conflicts and subsequent reception in the case of jamming. This access mode is suitable for use in an environment where the available capacity is to be shared by a varying community of users with fluctuating demands.

The first J0.7 message sent by a JU that enters a TSR Pool must occur in a TSR Initial Entry Access time slot, if there is no dedicated access time slot assignment for the PG.

d. Call-Up Access Mode. In the Call-Up Access mode, the allocation of transmission time slots within the PG is dynamically controlled through the use of J0.6 Communications Control messages. After receipt of a J0.6 message, the interrogated JU transmits in all of the subsequent time slots of the PG until the message queue for that PG is exhausted or until the JU reaches the designated transmission limit, at which time another JU is interrogated. Interrogations may be made by a centralized control (Roll Call mode) or by successive terminals at the end of their own transmissions (Round Robin mode).

4.2.1.2.2 CALCULATION OF PARTICIPATION GROUP TIME SLOT REQUIREMENTS

When an access mode (or modes) for a PGC has been selected, the capacity requirements for the PG may be calculated. Time slot requirements are primarily determined by the transmit time slot requirements of the individual JUs in the PGC, the number of JUs in the PGC, their relative locations, the chosen access mode(s), the relay requirements, and the chosen acknowledgement protocol.

The transmit time slot requirement of a JU is equal to either the throughput requirement (the number of time slots each epoch required to support the JU's throughput requirements for original transmissions, relay transmissions, and acknowledgements) or the response time requirement (the number of time slots each epoch required to provide the specified response time for messages to be transmitted by the JU in that PG), whichever number is greater.

For the Dedicated Access mode, the PG time slot requirement is equal to the sum of the transmit time slot requirements of the individual JUs in the PGC. For the Contention Access mode, the time slot requirement is a function of the JU's transmit time slot requirements, the density of the JUs, and the required message reception probability by specific receivers. For the Time Slot Reallocation Access mode, the time slot requirement is equal to the maximum combined requirement of the PGC including an allowance for the transmission of J0.7 messages and the Time Slot Reallocation initial entry time slot requirements which are a function of the required time for a JU to begin participation in the reallocation pool and the number of JUs that may be expected to attempt to enter a Time Slot Reallocation pool simultaneously. For the Call-Up Access mode, the PG time slot requirement is the sum of the average throughput time slot requirements of the JUs in the PGC plus the number of time slots required for overhead.

4.2.1.2.3 ASSIGNMENT OF TIME SLOT BLOCKS

Once the time slot requirements for all PGs have been computed, the Network Manager may begin to allocate the system capacity. The first step in this process is to determine the time slot block requests for each PG. Since JTIDS/MIDS terminals are assigned time slot blocks of size 2^N (0 is less than or equal to N is less than or equal to 15) per epoch, and since any single JU can accept only a limited number of block assignments, it may not be possible to match the exact number of time slots allocated to the PG's actual requirements. Therefore, it may be necessary to round off the time slot requests of some PGs. When time slot block requests have been determined for each PG, the Network Manager must assign specific time slot blocks in accordance with these requests.

4.2.1.2.4 METHODS TO REDUCE RESOURCE UTILIZATION

When JTIDS/MIDS is fully deployed, capacity requirements may exceed the available terminal, network or system capacities. When the sum of the time slot block requests for all PGs exceeds the capacity of one net, multinetting and stacking of PGs may be employed by the network/system manager to increase available capacity. If multinetting and stacking do not provide enough additional capacity to meet the demand, the Network Manager has several other options available to reduce the time slot block allocations to the various PGs. For a specific PG, methods for reducing capacity requirements include:

a. Time slot reuse (assigning the same time slots to more than one JU in the PG).

b. Changing the access mode.

c. Using Packed-2 messages.

d. Reducing the number of relay hops.

Any of these methods may reduce the message reception probability and thus must be used with caution. In some cases, it may be preferable to reduce capacity demands by easing performance requirements, e.g., by lessening response time requirements.

4.2.1.3 NETWORK INITIALIZATION AND MAINTENANCE

The following paragraphs describe the procedures for network initialization and maintenance.

4.2.1.3.1 DYNAMIC VERSUS STATIC NETWORK MANAGEMENT

To achieve a maximum degree of nodelessness, a JTIDS/MIDS network should operate with minimal intervention from Network Managers. To the maximum extent possible, Network Management should be carried out in advance of operations. Advance preparations can include determination of the PGCs, nets, cryptonets, capacity allocations, access modes, mission channel assignments, Net Time Reference (NTR), and Initial Entry JTIDS Unit (IEJU) assignments. Network Management performed without real-time intervention of a Network Manager is referred to as Static Network Management.

Dynamic Network Management denotes real-time or nearly real-time management of the network by a Network Manager or Managers. Typically, Dynamic Network Management is executed by transmitting commands, via JTIDS/MIDS, using J0 System Information Exchange and Network Management messages. Dynamic Network Management allows a rapid adjustment of the network to changing circumstances, but it has the disadvantage of creating communications nodes and increasing the opportunity for error. Some degree of Dynamic Network Management will probably be necessary as part of network initialization and maintenance activities.

4.2.1.3.2 NETWORK INITIALIZATION AND NET ENTRY

Network initialization activities include the establishment of time synchronization among all JUs in the network and the communication of network capacity assignments and relay assignments to participating JUs. Time synchronization within a net is accomplished as follows:

a. Time Synchronization. One JU is assigned as the Network Time Reference (NTR) to establish system time. The NTR begins transmitting in a designated set of time slots known as the Net Entry time slots. Other JUs then join the network as operationally required by synchronizing directly or indirectly with the NTR. This process is known as network entry.

b. JTIDS/MIDS Network Entry. JTIDS/MIDS Network Entry is achieved in two steps: Coarse Synchronization and Fine Synchronization. The process begins with the operator entering into the terminal an estimate of system time and a corresponding time uncertainty. After this, Network Entry is an automatic terminal function.

The terminal begins listening for a message in the Net Entry time slots. When one error-free message signal has been received, the terminal achieves a state of Coarse Synchronization. At this time, it is capable of receiving messages, but it is not permitted to transmit any message except the Round-Trip-Timing (RTT) Interrogation.

Fine Synchronization is achieved by further improving the JU's estimate of system time. This may be accomplished either in the Active mode (exchanging an RTT Interrogation/Reply with a JU already in the network, i.e., already synchronized to the NTR) or in the Passive mode (using J2 PPLI messages received from JUs in the network). Active main net relays, and IEJUs will also broadcast in the Net Entry time slots to support the entry of JUs that are not within LOS of the NTR.

Network capacity assignments and relay assignments may be entered into the terminal either manually by the operator or automatically via Link 16 messages. Preferably, network capacity assignments shall be issued to the JUs prior to their entry into the network. However, the J0.0 Initial Entry message shall contain the time slot assignments for certain Network PGs.

4.2.1.3.3 NETWORK MAINTENANCE

Network maintenance activity includes the preservation of synchronization, connectivity, communications security and network capacity assignments appropriate to the communications requirements of the network participants. The activities associated with network maintenance include:

a. The assignment of a replacement NTR if the current NTR fails or is destroyed.

b. The assignment of replacement and/or additional IEJUs.

c. The assignment and cancellation of relay responsibilities to meet current connectivity requirements.

d. The assignment and cancellation of network capacity allocations to meet current communications requirements.

e. The updating of the Network Management database and the reassignment of network capacity as subscribers enter and exit the network.

f. The distribution and management of cryptovariables to meet communications requirements and communications security requirements.

4.2.2 PLANNING AND EXECUTING NETWORK MANAGEMENT

Two phases of Network Management must receive attention before and during tactical operations. The phases are:

a. Planning for Network Management.

b. Executing Network Management.

Detailed discussions of each topic are presented in the sections that follow.

4.2.2.1 PLANNING FOR NETWORK MANAGEMENT

Two phases of planning for Network Management can be identified:

a. Planning Network Management facilities.

b. Planning Network Management for subscribers.

4.2.2.1.1 PLANNING NETWORK MANAGEMENT FACILITIES

This phase of preparation involves the acquisition of equipment and the training of people capable of performing Network Management. These resources are located at appropriate operational and organizational facilities. A Network Management facility is required to support a Network Manager's activities. Network Managers engaged in Dynamic Network Management must have access to the JTIDS/MIDS network through JTIDS/MIDS terminals collocated with the Network Management facility. Thus, such facilities must also be JUs.

When there is more than one Network Management facility in a given network, the Network Managers are hierarchically organized. Each Network Manager performs Network Management for a segment of the network capacity. If the active Network Manager's facility suffers catastrophic failure, a designated backup facility will assume the Network Management function. If the Joint Operational Commander (JOC) decides to use one of the Service's facilities as the joint Network Manager (such as U.S. Air Force Tactical Air Control Center (TACC)/Message Processing Center (MPC), U.S. Marine Corps C^2 Unit, U.S. Army NCS, or U.S. Navy C^2 Unit), this facility is expected to provide its own backup facility. This implies prioritized, designated backup Network Managers who monitor the activity of the active Network Manager and store an essentially duplicate database to enable the priority backup Network Manager to assume Network Management functions with minimum delay. Real-time communications connectivity between active Network Managers and backup Network Managers can be through JTIDS/MIDS or other conventional means.

4.2.2.1.2 PLANNING NETWORK MANAGEMENT FOR SUBSCRIBERS

This phase of planning involves the initialization and maintenance of the network database with required data on subscribers. This database should include a list of subscribers and potential subscribers whose network capacity assignments must be managed, a compilation of cryptovariables and their associated cryptovariable logical labels available for use by these subscribers, and any capacity constraints imposed by the need to partition the network capacity among joint and individual service applications. In addition, for each subscriber, the database should include the type of unit and its mobility, approximate location, permanence in that location, and communications requirements. Communications data includes items such as PGs, message types and associated response times, throughput/update rates, and rate matching. Other needed parameters characterize the terminal's capability to support relay modes such as the Paired Slot Relay mode, the Repromulgation Relay mode, and the Addressed Relay mode.

This database should exist with appropriate backup provisions. It should be maintained on a continuous basis, and it should be updated as soon as terminals are designated for a particular operational facility. Contingency plans, communications plans, and operations plans should include this type of information as far in advance as possible to ease the initial burden on Network Managers.

4.2.2.2 EXECUTING NETWORK MANAGEMENT

In the execution phase, Network Management functions are performed by both Network Manager JUs and subscriber JUs. Thus, two types of Network Management functions should be considered:

a. Network Management functions executed at the Network Management facilities.

b. Network Management support functions executed by the subscribers (including relays).

4.2.2.2.1 FUNCTIONS EXECUTED AT THE NETWORK MANAGEMENT FACILITIES

These facilities carry out unique Network Management tasks that cannot be performed by other subscribers. These tasks can include making NTR and IEJU assignments, the partitioning of available capacity into PGs, the distribution and/or assignment of cryptovariables, the determination of the need for relays and the designation of relay terminals. A Network Manager shall also dynamically respond to changes in subscriber participation, communications security, and relay requirements during the course of an operation. Appropriate Network Management messages shall be generated to implement the required changes.

4.2.2.2.2 FUNCTIONS EXECUTED BY THE SUBSCRIBERS

Network Management support includes Network Management tasks that can be performed by subscriber JTIDS/MIDS terminals that are not necessarily network managers. A JTIDS/MIDS terminal can declare itself NTR, synchronize with an already existing NTR, enter the network to a full participation status, exit the network, accept relay instructions and network capacity assignment instructions, abide by the protocols of the various access modes, and contribute to relaying based on the Conditional Relay Algorithm.

4.2.3 ESTABLISHMENT OF PARTICIPATION GROUPS

The establishment of PGs shall be a responsibility of the Network Manager. This establishment of PGs is the first step in a multistep process of time slot management which consists of allocating the available JTIDS/MIDS capacity to a given set or type of subscribers. The two categories of PGs are:

a. Network PGs.

b. Needline PGs.

Within each category of PG, there may be numerous specific PGs. Each subscriber may participate in either or both PG categories, but a subscriber is limited by terminal implementation on the exact number of PGs in which he may participate.

4.2.3.1 NETWORK PARTICIPATION GROUPS AND NEEDLINE PARTICIPATION GROUPS

A Network PG is characterized by a list of applicable messages used to support an agreed upon technical function without regard to subscriber identities. A Needline PG is characterized by a list of netted subscribers compiled without regard to the specific messages they exchange with each other.

JTIDS/MIDS network capacity must first be allocated among Network PGs based on the combined needs of the users, the priority of those needs, and the characteristics of the JTIDS/MIDS technical functions. This allocation shall be relatively fixed; it is based on the general need to maintain network operation and essential connectivity. The remainder of the allocation shall be flexible to permit adaptation to changing operational needs and various levels of network loading. This scheme provides for a single net and cryptonet in situations demanding total interoperability. It also provides for multinets, multiple cryptonets, and stacked nets where the network loading, security, and functional, mission, or tactical operation connectivity requirements make such network organization desirable.

After an initial portion of the JTIDS/MIDS network capacity is allocated to required joint Network PGs, the remaining capacity can be allocated among Service-unique Network PGs or Needline PGs. A Needline PG is characterized by the following parameters: source user military identification, destination user military identification, bits per message, number of messages each peak period, end-to-end response time, and the needline priority with respect to the source.

The capacity associated with a Needline PG is that required to support a needline from a single source to one or more destinations which are to receive the same messages.

As mentioned above, the distinction between a Network PG and a Needline PG is that Network PGs allow transmission of specific message labels and sub-labels by/to any subscriber, and Needline PGs allow transmission of any message labels and sublabels by/to a specific set of subscribers. By assignment of time slots, the Network Manager may establish a Network PG which allows transmission of specific message labels and sublabels by/to a specific set of subscribers.

The specific PGs to be established are determined by the participants in the various communities of interest that exist among participants, minimum implementation requirements, response time and throughput requirements for each message label or needline, and allowed access modes and other information exchange requirements (See paragraph 4.2.3.10). These technical considerations are described in the following paragraphs.

Joint Network PGs that have been defined for Link 16 are described in paragraph 4.2.3.10. No joint Needline PGs have been identified; however, the U.S. Army has defined numerous Needline PGs for intra-Service use.

Once PGs are established, they must be supported by the subscribers. A JU must organize and execute its transmissions according to the PG assignments made to it. The PG assignments may be predefined in the terminal database, be preloaded into the terminal as initialization input, vary dynamically through control inputs received during terminal operation via the host platform, or they may vary dynamically by radioed Network Management messages. Since the Link 16 time slot assignment messages cannot associate specific PG numbers with message labels and sublabels which characterize the PG, this correspondence must be previously agreed upon. Similarly, with Needline PGs, a Needline PG number must be preassigned during initialization or by operations order to associate a source JU with allowed destination JUs.

The rudimentary assignments necessary for subscriber network entry, position location, and Network Management support functions must be known and initialized as described herein.

4.2.3.2 INFORMATION EXCHANGE REQUIREMENTS

Information exchange requirements are determined from the mission of the subscribers. Only a subset of these requirements need be given to the Network Manager as an input to the Network Management database. The parameters of the information exchange requirements may vary from user to user. To avoid confusion and misinterpretation of these parameters, the Network Manager may establish a standard set of parameters which he shall accept from subscribers. Operational requirements may dictate the use of nonstandard parameters. The following parameters are most useful to the Network Manager:

a. PG types.

b. Labels and sublabels of messages per PG type.

c. Length of messages, in bits.

d. Number of messages per unit time per label/sublabel per PG type.

e. End-to-end response time per message label/sublabel per PG.

f. The connectivity requirements of the PGCs using each PG type.

g. Security requirements of the PGCs using each PG type.

If the PG types are not specified by the potential subscriber or his proponent, the Network Manager shall use the JTIDS TIDP for guidance. This document provides a set of Network PGs that have been agreed upon jointly.

Message labels and sublabels are defined for each Link 16 message, and terminal's response times and update rates are given along with T/R rules to facilitate the derivation of required throughput and end-to-end response times. If the message labels and sublabels do not match the guidance outlined herein, the Network Manager must determine the PG categories and types within categories based upon the given subscriber's missions and other subscribers associated with his missions. The Network Manager shall align the throughput/response time requirements to minimize the total network capacity utilization.

Most of the data needed to make capacity estimates are available in the form of force structure, intelligence estimates, and other operational planning information. Once the gross capacity estimates have been made for each Network PG, they should be refined into maximum, average, and minimum loading estimates. Based on these estimates and communications security requirements, determinations can be made regarding such functions as access mode, time slot reuse, multiple cryptonetting, multinetting, and stacked netting. The specific arrangement will be somewhat dependent on the operational situation and the feasibility of partitioning various information exchange requirements into PGCs.

4.2.3.3 MINIMUM IMPLEMENTATION

Minimum implementation requirements are defined in Appendix A to this volume. Of importance to the task of Network Management is the fact that Link 16 participation requires that specific technical functions be implemented by all JUs on the network. The requirements of minimum implementation will, by necessity, use a portion of the total JTIDS/MIDS network capacity.

4.2.3.4 RESPONSE TIME

JTIDS/MIDS capacity assignments may be driven by response time requirements. Response time is a term used to characterize delay performance of a system given a set of inputs or stimuli. Response time is therefore dependent on the specific messages entering the system and the "extent of the system." The "extent of the system" may include the JU, or may encompass the originator and recipient (end-to-end process) including both people and equipment. Response times are defined below:

a. JU Response Time. The time from new information availability at the JU to the transmission of the information on the link. This time is defined for each message in Table 4.1-3.

b. Terminal Response Time. The time from new information availability at the terminal to the transmission of the information on the link. The JU Response Time is made up of the Terminal Response Time and the platform system response time. For purposes of platform system implementation, the Terminal Response Time begins when the data are available at the output interface of the platform system and ends when the message signal has been emitted on the source antenna. This time can be divided into necessary processing time and time to availability of the next transmission time slot. The necessary processing time is 100 msec (approximately 13 time slots). The time to the availability of the next transmission time slot is a function of Network Management decisions. The access rate and access mode are principal determining factors.

c. End-to-End Response Time. The time from new information availability at the source JU to the reception of the message at the destination JU.

In terms of operational requirements, the End-to-End Response Time is the item of concern. This response time is made up of the JU Response Time and the transmission time. Transmission time varies with the transmission path which, to the extent it is controllable, depends on Network Management decisions. The number of relays and the offset delay at each relay unit are the principal determining factors.

The Network Manager must consider the delays resulting from access rate, access mode, and relay delay in arriving at an End-to-End Response Time that is operationally acceptable. The Network Manager uses Terminal Response Time to estimate the time slot capacity (time slots per second) needed to meet End-to-End Response Time requirements.

4.2.3.5 THROUGHPUT

Assignment of the JTIDS/MIDS network capacity may be driven by throughput requirements. Throughput is a general term used to characterize the load performance of a system, given a set of inputs or stimuli. Throughput requirements are therefore dependent on the length of specific messages entering the system and the frequency with which these messages are exchanged.

For periodic messages, such as surveillance track reports, the message frequency is the product of the total number of tracks to be exchanged per unit of time and the update rate of a track during the same unit of time. For nonperiodic messages, such as control commands or requests for support, the subscriber or his proponents must provide an estimate of frequency of given messages based upon scenarios or experience. The throughput requirement may then be estimated from the product of the average message length and the message frequency.

The throughput requirement should also be reduced to units of time slots per second. The assignment of time slots then becomes dependent on whether throughput or response time requires more capacity. Message update rates are specified in Table 4.1-3 and in the T/R rules for each message.

4.2.3.6 RATE MATCHING REQUIREMENTS

When a PG is established for interconnection with nonJTIDS/MIDS nets or for interfacing certain types of platform systems, the requirement for rate matching may arise. Rate matching is required when the following two conditions exist simultaneously. The first is that the size of the PG time slot assignment must match very closely an arbitrary value that cannot be matched by a single time slot block. The second is that the interval between the time slots must be nearly uniform. The need for a uniform interval arises when a PG containing multiple time slot blocks of different Recurrence Rate Numbers must be interfaced through a buffer with a channel having a uniform rate. The size of the buffer determines the maximum interval between the time slots in the PG. By suitably assigning multiple time slot blocks of the same Recurrence Rate Number, a near match to both requirements can be made. In general, the smaller the Recurrence Rate Number used, the closer the match will be (at the expense of increased fragmentation of the assignable capacity).

4.2.3.7 TRANSMIT ACCESS MODES

The transmit access modes identify the algorithms (rules and procedures) used by a JU in scheduling its transmissions. The scheduling of transmissions involves the assignment of the next available time slot, as constrained by the access mode, to the transmission of the message(s) waiting in queue.

Four access modes are defined: Dedicated Access mode, Contention Access mode, Time Slot Reallocation Access mode, and Call-Up Access mode. Network loading and the communications mode in use will have a bearing on which transmit access mode is selected. The transmit access modes are assigned as a part of the time slot block assignments for each PG.

4.2.3.7.1 DEDICATED ACCESS MODE

Dedicated Access mode time slot assignments are used to increase the probability of receipt of a transmitted message. When there are sufficient time slots available in the network capacity to simultaneously satisfy the information exchange requirements of each JU, the Dedicated Access mode may be used. As the demand for time slots increases, a mixture of Dedicated Access mode and the other two modes will be required to provide each JU with sufficient transmission opportunities. Time slots used for the Dedicated Access mode are assigned to a terminal for its use in transmitting messages. Also, as in the case of the acknowledgement function, a Dedicated Access mode time slot can be assigned temporarily to another terminal for its use in transmitting a message. Normally one terminal participating in an organized JTIDS/MIDS net transmits a message in a time slot assigned as a dedicated access slot; however, Dedicated Access mode time slots may be reused by JUs either beyond or within LOS of each other, depending on the communications performance requirements of the involved JUs.

4.2.3.7.2 TIME SLOT REUSE IN THE DEDICATED ACCESS MODE

In non-LOS situations, a Network Manager may assign the same dedicated access time slot blocks to JUs that do not directly communicate with one another or do not communicate with a common third JU using these assignments. Propagational attenuation should be determined to be sufficient to preclude possible transmission capture between JUs that are not interoperating.

4.2.3.7.3 CONTENTION ACCESS MODE

When there are JUs demanding more time slots than are available in the JTIDS/MIDS network capacity, the Contention Access mode can be selected by the Network Manager. Time slots assigned for the Contention Access mode form a pool that is shared by a community of terminals for transmitting and receiving messages. In this mode, more than one terminal can transmit messages in any specified time slot. If two or more transmissions occur in the same time slot, a receiving terminal will lock onto the message from the closest transmitting terminal, which may or may not be the message it needs. The transmission with the earliest time of arrival (TOA) will be processed by the receiving terminal.

The Contention Access mode can be used only in Communications Mode 1 (wideband transmissions). Time slots are assignable to a particular pool for the Contention Access mode and are used by a terminal to transmit messages belonging to that pool. Transmission time slots belonging to the pool are allowed at an average rate of one transmission per time interval. This transmission slot is selected from all assigned slots that occur during the time interval in a manner that is pseudorandom with respect to the selection process at all other terminals.

4.2.3.7.4 TIME SLOT REALLOCATION ACCESS MODE

This access mode can be selected by the Network Manager when the demand for time slots using dedicated assignments exceeds supply. This mode is useful when user numbers and demands cannot be predicted at initialization and demands may fluctuate with changes in Reporting Responsibility, for example.

This access mode allows the sharing of a specified pool of time slots, referred to as a reallocation pool, with other participating terminals to exchange messages other than voice. A JU determines its time slot requirements for each interval referred to as a reallocation period, and announces the percentage of the reallocation pool's time slots that it desires to use during the next reallocation period in a time slot reallocation message. A JU also repeats, in the same message, the requirements of any JUs previously received in a process known as mutual dissemination.

A JU that has implemented Time Slot Reallocation will be able to operate simultaneously in at least two reallocation pools. Each reallocation pool is associated with only one Network PG and time slots in that pool may be used only for messages from that Network PG. More than one reallocation pool may be operated in a single PG. However, in a single PG, no JU may transmit in more than one reallocation pool. A reallocation pool must be specified in no more than 3 time slot blocks.

JUs allocate capacity to themselves according to their own demands and those heard from the other community members. JUs scale their demands so that the total scaled demand is within the pool capacity. JUs select time slots on a pseudo-random basis, avoiding time slots that they calculate have been allocated to JUs that have a higher priority in the selection sequence. The selection sequence is based on the number of JU demands received by a given JU, either directly, by relay, or by mutual dissemination. The JU hearing the lowest number of demand reports from other terminals selects time slots first and so on, ties being broken by Table Position Number and, if none, by Source Track Number. Thus the Network Manager has no involvement in the time slot selection ordering, either dynamically or at initialization. This combination of pseudo-random selection and ordering by receive count ensures that in very poor connectivity the access method degrades gracefully. In moderate connectivity a small amount of time slot reuse may occur.

4.2.3.7.5 TIME SLOT REUSE IN THE TIME SLOT REALLOCATION ACCESS MODE

The Time Slot Reallocation Access mode is designed to prevent time slot reuse by uniformly scaling down JU capacity allocations in overload conditions. Some reuse may occur in conditions of poor connectivity. As an initialization option, Network Designers may limit the dissemination of the demand information deliberately so that reuse can occur among widely separated JUs. This is done by setting the maximum dissemination hops parameter to the required number of repetitions of demand information.

4.2.3.7.6 TIME SLOT REALLOCATION INITIAL ENTRY

Each JU that participates in a PG using the Time Slot Reallocation Access mode must initially transmit the J0.7 Time Slot Reallocation message in a Dedicated Access time slot or, if there is no Dedicated Access mode time slot assignment for the JU, in one of the initial entry time slots. Initial entry time slot assignments are basically dedicated access mode assignments with time slot reuse. A JU that has not joined the reallocation pool uses a time slot from one of these assignments to announce the percentage of the reallocation pool's time slots it desires to use during the next reallocation period. JUs that have a time slot assignment using Dedicated Access mode in the PG must use that assignment for this message transmission and do not need an initial entry time slot assignment.

4.2.3.7.7 TIME SLOT REUSE OF THE TIME SLOT REALLOCATION INITIAL ENTRY TIME SLOTS

A Network Manager can limit time slot reuse of the Time Slot Reallocation Initial Entry time slot assignments by giving JUs Dedicated Access mode assignments. However, in situations of limited net capacity, initial entry time slots can be shared by all JUs in an assignment with this access mode. Since these initial entry time slots are used only to enter the reallocation pool, there is a small probability of use by more than one JU in a single time slot. The Network Manager assigns initial entry time slots to meet the response time requirement for JUs entering a reallocation pool.

4.2.3.7.8 CALL-UP ACCESS MODE

In the Call-Up Access mode, information exchange is controlled in the Roll Call or Round Robin modes. When these modes are implemented by the terminals of the participating JUs, the PG time slot blocks are assigned in the Dedicated Access mode. The Roll Call mode is controlled by a Network Manager who has been assigned this specific responsibility. The J0.6 message is used to initiate information exchange by a specific JU and is used by the JU to terminate the exchange. The Round Robin mode requires the assignment of a sequential position to each JU for information exchange. It is also controlled by the J0.6 message.

Both of the Call-Up Access modes have the characteristic that, within a fixed assignment of time slot blocks, the response time automatically increases with increasing traffic loads and decreases with decreasing traffic loads. The platform systems can control the response time by controlling the amount of information that is exchanged. Because of the role of the platform system in controlling the characteristics of the information exchange, the Call-Up Access modes should be used only when all participating JUs in the PGC have the requisite capability.

The capacity that must to be allocated to a PG that uses the Call-Up Access mode is determined in the same way as for any other PG using a Dedicated Access mode.

4.2.3.7.9 RECEIVE ASSIGNMENTS

Terminals shall receive messages as follows:

a. In all time slots that are assigned specifically as receive slots, on the nets specified in the assignments.

b. In all assigned transmit and paired relay transmit time slots that are not used by the terminal for its own transmissions, on the nets specified for the transmit time slots.

c. In all time slots that have not been assigned specifically as either receive or transmit time slots, on the Initial Entry Network PG net.

d. During those time slots that are specified for message acknowledgements, even when such messages requiring acknowledgement are not addressed to the terminal.

The Network PG to which a time slot is assigned shall not be used as a criterion for rejecting a received message.

4.2.3.8 PARTICIPATION GROUPS ON MULTINETS

JTIDS/MIDS capacity on a single net is limited to 128 time slots per second. Therefore, no PG may be larger than 128 time slots per second. When the throughput or response time requirements exceed the available capacity of a single net, a PG may be assigned blocks of time slots on other nets. The Network Manager must arrange the blocks from other nets so that minimum conflict (overlap) results if users require interoperability on several PGs. A multinetted PG may have some time slot blocks on one net and other time slot blocks on another net, provided that no time slot within a PG occurs simultaneously with another time slot in the same PG.

4.2.3.9 MESSAGES USED IN ASSIGNING PARTICIPATION GROUPS

The J0.3 Time Slot Assignment message is used to associate blocks of time slots and their associated cryptovariables with a specific PG number. The J0.7 message is used to request time slots within PGs that contain time slot reallocation pools.

4.2.3.10 NETWORK PARTICIPATION GROUPS DESCRIPTION

Network PGs have been defined to support Link 16 information exchange as follows:

PG 1	-Initial Entry
PG 2	-RTT-A
PG 3	-RTT-B
PG 4	-Network Management
PG 5	-PPLI and Status Group A
PG 6	-PPLI and Status Group B
PG 7	-Surveillance
PG 8	-Mission Management/Weapons Coordination and Management
PG 9	-Control
PG 10	-Electronic Warfare
PG 12	-Voice Group A
PG 13	-Voice Group B
PG 19	-NonC^2 JU-to-NonC^2 JU A
PG 20	-NonC^2 JU-to-NonC^2 JU B
PG 21	-Engagement Coordination
PG 22	-Composite A
PG 23	-Composite B
PG 27	-Joint Net PPLI
PG 28	-Distributed Network Management
PG 29	-Residual Messages
PG 30	-IJMS Position and Status
PG 31	-Other IJMS Messages

(Network PG numbers not listed above are currently undefined but may be specified for use in tactical communications plan(s) in accordance with interface operating procedures.)

Participation in a Network PG is the organization and execution of the transmission of messages according to message label and sublabel as described in the JTIDS/MIDS Class 2 System Segment Specification. The host TDS will normally specify in which Network PG a message is to be transmitted. However, for the guidance of network designers and the Network Manager, a standard Network PG and other applicable Network PGs are identified for each message in Table 4.2-1. Not all JUs will be able to exchange the complete list of messages shown, and some JUs may exchange messages in a Network PG other than shown in the Table. Nevertheless, the guidance provided by Table 4.2-1 should provide a firm basis upon which the Network Manager can determine allocations of transmission capability, relay capabilities or cryptographic assignments in the selected functional area(s). In addition, in the absence of different instructions from the host TDS, some terminals will transmit in accordance with the message to standard Network PG applicability given in Table 4.2-1.

Table 4.2-1 Message to Network PG Applicability Table

Message No	Standard NPG	Other Applicable NPGs
J0.0, J0.2	1	-
J0.3, J0.4, J0.6	4	Composite A
J0.5	As required	All except 2, 3, 12, 13
J0.7	As required	All except 2, 3, 12, 13
J1.1	4	6, Composite A
J2.0	7	Composite B
J2.2, J2.3, J2.4, J2.5, J2.6	6	5, 27, 4, 7
J3.0, J3.1, J3.2, J3.3, J3.4, J3.5, J3.6, J3.7	7	Composite B
J5.4	7	29, Composite B
J6.0	7	Composite B
J7.0, J7.2, J7.3, J7.4, J7.5, J7.6, J7.7	7	Composite B
J7.1	7	Composite A
J8.1	7	Composite B
J9.0, J9.2	8	Composite A
J9.1	21	-
J10.2	8	21, Composite A
J10.3, J10.5, J10.6	8	Composite A
J12.0	9	19, 20, Composite A
J12.1, J12.2, J12.3, J12.4, J12.5	9	Composite A
J12.6, J12.7	9	19, 20, Composite A
J13.0, J13.2, J13.3, J13.5	6	5, 27, 8, 9, 10, Composite A
J14.0, J14.2	10	Composite B
J15.0	7	8, Composite B
J17.0	9	19, 20, Composite A
J28.20	As required	All except 2, 3, 12, 13
J31.0, J31.1	4	Composite A
J31.7	As required	All except 2, 3, 12, 13
JTIDS Free Text (Voice)	12/13	-
JTIDS Free Text (Non-Voice)	As required	All except 2, 3, 12, 13
RTT-A	2	5, 6, 27, 30
RTT-B	3	-
IJMS P1, P2, P3, N7-1	30	-
Other IJMS	31	-

4.2.3.10.1 INITIAL ENTRY NETWORK PARTICIPATION GROUP

The first time slot of every 12-second interval is reserved for the transmission and reception of the J0.0 message to support system-wide initial entry. The time slots that satisfy this criterion define the Initial Entry Network PG, which is a fixed assignment shared by all terminals. The fixed block assignments are time slots (512 x N) of Set A, where N is equal to integers 0 through 63. This corresponds to the assignment of Time Slot 0, Set A, with the Recurrence Rate Number equal to 6, and a Net Number equal to 0.

4.2.3.10.2 ROUND-TRIP-TIMING NETWORK PARTICIPATION GROUP

A terminal can accept and use one or more blocks of time slots for transmitting RTT Interrogations and Replies. This Network PG may be used for either RTT-A Interrogations in a Dedicated Access mode or RTT-B Interrogations in a Contention Access mode, or time slots may be assigned within the Network PG for each type. The rate at which RTT Interrogations are transmitted conforms to the requirements for achieving and maintaining Fine Synchronization. These requirements are described in the JTIDS/MIDS Technical Description, Section 3.0 Terms and Definitions.

4.2.3.10.3 NETWORK MANAGEMENT NETWORK PARTICIPATION GROUP

A terminal can accept and use one or more blocks of time slots for transmitting J0 messages. This Network PG may be used for all J0 messages, except for the J0.0 and J0.2 Network Time Update message, in any access mode assigned. J2 messages may be transmitted in a Dedicated Access mode in time slots of this Network PG when there are no J0 messages to be transmitted.

4.2.3.10.4 PRECISE PARTICIPANT LOCATION AND IDENTIFICATION AND STATUS NETWORK PARTICIPATION GROUP

A terminal can accept and use one or more blocks of time slots for transmitting J2 messages in the access mode specified for the transmission. A terminal can operate with three specified groups referred to as the Special Group (Group A), the Common Group (Group B), and the Joint Net. The terminal always transmits its J2 messages in Group B and the Joint Net (except when transmitting Conditional Radio Silence as specified below) at the specified access rate and mode. The terminal also transmits its J2 messages in Group A, at the specified rate, as follows: (1) when so commanded through the subscriber interface, (2) when it is an active, unconditional relay or an active conditional relay for the main net, voice channel, or control channel relay function, (3) just before it goes to the Conditional Radio Silence mode, or (4) when the host aircraft has set the Flight Leader Indicator in its PPLI message. The terminal shall set the Flight Leader Indicator as directed by the subscriber interface. The terminal shall only transmit Conditional Radio Silence in one NPG. If a transmit slot is not available in Group A, it will then go to Group B. If a transmit slot is not available in Group B, it will then go to the Joint Net. The J13 Platform and System Status messages may be transmitted in the same time slot as J2 messages. Only J2 and J13 messages shall be transmitted in these slots at the specified rate except when in Test Mode 1. When in Test Mode 1, the terminal shall transmit a J0.1 Test message in place of the J2 message in all slots in which it would normally transmit a J2 message.

4.2.3.10.5 SURVEILLANCE NETWORK PARTICIPATION GROUP

A terminal can accept and use one or more blocks of time slots for transmitting surveillance data in the access mode specified for the transmission. Each group of C^2 JUs that are to participate in a single Surveillance Network PG are to be assigned time slot blocks on a net that supports the Surveillance Network PG.

4.2.3.10.6 MISSION MANAGEMENT/WEAPONS COORDINATION AND MANAGEMENT NETWORK PARTICIPATION GROUP

A terminal can accept and use one or more blocks of time slots for transmitting the Mission Management and the Weapons Coordination and Management messages in the access mode specified for the transmission. Some or all of the time slots in this Network PG can be assigned in the Paired Slot Relay mode, and the J0.5 Repromulgation Relay message can be used with the messages in this Network PG.

4.2.3.10.7 CONTROL NETWORK PARTICIPATION GROUPS

A terminal can accept and use one or more blocks of time slots for transmission of Control information. When the net number is not specified, the block assignment establishes a set of subscriber-selectable channels (stacked net). The terminal enables the subscriber to select a net number from 0 through 126 as a channel. Selection of net number 127 by the subscriber indicates that no channel is in effect for that terminal in that control group. It is possible to assign separate cryptovariables to subsets of these stacked nets.

A specific Control Network PG is assigned to limited sets of JUs for specific tactical operations. The time slot assignments for each PG may be subdivided into subsets of slots assigned to each participant in the Dedicated Access mode, assigned in the Contention Access mode, or assigned in the Time Slot Reallocation Access mode.

The terminal is also capable of accepting blocks of time slots for control with a net number assigned. In this case, the terminal shall use these time slots on the specified net, instead of the applicable common group of time slots, when that net number is selected as a channel using the selector for the applicable common group.

4.2.3.10.8 VOICE

A terminal can accept and use one or more blocks of time slots for voice transmission. The terminal is capable of accepting two common groups of time slots for voice. They are designated Voice Group A and Voice Group B. The net number is not assigned. In this case, for each voice group, the terminal enables the subscriber to select a net number (0 through 126) as the channel. Selection of net number 127 by the subscriber indicates that no channel is in effect for that terminal in that voice group. Multiple subscribers may select the same voice channel, as determined by the communication requirements. It is possible to assign separate cryptovariables to subsets of these stacked nets.

The terminal is also capable of accepting blocks of time slots for voice where the net number is assigned. In this case, the terminal shall use these time slots on the specified net, instead of the applicable common group of time slots, when that net number is selected as a channel using the selector for the applicable common group.

The terminal can utilize each of the time slot blocks to transmit digitized voice data. Voice can be transmitted using either nonerror-coded free text messages or error-coded free text messages as specified during initialization, depending on the voice data rate. The terminal determines the specific message type to be used depending on the voice group block assignment slot type, the Recurrence Rate, and the error coding option. Voice messages shall normally be handled as nonerror-coded free text messages.

4.2.3.10.9 PARTICIPATION GROUPS FOR DISTRIBUTED NETWORK MANAGEMENT

The U.S. Army terminal can accept and use time slot assignments in this Participation Group to conduct intra-Army communications. Net management messages to establish, maintain, and report connectivity among community members will be transmitted in the broadcast mode in this Participation Group.

4.2.3.10.10 PARTICIPATION GROUP FOR RESIDUAL MESSAGES

A terminal can accept and use time slots in this Participation Group for transmission of messages for which no specific Participation Group has been defined.

4.2.3.10.11 PARTICIPATION GROUPS FOR AN IJMS INTERFACE

Terminals with a bilingual capability can accept and use time slots in these two Participation Groups. These are used by JUs participating in an interface with terminals that implement the Interim JTIDS/MIDS Message Specification (IJMS).

4.2.3.10.12 PARTICIPATION GROUPS FOR JTIDS UNITS PARTICIPATING IN NET CONTROL STATION COMMUNITIES

JUs participating in a given NCS community must be capable of participating in additional Net Management related Needline PGs. These Needline PGs are required to provide capacity for solicitation of new entrants into the community, initialization of Net Control, and connectivity information. These Net Management related Needline PGs are described in the following subparagraphs.

a. Net Status Needline Participation Group. A terminal can accept and use one block of time slots for transmitting and receiving J1.4 Communicant Status messages. The terminal transmits its J1.4 message in dedicated time slots, according to the Net Number, Control Net Entry and Time Slot Offset, Control Net Entry assigned to it by the J1.5 Net Control Initialization message. The terminal receives the J1.4 message of other JUs participating in NCS communities in all other time slots given by the Overall Recurrence Rate, Net Status Participation Group value which is also provided in the J1.5 message. By assigning a different Time Slot Number, Net Status Participation Group value and Time Slot Set, Net Status Participation Group value to each JU in the NCS community, the NCS insures that each participating JU has the opportunity to transmit its J1.4 message without interfering with other participating JUs, exactly once every cycle determined by the Recurrence Rate, Net Status Participation Group value.

The J1.4 messages will be reported periodically in the Net Status Needline Participation Group. The following messages will also be allowed in this Needline Participation Group (pre-empting the J1.4 messages):

(1) The J2.5 Land (Ground) Point PPLI message, reported periodically using the ratio of one PPLI message to every 10(5-20, 1) J1.4 messages.

(2) A J1.1 Connectivity Status message, relayed from a JU wishing to enter the NCS community.

(3) A J0.6 message, initiated when a JU determines a Needline PG inadequacy or failure that must be reported to the NCS.

b. Relaying of Net Status Needline Participation Group Messages to the Net Control Station. In NCS communities all messages reported in the Net Status Needline PG must be received by the NCS. This enables the NCS to monitor the status of the nets under its control, verify that essential connectivity is preserved and adapt to dynamic changes in connectivity. For JUs within LOS of the NCS, the Net Status Needline PG information is received directly. For each JU beyond LOS of the NCS, the NCS must provide a relay for the original Net Status Needline PG information. No additional assignments are necessary for the JUs originating the messages in the Net Status Needline PG. However, to support this relaying, the NCS establishes a route using the Paired Slot Relay mode. This enables all messages reported by JUs participating in the Net Status Needline PG to arrive at the NCS.

c. Net Control Needline Participation Groups. In NCS communities a terminal can accept and use one block of time slots for receiving messages from its division NCS as identified by the Unit Designator. These messages include the J0.1 messages, the J0.3 messages, the J0.4 Radio Relay Control messages, the J1.5 messages, the J1.6 Needline Participation Group Assignment messages and the J8.0 Unit Designator messages. The Net Control Needline PG is assigned to each participating JU using the J1.5 message.

d. Net Control Entry Needline Participation Group. In NCS communities a terminal can accept and use one block of time slots for receiving J1.1 Connectivity Status messages from JUs seeking to reach the NCS as new entrants to the NCS community. The time slot block specifications for new entrants are provided in the J1.4 message. The information broadcast in the J1.4 message is established in either of two ways. The NCS has the option of allowing all JUs to use a database definable default parameter called the Net Control Entry Time Slot Offset, which is common to all JUs participating in an NCS community, or the NCS may deviate from a fixed offset by assigning the Net Control Entry time slot block information directly in the J1.5 message. The JU under control will transmit this information to potentially new entrant JUs in the J1.4 message. The Net Control Entry Time Slot Offset value provides the difference in time slots between the time slot number in which the JU transmits a message in the Net Status Needline PG and the time slot number in which the JU under control is ready to receive a J1.1 message from a new entrant JU. A new entrant JU processes the J1.4 message of the controlled JU to determine which option is to be used and thus in which time slot its J1.1 message is expected to be received.

4.2.3.10.13 NONC^2 JU-TO-NONC^2 JU NETWORK PARTICIPATION GROUPS

A terminal can accept and use one or more blocks of time slots for the exchange of data among a group of nonC^2 JUs. Operation is normally in a multinet or stacked net structure. The time slot assignments for the PGs may be subdivided into subsets of slots assigned to each participant of a stacked net in the Dedicated Access, Contention Access, or Time Slot Reallocation modes. Joint networks may operate a combination of access modes (some nonC^2 JUs transmitting in the Dedicated Access mode and some nonC^2 JUs transmitting in the Contention Access mode and some nonC^2 JUs transmitting in the Time Slot Reallocation mode). If Control NPG and/or NonC^2 JU-to-NonC^2 JU NPG A time slots are made available in the network design, all nonC^2 JUs on a given mission will exchange data using these time slots. The use of NonC^2 JU-to-NonC^2 JU NPG B does not negate or otherwise impact the use of Control NPG and NonC^2 JU-to-NonC^2 JU NPG A for the exchange of flight data.

4.2.3.10.14 JOINT ENGAGEMENT COORDINATION NETWORK PARTICIPATION GROUP

A terminal can accept and use one or more blocks of time slots for transmitting the Engagement Coordination message as well as related Surveillance, Information Management, and Weapons Coordination and Management data in the access mode specified for the transmission. The NPG may be used for engagement coordination among systems in a multi-net environment.

4.2.4 CAPACITY CONSTRAINTS

4.2.4.1 GENERAL CAPACITY CONSTRAINTS

In most of the projected scenarios that include the future use of JTIDS/MIDS, a single 98,304-time-slots-per-epoch net will not provide sufficient capacity to meet user requirements for information exchange. The JTIDS/MIDS architecture provides for the simultaneous operation of 128 single nets per TRANSEC variable, but it has been estimated that only about 15 to 20 nets can operate at any one time in a given geographical area without excessive mutual interference.

Security factors that affect JTIDS/MIDS capacity are:

a. Cryptonet size limitations.

b. Limiting access on the basis of need-to-know.

c. Information sensitivity, e.g., long-term vs short-term information, special sources.

An additional capacity constraint also arises. Any given terminal can handle only an assignment of a limited number of time slot blocks, as shown in Table 4.2-2. Because of these limitations, a terminal may not be able to participate in all PGs if the capacity of the PG is fragmented among several time slot blocks. The optimum number of time slot blocks to be assigned depends on the time slot block size, required capacity, required fragmentation, and a terminal's capability to accept additional time slot blocks.

Another capacity constraint is the number of cryptovariables a terminal can use concurrently. This is fixed for each terminal as shown in Table 4.2-2. If "over-the-air rekeying" is employed this permits a terminal to be given new cryptovariables, but it does not increase the terminal's real-time concurrent use of this fixed number of cryptovariables.

TABLE 4.2-2. Time Slot Block Assignment Capabilities (Sheet 1 of 2)

	COMMUNICATIONS MODE	TRANSMIT ACCESS MODE	NUMBER OF CONCURRENT CRYPTOVARIABLES	TIME SLOT BLOCKS TRANSMIT		
				NET NUMBERS	NUMBER OF BLOCKS	RECURRENCE RATE
HIT/ASIT/E-3A AN/URQ-31(V-5) Hughes Class 1	1	Dedicated Only	1	0-31[A] 32-127	3 Fixed Format, 1 P-Message and Free Text[D]	0-15
	2,4	Dedicated Only	1	0 32	3 Fixed Format, 1 P-Message and Free Text[D]	0-15
HIT/ASIT/E-3A AN/URQ-33(V-1) Hughes Class 1	1	Dedicated Only	1	0-127[A]	3 Fixed Format, 1 P-Message and Free Text[D]	0-15
	2,4	Dedicated Only	1	0	3 Fixed Format, 1 P-Message and Free Text[D]	0-15
AN/URQ-28 Singer-Kearfott Class 2 (ADM)	1	Dedicated Only	1	0-31 32-127	5 Fixed Format and Free Text	0-15
	2,4	Dedicated Only	1	0 32	5 Fixed Format and Free Text	0-15
FULL-SCALE DEVELOPMENT (FSD) Singer-Kearfott Class 2	1	Dedicated, Contention	8[B]	0-127	Up to 64[E]	0-15
	2,4	Dedicated	6[C]	0	Up to 64[E]	0-15

NOTES
[A] Transmission on one net: one net called "Main Net."
[B] Without over-the-air rekeying.
[C] With over-the-air rekeying.
[D] One Block on one net per Unformatted Message Element [UME] control head. Total 20 control heads possible.
[E] The sum of the TX, RX, and relay time slot block assignments is less than or equal to 64.

TABLE 4.2-2. Time Slot Block Assignment Capabilities (Sheet 2 of 2)

	TIME SLOT BLOCKS (RECEIVE)		TIME SLOT BLOCKS (RELAYS)		
	NET NUMBERS	NUMBER OF BLOCKS	NET NUMBERS	NUMBER OF BLOCKS	RELAY DELAY (SLOTS)
HIT/ASIT/E-3A AN/URQ-31(V-5) Hughes	0-31 32-127	9 Fixed Format[F], Default Main Net and Free Text[D]	0-31[G] 32-127[H]	3 Fixed Format and 3 Free Text	∃ 3 3,4,5,6
Class 1	0 32	Fixed Format and Free Text	0 32	3 Fixed Format and 3 Free Text	∃ 3 3,4,5,6
HIT/ASIT/E-3A AN/URQ-33(V-1) Hughes	0-127	9 Fixed Format[F], Default Main Net and Free Text[D]	0-127[G]	6 Fixed Format and 6 Free Text Mix	∃ 3
Class 1	0	Fixed Format and Free Text	0	6 Fixed Format and 6 Free Text Mix	∃ 3
AN/URQ-28 Singer-Kearfott	0-31 32-127	9 Fixed Format or 6 Free Text	0-31[G] 32-127	3 Fixed Format and Free Text Mix	∃ 3
Class 2 (ADM)	0 32	Fixed Format and Free Text	0 32	3 Fixed Format and Free Text Mix	∃ 3
FULL-SCALE DEVELOPMENT (FSD) Singer-Kearfott	0-127	Up to 64[E]	0-127[G]	Up to 64[E]	∃ 3
Class 2	0	Up to 64[E]	0	Up to 64[E]	∃ 3

NOTES
[D] One Block on one net per Unformatted Message Element [UME] control head. Total 20 control heads.
[E] The sum of the TX, RX, and relay time slot block assignments is less than or equal to 64.
[F] Three blocks on each of three nets.
[G] Net-to-net or same net.
[H] Single net relay only.

4.2.4.1.1 MULTINET OPERATIONS

JTIDS/MIDS provides for multinet operations in which two or more JUs can transmit in the same time slot on different nets to increase communications capacity. A multinet operation can be conducted only in Communications Mode 1 (wideband) where the mutual interference caused by simultaneous transmissions can be tolerated by the inherent jamming protection offered by this mode. It must be noted, however, that multinet operation precludes interoperability and connectivity among users who operate simultaneously on different nets. Because of this, multinetting should be used only when the time slot blocks associated with the particular functions to be accommodated (e.g., Control Network PGs) can be assigned to exclusive communities of JUs performing functions on an organizational basis. JUs operating in one net normally would not need to participate in another net.

In a multinet structure, all nets are mutually synchronized so that each time slot of each net is coincident in time with the corresponding time slot of every other net. Only one unit is designated as the NTR at any given time, establishing one system time for all synchronized nets. A JU can participate in several nets on a time-slot-to-time-slot basis, depending on its assignment.

Multinetting is the simultaneous use of specific blocks of time slots on different nets of a JTIDS/MIDS network independently by different sets of users. Connectivity is not maintained among all users of these time slots.

A stacked net operation is the coordinated use of simultaneous blocks of time slots. These blocks of time slots are characterized by the same Set Number, Initial Slot Number (ISN), and Recurrence Rates, but different net numbers and/or cryptovariables. Time slot blocks may be changed by switch action to select a desired net number.

4.2.4.1.2 RELAY CAPACITY

Relay capability is required for subscribers who must communicate with other subscribers beyond LOS. The relay capacity requirement is directly proportional to the number of relays that are required to reach the destination. The proportionality constraint depends upon the access mode.

The relay capacity requirement may also depend on the location of the relay. A more judiciously positioned relay may require more relay capacity since it will likely be selected to support more subscribers with relay requirements.

To properly estimate the required relay capacity at a particular relay terminal, the Network Manager must sum the relay requirements of each PG that will require the support of the particular relay. In the Paired Slot Relay mode, the Network Manager shall assign the relay receive time slots and the relay transmit time slots to each designated relay. In the Repromulgation or Addressed Relay mode, the Network Manager shall assign all of the relay transmission capacity to the message originator who will then donate time slots to potential relays. Potential relays and destinations must be assigned the same time slots as receive time slots.

Whenever a receive assignment is issued for time slots that will contain relayed messages in the Partitioned Variable mode, the Network Manager must inform the recipient of the total relay delay and original net number. This is not required for messages transmitted in the Common Variable mode.

4.2.4.1.3 MESSAGES USED TO SUPPORT CAPACITY REQUIREMENTS

The J0.0 message provides the basic, minimum, mission independent capacity to process RTT, voice, and PPLI information. The J0.0 message is required for network entry and maintenance.

The J0.3 message supports subscriber oriented, mission dependent capacity assignments.

The J0.4 message assigns relay capacity for use by Conditional and Unconditional Relays operating in the Paired Slot Relay mode.

The J0.5 message or an appropriate Variable Format Message supports the donation of relay transmission time slots.

The J0.6 message is used to request additional capacity or to delete capacity.

The J0.7 message is used to request time slots in a time slot reallocation pool.

4.2.5 RELAY CONTROL

Every JU has the capability to provide relay support for other JUs that are beyond LOS of one or more of their associated PGCs. However, every relay will not be able to provide the full spectrum of relay options. Restrictions such as the PG related relay state or the transmit mode and relay mode likely to be implemented by each JU must be taken into account.

The overall JTIDS/MIDS relay architecture is based upon three compatible, but independent, relay modes whose implementation and usage depend upon the types of JUs involved and the environment in which they operate. The three modes for relay are Paired Slot Relay mode, Repromulgation Relay mode, and Addressed Relay mode.

All relay modes operate on the principle of time slot delay in which messages received in one time slot are relayed at a later time in a specified preallocated or donated transmission time slot. The relay must take place no sooner than the sixth time slot following the time slot in which the original message was received. A terminal must have previously achieved Fine Synchronization in the Normal mode before it can participate in the relay of messages. It is assumed that the performance of relay functions will not degrade the JU's performance in other PGs in which it is expected to participate as a subscriber. Messages which upon receipt have an uncorrectable error are not relayed. RTT Interrogation and Reply messages cannot be relayed.

The following paragraphs provide additional technical considerations for each relay mode.

4.2.5.1 PAIRED SLOT RELAY MODE

The Paired Slot Relay mode requires the selection and assignment of candidate JUs to serve in one of the JTIDS/MIDS terminal relay modes: Unconditional Relay or Conditional Relay. Relay receive time slot blocks and relay transmission time slot blocks are assigned to each JU that is selected to serve as a relay.

Paired time slot blocks are assigned as a part of each PG that requires Paired Slot Relay mode support. Multiple paired blocks of relay time slots can be assigned to a JU. A JU that operates in the Paired Slot Relay mode shall indicate its Active or Inactive status in its J2 messages. A JU may be assigned to operate in the Paired Slot Relay mode for more than one PG. It may be designated as either an Unconditional relay for each PG to which it is assigned, or it can be a Conditional Relay for main net, voice channels, and/or Control Channels. Paired time slot blocks provide a relatively fixed, dedicated access relay capacity that can be changed only by a Network Manager.

In paired slot relay, messages can be relayed either in the same net number as that on which the original messages are received or on a different net number. In the Partitioned Variable mode terminals can blind relay messages for which they do not hold the MSEC variable and therefore cannot read the messages.

4.2.5.1.1 UNCONDITIONAL RELAY MODE

A JU is assigned to operate as an Unconditional Relay in the Paired Slot Relay mode either during initialization or by a J0.4 message addressed to the JU by the Network Manager. Certain PGs for which relay support is being provided are indicated in the J2 messages of the Unconditional Relay. The Unconditional Relay mode should be assigned to JUs that provide the needed connectivity among JUs that are not within LOS of each other. The JUs selected for this relay mode need a high degree of permanence in the geographical area in which they were originally assigned to relay.

4.2.5.1.2 CONDITIONAL RELAY MODE

A JU is assigned to operate as a Conditional Relay either during initialization or by a J0.4 message addressed to the JU by the Network Manager. Certain PGs for which relay support is being provided are indicated in the J2 messages of the Conditional Relay. If other Conditional or Unconditional Relays are active in the PG and the geographical area covered by assigned Conditional Relays, as indicated in their J2 messages, and are situated at a higher altitude, the Conditional Relay remains inactive as a relay for this PG. If this is not the case (i.e., if no relay activity is reported in the J2 messages received during a specified period of time), the assigned Conditional Relay becomes active provided it maintains an altitude advantage relative to other JUs. Further details on the Conditional Relay are contained in the JTIDS/MIDS Technical Description Section 3.0, Terms and Definitions.

4.2.5.1.3 MESSAGE DIRECTED RELAY MODE FOR JUS

For JUs participating in an NCS community, a JU may be assigned by the NCS to operate as a relay in a Needline PG. If selected, a JU relays only when a match occurs between the Relay Select field in the J0.4 message and the Message Directed Relay (MDR) field in the Header Extension provided by the source of the needline. On a message-to-message basis, the source terminal alternates messages between two independent relay paths that are established by the NCS using the relay select feature.

4.2.5.2 REPROMULGATION RELAY MODE

As an alternative to the Paired Slot Relay mode that must be previously assigned by the Network Manager, every JU is capable of acting as a relay on a time-slot-to-time-slot basis. The JU must be a member of the PGC for which relay support is required. Multiple hops may be achieved without the need to establish a path ahead of time. However, the messages relayed by the Repromulgation Relay mode cannot be directed to follow a prescribed path unless the terminal has been configured and initialized to perform the Repromulgation Relay filtering function. The messages shall be relayed by all JUs that receive the messages if they are in the active Repromulgation Relay Mode. This relay will occur provided that the donated time slots do not conflict with previously assigned transmission/reception requirements on a different net. The Repromulgation Relay mode does not require intervention of the Network Manager.

4.2.5.3 ADDRESSED RELAY

This relay mode provides a distributed capability to each JU to determine the exact route/path along which a message is relayed. This method is particularly suited to addressed messages in which a centrally managed, Paired Slot Relay mode fails to provide the necessary paths.

The information needed to determine which JUs can be addressed for relay is obtained from the J2 messages and the J1.1 messages. Since management of the relays to be addressed is performed by the subscribing JUs, the Network Manager merely assigns sufficient capacity to each JU to include the relay capacity that is subsequently donated by the originating JU for the use of the relay terminal on a message-by-message basis.

An adaptive routing algorithm must make efficient use of the following items:

a. A JU's capacity management function.

b. A JU's position assessment capability.

c. A JU's identification capability.

A JU's capacity is determined by the time slots assigned to it for transmission and reception. Time slots are assigned either statically or dynamically using the J0.3 message. Position and identification information are also available through dynamic exchange of J2 messages or through other means. An additional level of control over JU relay functions is through a routing algorithm that uses dynamically exchanged J1.0 Connectivity Interrogation messages, J1.1 messages, J1.2 Route Establishment messages. These messages identify the JUs that participate in routing.

The information needed to control a relay by addressing is obtained in two phases, address data initialization and address data maintenance.

The Addressed Relay mode requires address data that identify a JU as a destination or as a relay. In order to originate messages using the Addressed Relay mode, a JU must initialize and maintain an address database that includes the following items:

a. A destination list (16(16-32,1) TNs).

b. A direct connectivity list (8(8-16,1) TNs).

c. Indirect connectivity lists (8(8-16,1) x 8(8-16,1) TNs).

d. A connectivity matrix (64(48-128,1) x 64(48-128,1) CQs and associated 64(48-128,1) TNs).

e. Destination associated relay lists (16(16-32,1) x 8(8-10,1) TNs).

f. Route lists (8(8-16,1) x 8(8-10,1) TNs).

For an explanation of the preceding parameters, see paragraph 5.7.1c.

A JU that can be controlled in the Addressed Relay mode is also required to initialize and maintain a source/route number list with up to 32 entries of source/route number combinations. The use of these lists and matrices is discussed below.

All required information for the address database may not be available at terminal initiation time. Address data initialization must therefore be completed through the use of the J1.0, J1.1, and J1.2 messages.

The messages are exchanged on the same net dedicated to fundamental applications in order to maximize connectivity. Initially, Network Management messages comprise a high percentage of the net capacity. However, as the participating terminals complete their various addressing lists and the connectivity bit matrix, the capacity will be quickly released for predominantly functional exchanges.

When T represents the number of transmitters operating per unit time in a given net, the average Recurrence Rate of each transmitter is given by:

a. $R = 15-\log_2 (T/3)$.

The integer part of R may therefore be initially assigned to all transmitting JUs as a baseline for dynamic allocation/reallocation required to adjust and shift the net from its initial primary orientation of Network Management to a final functional mission orientation.

To complete the address database, a terminal must first have initialized its destination list array. This is normally done through the host platform. To complete the direct connectivity list, one or more of the following alternatives is used: monitoring the Initial Entry Network PG, monitoring the PPLI Network PG and monitoring the RTT Network PG.

The J0.0 message is augmented with local connectivity information. The initializing terminal may transmit RTT Interrogation messages to specific destination terminals to obtain connectivity information.

It is required that each JU shall be within LOS of at least one other JU. If a JU is in danger of isolation, measures must be taken to position additional JUs as required to maintain communications.

During the buildup of its direct connectivity list, a JU may find a TN matching a required destination. Therefore, direct functional communications with that JU may be initiated immediately on the same net.

If one or more destination TNs are not matched by the direct connectivity list, the terminal may begin to build indirect connectivity lists corresponding to JUs given in the direct connectivity list. There are two ways to obtain indirect connectivity lists (assuming they are not available off line). One way is to monitor the addressed communications of directly connected JUs and other JUs. The second way is to use J1.0 messages. Interrogated JUs then reply with J1.1 messages from which indirect connectivity lists can be compiled. By interrogating JUs on the direct connectivity list and subsequently interrogating JUs on the indirect connectivity lists, the required connectivity matrix is completed.

During the buildup of the indirect connectivity lists, a JU may find a TN matching a required destination. Functional communication with that JU is then possible through use of the associated relays. At that point functional messages can be formulated with a header extension word that identifies the relays and provides the capacity required for the relays to retransmit the message.

To achieve routing through multiple relays, several J1.0 messages may be required. By interrogating potential relays identified in the first level of indirect connectivity lists and obtaining their J1.1 messages, a connectivity matrix is initialized. Analogous to a bootstrapping process, destination associated relay lists are also initialized. Once a relay list is completed for a particular destination, functional messages may be exchanged with that destination using the header extension words that identify the associated relays and provide the needed capacity for each relay to transmit the message.

If communications to particular destinations or through a number of relays are frequent, the Route Number may be initialized and established by transmitting a J1.2 message that includes all the relays on the route and that provides the Route Number which shall be used in the header extension words in lieu of the string of relay TNs. A JU receiving a J1.2 message with its own Source TN as a relay or destination is required to store the Route Number along with the Source TN for filtering future receptions. A JU is required to store up to 4(4-8,1) Route Numbers for up to 4(4-8,1) sources. This list is called the source/route number list. A source JU shall establish preferred and alternate routes based upon the connectivity information available and a minimum-hop, path-finding algorithm. Relays on the route are stored in lists called route lists. The route list is identified by a Route Number. For each Route Number, a variable number of up to 16 relays and/or destination TNs make up the route list.

The control over the initialization of the JU address database is two-fold. Initialization may proceed under direct control by an operator or host computer. In contrast, the initialization process may proceed automatically employing a trial and error search algorithm. Maintenance of the JU address database is similarly controlled. However, J1.0, J1.1 and J1.2 messages are exchanged at a much slower rate during database maintenance.

The general message flow from a source perspective is diagramed in Figure 4.2-1. A normal sequence of events is identified through the time slot subscripts. The general message flow from a relay/destination perspective is diagramed in Figure 4.2-2.

4.2.5.4 MESSAGES USED IN SUPPORT OF THE RELAY METHODS

The J2 messages are used to support the Paired Slot Relay and Addressed Relay modes.

The J0.0 message provides optional connectivity information to support the Addressed Relay mode.

The J0.4 message is required to assign relays and paired time slot blocks to support the Paired Slot Relay mode.

The J0.5 message supports the Repromulgation Relay mode.

The J1.0, J1.1, and J1.2 messages support the Addressed Relay mode.

4.2.6 NETWORK INITIALIZATION, ENTRY, MAINTENANCE, AND EXIT

A JU designated as the NTR is essential to network initialization, entry, and maintenance. The NTR must be assigned by the Network Manager. In addition, alternate NTRs must be identified and activated by the Network Manager in nonreal time through a nonJTIDS/MIDS communications medium.

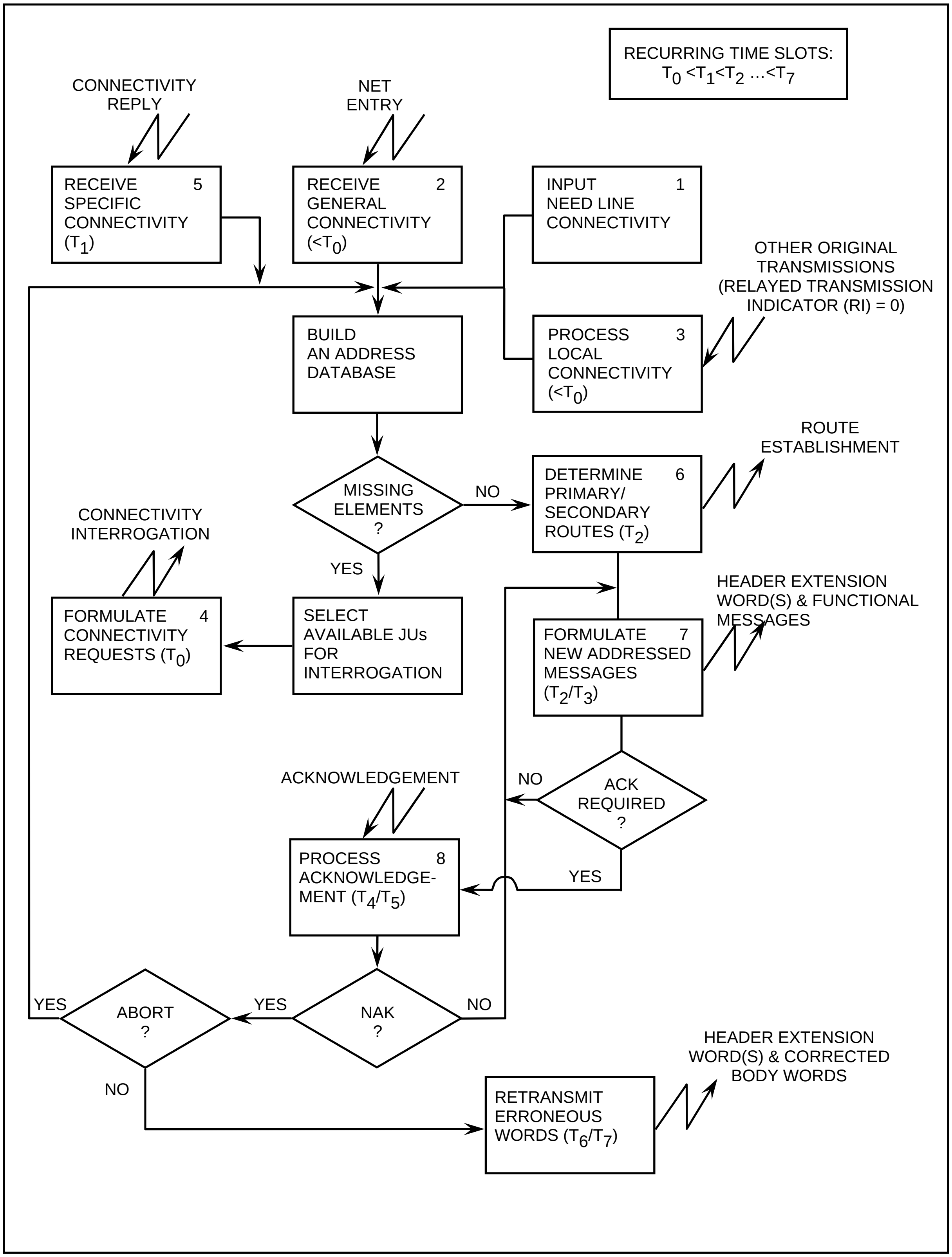

FIGURE 4.2-1. General Data Flow Routing (Source Perspective)

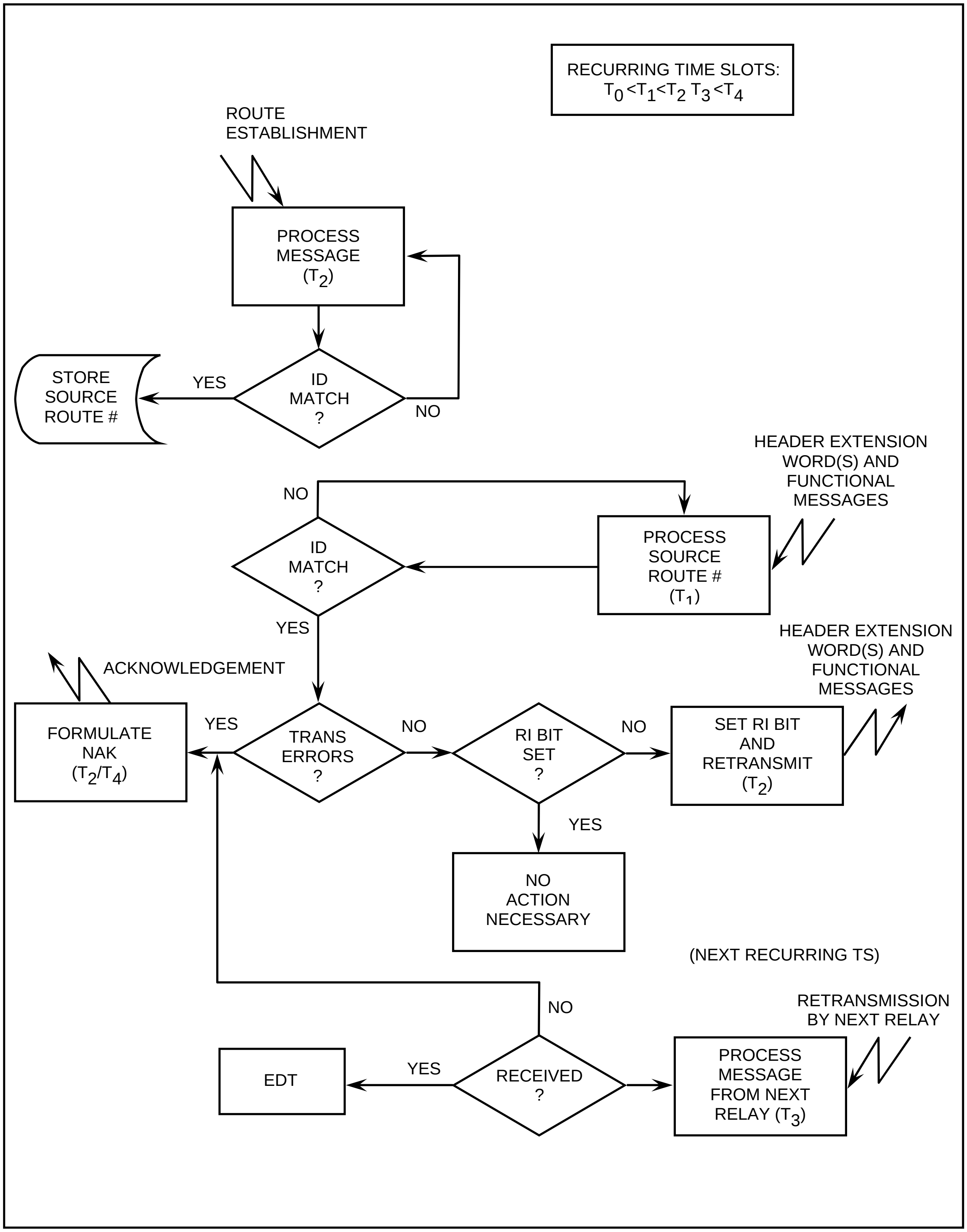

FIGURE 4.2-2. General Data Flow Routing(Relay/Destination Perspective)

A JU becomes an NTR through operator action once it is assigned by the Network Manager. When an NTR JU starts to transmit messages, other JUs may enter the network after initializing themselves as Primary Users (by employing RTT messages) or as Secondary Users (by employing J2 messages) during achievement of Fine Synchronization. As identified by the J0.0 message, special PGs called RTT and PPLI are allocated on the main net (Net Number 0) for all JUs. The Network Entry PG is Set A, with ISN equal to 0, and RRN equal to 6. This assignment is built into all Class 2 JTIDS/MIDS terminals and, for operational purposes, it is a fixed assignment.

Maintenance of network synchronization is automatic. It does not require Network Manager intervention except as already discussed under dynamic time slot management; it does require that the NTR is functioning properly.

To facilitate Network Management, JUs that exit the network are required to transmit their change of participation status. Dynamically allocated capacity to an existing JU may be cleared for reallocation to JUs that have requested more capacity or to new JUs that have recently entered the network.

When over-the-air rekeying is used, the Net Manager is responsible for the administration, coordination and distribution of a unique variable to each of the subscribers in his net in accordance with COMSEC procedures. The unique variable is used by the KGV-8 to decrypt and process J31.0 Over-the-Air Rekeying Management and J31.1 Over-the-Air Rekeying messages.

4.2.6.1 JTIDS/MIDS UNIT TERMINAL INITIALIZATION

The JU terminal must be initialized properly to support Network Management. All terminals in a network must be initialized to operate in a common communications mode, common time of day, and common network entry TRANSEC cryptovariable. Network time is the clock time of the JU that has been designated to be NTR. Ideally, this time should be the same as Greenwich Mean Time (GMT) or some other standard time. The primary reason for using a standard time is to facilitate network entry.

Additional JU terminal initialization parameters depend upon the subscriber's mission and the degree to which the Network Manager can rely upon a particular subscriber to support the network entry, relay, and network maintenance functions. The JU identified by the Network Manager to act as an NTR shall initialize the Organization User Type as NTR. All JUs have the option, depending upon their mission, to declare their Organization User Type as Navigation Controller (NC) and/or Position Reference (PR). All JUs except the NTR, NC, and PR shall declare their Organization User Type as Primary User or Secondary User. NCs and PRs are Primary Users. NonNTR JUs must also enter the uncertainty of the time of day into the terminal. JUs that are Secondary Users must enter their initial position and position quality to enable them to achieve Fine Synchronization. The Network Manager must provide initial time slot blocks for the NTR and Primary Users to transmit J2 messages essential for achieving Fine Synchronization using the Passive mode.

A JU identified by the Network Manager to serve as a Conditional or Unconditional Relay shall initialize its relay assignments for each time slot block specified by the Network Manager. The relay assignments may be subsequently updated by the J0.4 message.

JUs that are Primary Users must be assigned RTT time slot blocks for use in interrogating the NTR, other Primary Users, PRs and NCs. Two types of RTT Interrogations are possible: RTT Interrogation-Addressed and RTT Interrogation-Broadcast. The Network Manager may preclude the use of one type or the other by not assigning time slot pools. RTT-A may be transmitted only in a dedicated pool, and RTT-B may be transmitted only in a contention pool. If both types of pools are assigned, the JU shall transmit the appropriate RTT message in the next available time slot assigned for RTT transmissions commensurate with the time quality triggering the requirement.

A JU (other than the NTR or an active main net relay) that is selected by the Network Manager to facilitate the network entry of other JUs by transmitting J0.0 messages must be initialized as an IEJU.

Prior to initialization, each JU shall be provided with the following:

a. Network entry parameters (net number and network entry TRANSEC and MSEC, as required) associated with the joint Network Manager or a subordinate Network Manager (intra-Service).

b. Time slot assignments and their associated cryptovariables for the static PGs.

c. A "unique variable" if over-the-air rekeying is used.

4.2.6.2 <u>NETWORK ENTRY</u>

The process of network entry is described in the following paragraphs.

4.2.6.2.1 <u>FIRST JTIDS/MIDS UNIT IN THE NETWORK</u>

Figure 4.2-3 shows the network entry process in flowchart form. The first JU in the network is initially designated the NTR JU and enters the network entry TRANSEC cryptovariable, MSEC cryptovariable if required, and network time. (There is only one NTR JU in a JTIDS/MIDS network.) This unit's transmit time slots are assigned during terminal initiation (e.g., by operations order or by operator designation). Once time slots are assigned, the JU can then begin transmitting J0 messages, J2 messages, and others.

4.2.6.2.2 <u>SECOND AND SUBSEQUENT JTIDS/MIDS UNITS ENTERING THE NETWORK</u>

Once an NTR JU has initiated a JTIDS/MIDS network, another JU enters the network by:

a. Entering the TRANSEC cryptovariable and MSEC cryptovariable as required.

b. Entering network time with an estimated uncertainty.

c. Entering a position estimate and position quality (for the Passive mode of synchronization, using J2 messages).

d. Entering the desired synchronization method:
- Active.
- Passive.

e. Attempting receipt of the J0.0 messages, which will enable Coarse Synchronization. (The NTR, active main net relays, and IEJUs will transmit

J0.0 messages in known time slots.) (A JU participating in an NCS community may also be initialized over-the-air using the J1.5 message to activate as an IEJU.)

Receipt of a J0.0 message establishes Coarse Synchronization. Once Coarse Synchronization is established, the unit can receive on all time slots and can achieve Fine Synchronization either Actively or Passively. If the Passive mode is selected, the unit must receive J2 messages until Fine Synchronization is achieved. Selection of the Active mode for Fine Synchronization requires the assignment of time slots for RTT Interrogation and Reply exchange.

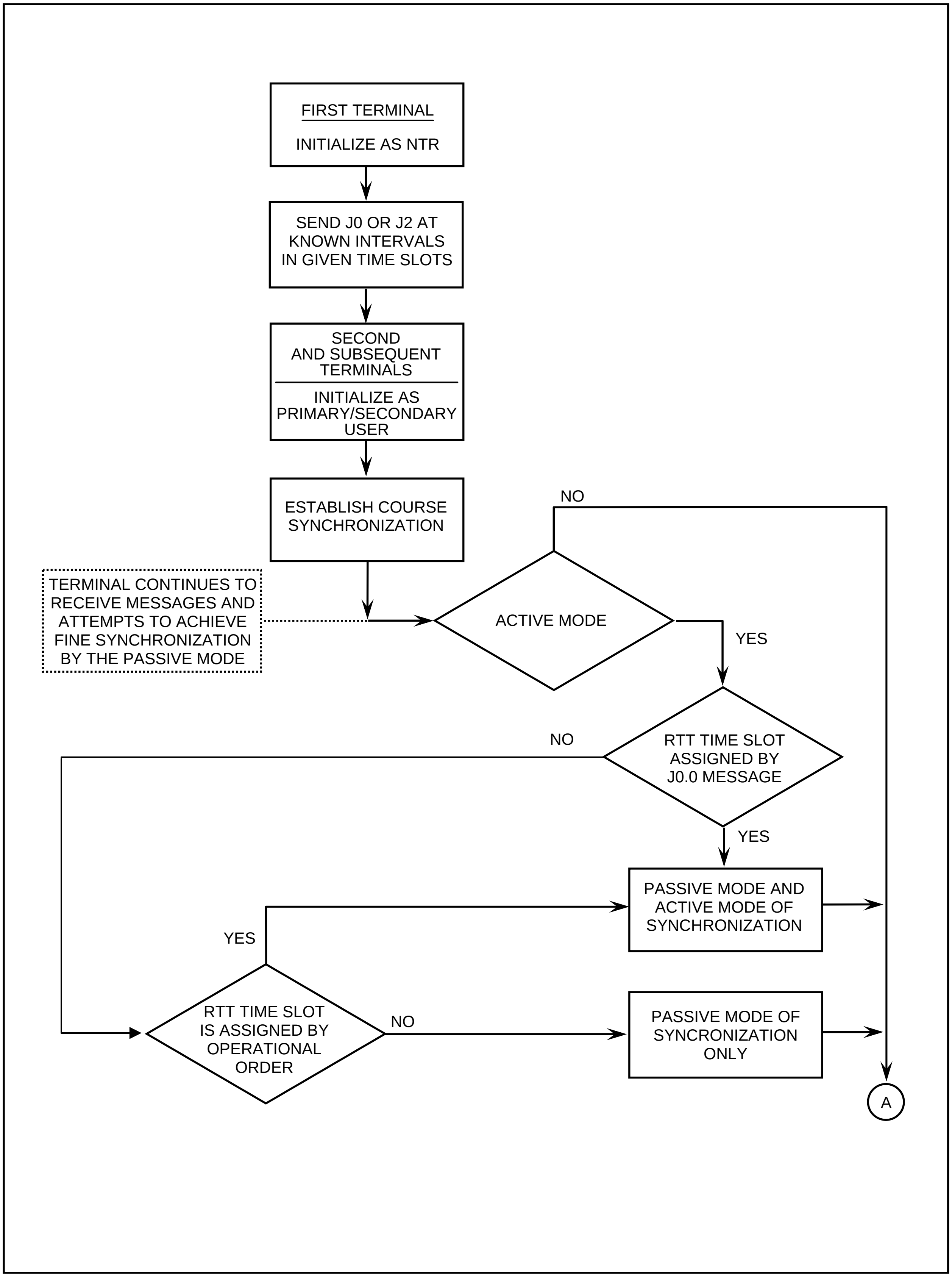

FIGURE 4.2-3. Flow Diagram of Network Entry (Sheet 1 of 2)

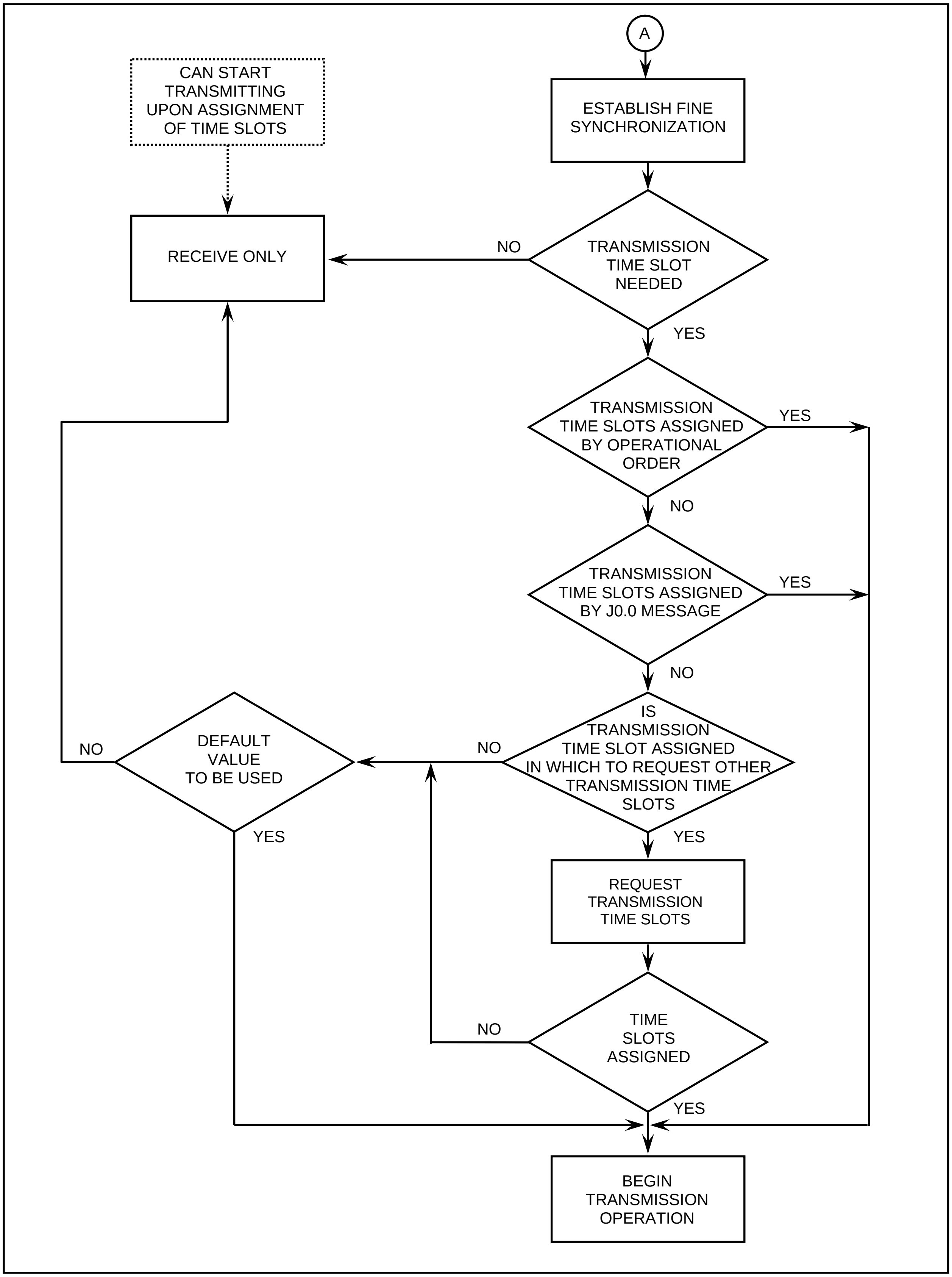

FIGURE 4.2-3. Flow Diagram of Network Entry (Sheet 2 of 2)

4.2.6.2.3 ACTIVE MODE FOR ACHIEVING SYNCHRONIZATION

A JU operating as a Primary User shall use the Active mode to obtain and maintain Fine Synchronization. The Active mode uses RTT Interrogations and RTT Replies. The RTT-B Interrogation is used to transmit a nonaddressed (broadcast) interrogation and is used in the RTT group in the Contention Access mode. Otherwise, the RTT-A Interrogation, which is addressed to a specified terminal, is used. Computation of system time from an RTT Interrogation/Reply sequence using either interrogation type provides the same accuracy. Independently derived position data are not required or used when operating in the Active mode.

The terminal responds to RTT Interrogations unless the terminal is in the Conditional Radio Silence or Polling mode or the last pulse of the interrogation arrives later than 3,375 microseconds after the start of the time slot. The RTT Reply is transmitted, in the same time slot and net as the RTT Interrogation, 4,275 microseconds after the start of the time slot. In the RTT group, the terminal programs to receive interrogations on a net number equal to its own time quality. The initiation of an RTT sequence will not exceed a rate of once per three minutes. Use of the Active mode does not preclude the simultaneous use of the Passive mode.

4.2.6.2.4 TIME SLOTS FOR ROUND-TRIP-TIMING EXCHANGE

RTT transmit time slots are assigned during terminal initialization or by the J0.0 message. Once the transmit time slots are defined, the RTT exchange can commence. A unit will not transmit messages other than RTT Interrogations until Fine Synchronization is achieved. The process of achieving Fine Synchronization shall be repeated as required.

4.2.6.2.5 PASSIVE MODE FOR ACHIEVING SYNCHRONIZATION

A JU operating as a Secondary User achieves and maintains Fine Synchronization primarily in the Passive mode. In the Passive mode, the terminal processes selected J2 messages and TOA data in a combined navigation/synchronization filter. Passive synchronization is performed without any transmissions by the terminal. However, if the terminal is not operating in the Radio Silence mode, Secondary Users may use RTT to augment the basic Passive mode only under conditions of initial Fine Synchronization when good geometry for the Passive mode does not exist. Secondary Users initiate an RTT sequence only as required to maintain a time variance within 25% of position variance, but not more often than one RTT sequence per epoch.

4.2.6.2.6 NET CONTROL STATION COMMUNITY NET CONTROL ENTRY

In an NCS community, Net Control Entry procedures are initiated after a JU achieves Fine Synchronization. The NCS JU will be the first JU to solicit other JUs with the same Community Designator that need to achieve Net Control Entry. Net Control Entry is said to be achieved when a JU receives the J1.5 message from the NCS, and the JU responds with periodic J1.4 messages. The following definitions are also often used in describing Net Control Entry:

a. Communicant - a transmitting JU capable of being heard directly (without relay) by a receiving JU.

b. Community of JUs - a community of JUs initialized to have the same Community Designator.

c. Intracommunity Communicant - a transmitting JU holding a Community Designator identical to that of the receiving JU.

d. Intercommunity Communicant - a transmitting JU holding a Community Designator different than that of the receiving JU.

e. External Communicant - a transmitting JU not initialized to have a Community Designator.

The NCS is the first JU to be initialized in its own community of JUs. The NCS builds the control network for its community by transmitting J1.4 messages in the Net Status Needline PG. The J1.4 message solicits JUs in its community to enter the NCS control network by providing information necessary to compute the time slot in which the transmitting JU (initially only the NCS) will expect to receive the J1.1 message to be transmitted by the JUs that are in line-of-sight of the transmitter and wish to enter the NCS community. Thus all JUs attempting Net Control Entry that are within LOS of the NCS will be in contention during this time slot; the new entrant whose transmission is captured by the NCS will achieve Net Control Entry first. Since any JU will continue to attempt Net Control Entry by repeatedly responding to net entry solicitations, all JUs within LOS of the NCS will eventually achieve Net Control Entry.

The NCS establishes these JUs as the first level of relays; these JUs in turn begin to solicit their intracommunity LOS communicants beyond LOS of the NCS to achieve Net Control Entry. In order for the NCS to transmit a J1.5 message to JUs beyond its LOS, the NCS must establish a route to the new entrant JU using J0.4 messages. While monitoring transmissions on the net number of this Net Status Needline PG, a new entrant JU is accumulating a list of communicants by inspecting the header of every message it receives and computing the connectivity quality from each communicant by counting erasures received within one time slot.

In case of an NCS failure, the backup NCS must reestablish Net Control Entry for all JUs under the control of the failed NCS. JUs beyond LOS of the failed NCS are made aware of the failure by processing the J1.4 message of JUs closer or within LOS of the failed NCS.

4.2.6.3 NETWORK MAINTENANCE

JTIDS/MIDS network maintenance includes maintenance of the synchronization process and the connectivity process. The maintenance of both processes is facilitated by monitoring the Network Participation Status Indicator (NPS IND) to determine if JUs key to synchronization and connectivity (such as the NTR), network entry, and active or potentially active relay service are operational or require replacement. The Network Manager shall identify JUs as candidate alternates to accommodate these functions. Alternates shall not be activated until required based upon the NPS IND of the active NTR, IEJUs, and relay JUs. If possible, the JUs actively performing these functions shall be notified when the assignments are to be changed or deleted.

JUs participating in an NCS community must monitor the status of each path of their own Needline PGs using acknowledgement techniques and periodic "probe" messages. Since needlines may be response time driven, their allocated time slots may far exceed their actual usage. "Probe" messages will be sent by source JUs during every eighth allocated time slot starting with the first executable time slot if no other messages are awaiting transmission. The destination JU will determine the path performance using a sequential hypothesis algorithm. If the algorithm indicates a path failure, the destination JU will transmit the J0.6 message to the NCS indicating which Needline PG has failed and requesting corrective action. The NCS will analyze the failure to determine the required corrective action, which may range from taking no corrective action, if failure is analyzed to be temporary, to the provision of a complete replacement for the failed path.

4.2.6.3.1 NETWORK TIME UPDATE

Whenever the J0.2 message is received in an initial entry time slot, all JUs designated to transmit the J0.0 message shall begin transmitting the J0.2 message following the J0.0 message in the initial entry time slot. The JUs shall continue these transmissions until the execution time in the J0.2 message.

4.2.6.3.2 NETWORK PARTICIPATION STATUS

A Link 11, 11B, or 16 unit shall be considered in either an Active (full interface participant) Status, Inactive (not participating in the interface) Status, or Limited (interface participation less than full) Status on the interface.

a. Active Status. A Link 11, 11B, or 16 unit shall be considered in the Active status on the interface when the NPS IND in the J2 messages is set to Active. A Link 16 participant in the Active Status must be in the Normal mode, in Fine Synchronization, and capable of exchanging messages on the JTIDS/MIDS network.

b. Return to an Active Status. Return to an Active Status is shown in Figure 4.2-4. A JU shall return to Active Status after leaving the network (Terminal Off or Loss of Coarse Synchronization) by following the net entry procedure as stated in paragraph 4.2.6.2.2. A JU shall return to Active Status from the Radio Silence mode, the Polling mode, Loss of Fine Synchronization mode, TDS Failure mode, Receiver High Message Error Rate mode, Transmitter Failure mode, Out of Range/Masked mode, or Receiver Failure mode by transmitting the J2 message with the NPS IND field set to Active.

When an FJU determines that a PU or RU has returned to Active Status, it shall set the NPS IND to Active in the J2.0 Indirect Interface Unit PPLI message.

c. Inactive Status. A PU, RU, or JU shall be considered in an Inactive Status on the interface upon receipt of a J2 message with the NPS IND set to Inactive or if a J2 message has not been received on that unit for a period of at least 60 seconds.

d. Changing to Inactive Status. A JU shall set the NPS IND to Inactive immediately prior to leaving the JTIDS/MIDS network. Additionally, when a FJU determines that a PU/RU is Inactive, it shall set the NPS IND to Inactive in the J2.0 message for the PU/RU.

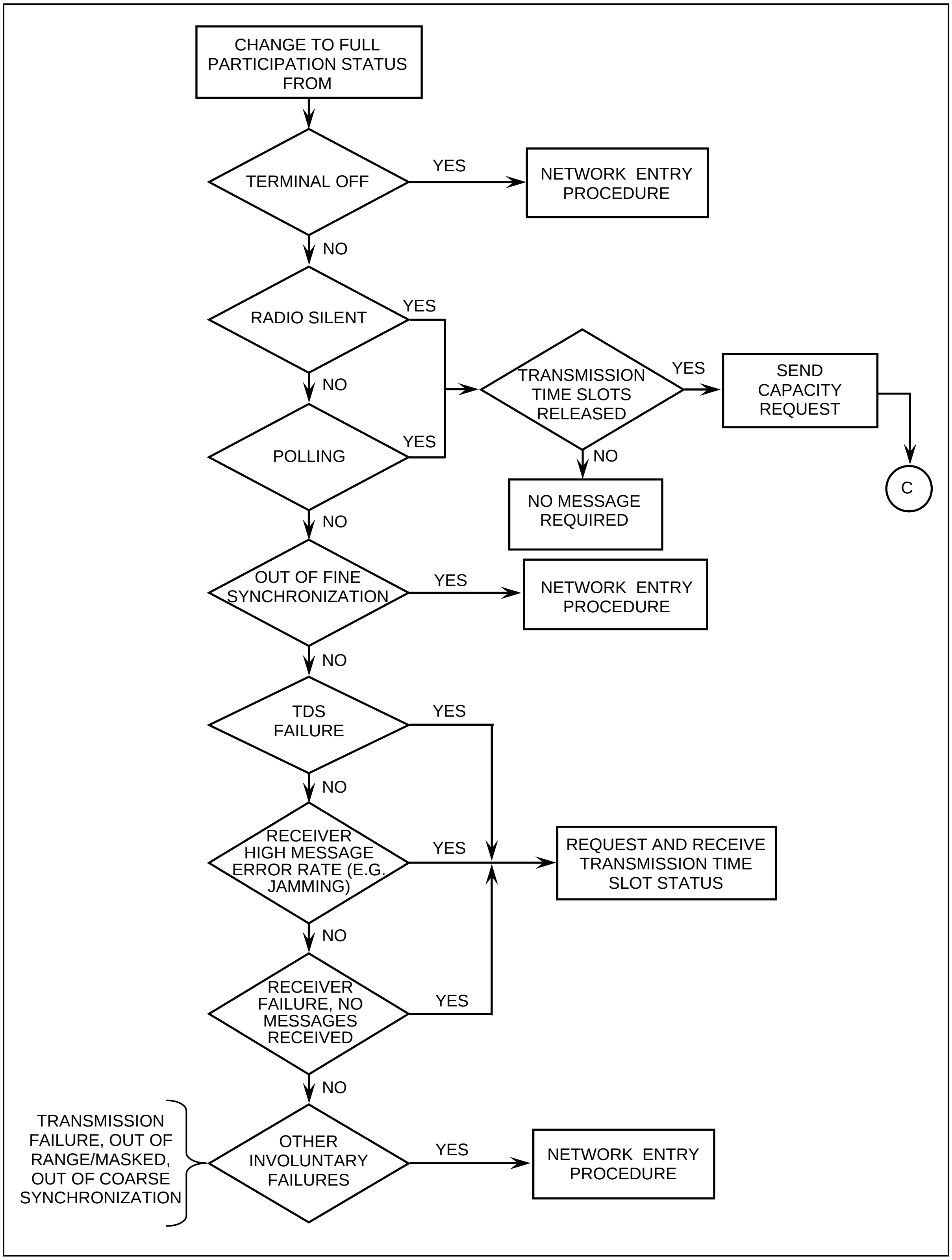

FIGURE 4.2-4. Flow Diagram of Network Participation Status Change to Active Status (Sheet 1 of 2)

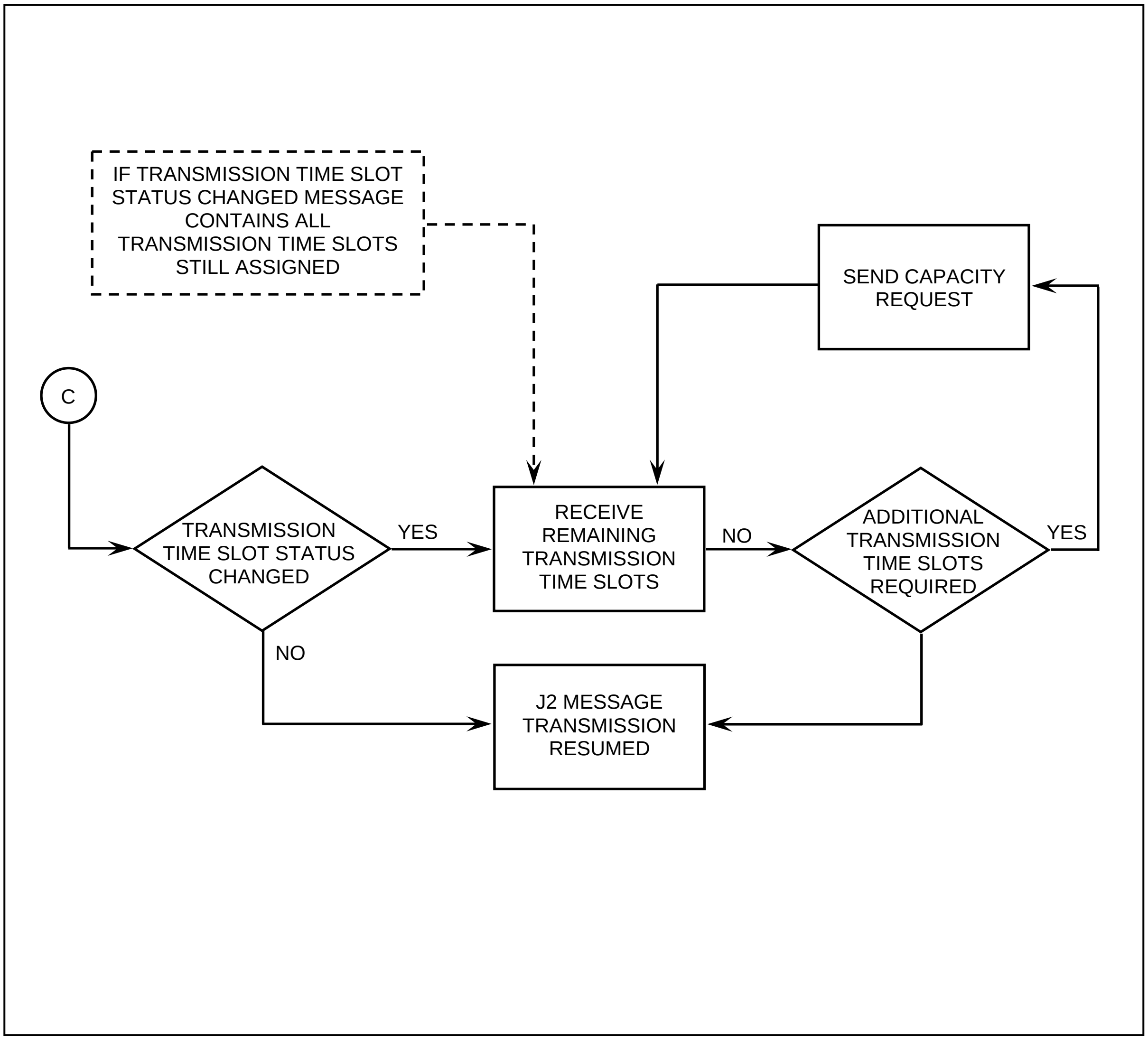

FIGURE 4.2-4. Flow Diagram of Network Participation Status Change to Active Status (Sheet 2 of 2)

e. Limited Status. The change to Limited Status is shown in Figure 4.2-5. The decision on retention of time slots is an operator decision. A JU shall be considered in a Limited Status on the interface when the NPS IND is set to any of the following:

(1) Polling.

(2) Radio Silence.

(3) No J0.0 Message Being Received.

(4) High Error Rate.

(5) TDS Failure.

f. Polling and Radio Silence Modes. The Polling and Radio Silence modes are described in Section 3, Terms and Definitions. A Link 16 unit shall set the appropriate value in the NPS IND when changing to one of these Limited Statuses.

g. No J0.0 Message Being Received. Some causes of No J0.0 Message Being Received are receiver failure, being out of range, or being out of LOS. When a J0.0 message has not been received for 120(60-180,12) seconds, the terminal shall alert the operator and set the NPS IND to No J0.0 Message Being Received. Network entry opportunities are discussed in paragraph 4.2.3.10.1. (This indicator may provide input to the conditional relay algorithm of a receiving terminal to determine possible activation of the Relay Function.)

h. High Error Rate. A High Error Rate of received messages can be caused by a number of conditions, including jamming. The NPS IND shall be set to High Error Rate when the ratio of messages received with error to the total messages received exceeds 10(5-100,5)%.

i. Tactical Data System Failure. The NPS IND shall be set to TDS Failure when the terminal can no longer communicate with the host TDS.

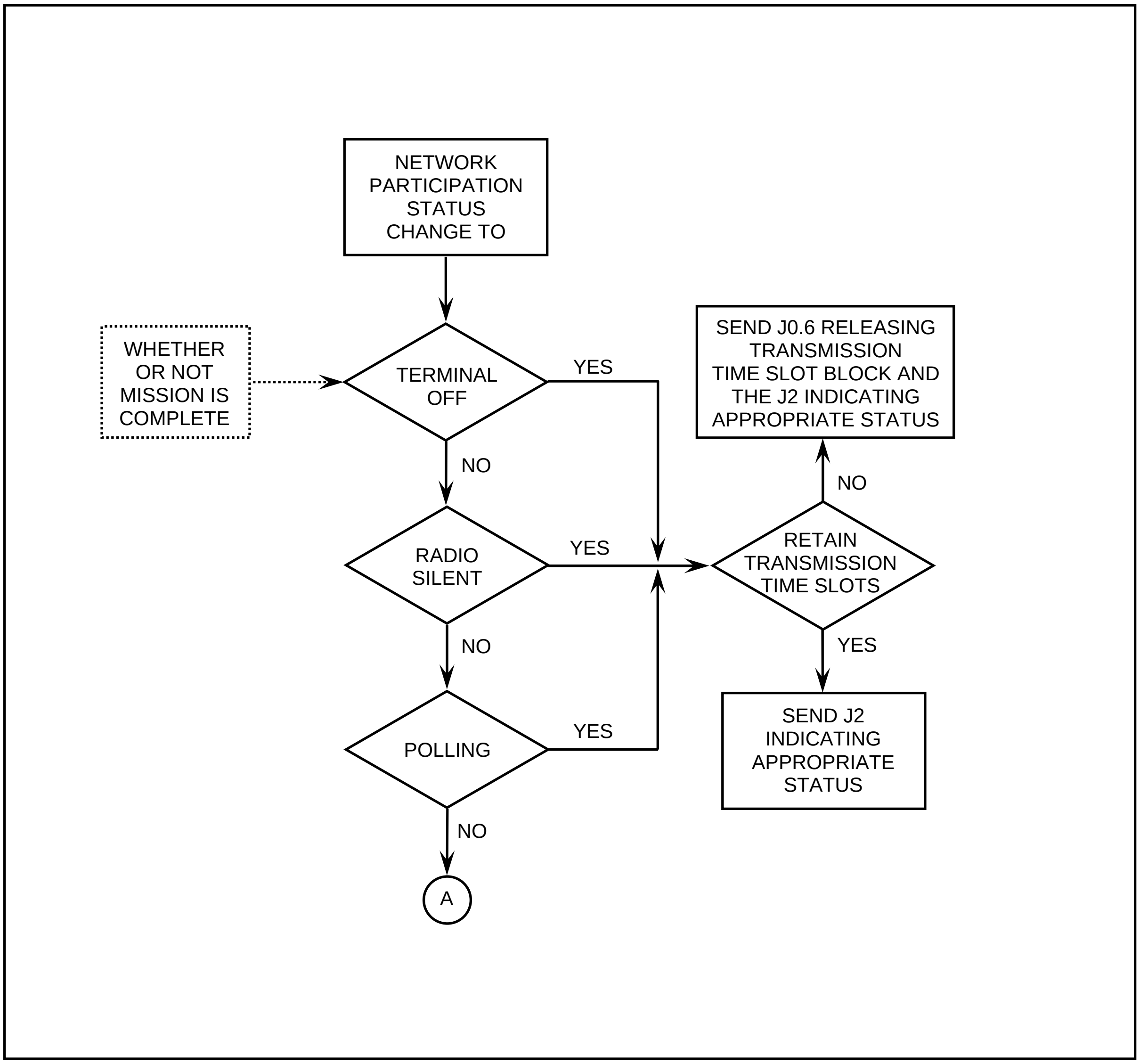

FIGURE 4.2-5. Flow Diagram of Network Participation Status Change to Limited Status (Sheet 1 of 2)

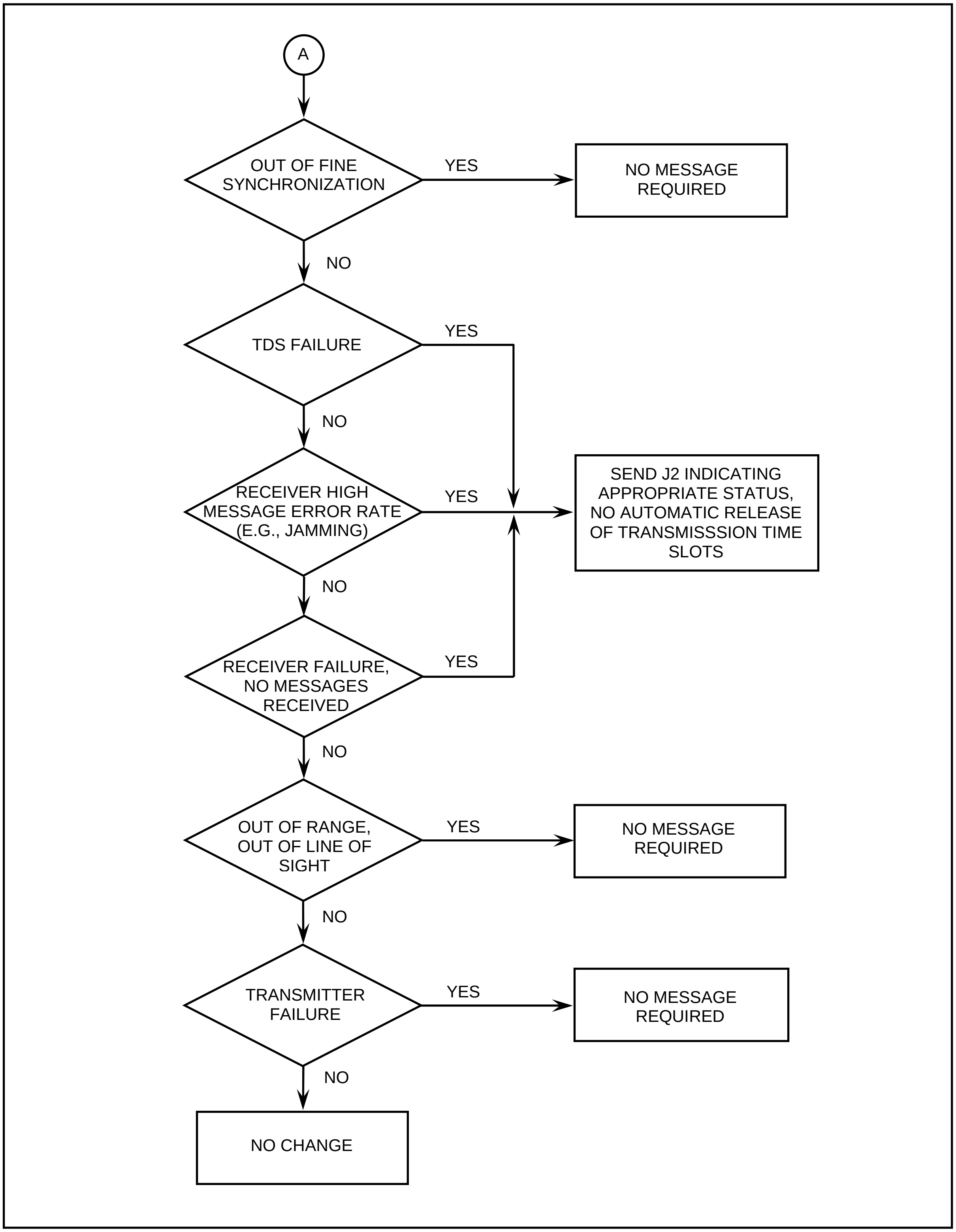

FIGURE 4.2-5. Flow Diagram of Network Participation Status Change to Limited Status (Sheet 2 of 2)

4.2.6.3.3 CRYPTOVARIABLE CHANGE

The cryptovariable for each cryptonet will be changed periodically (every 24 hours) or in reaction to compromise situations. This change over must be coordinated by the Network Manager among all of the participants within the net.

4.2.6.3.4 OVER-THE-AIR REKEYING (OTAR)

OTAR provides dynamic rekeying capability to JUs. This flexibility is provided OTAR JUs by the J31.0 and J31.1 message types. The new cryptovariable to be used by a JU is transmitted in message J31.1 and is protected by being uniquely encrypted by another cryptovariable referred to as the unique cryptovariable. The unique cryptovariable is held only by the rekeying facility and the receiving JU. Other JUs in the same cryptonet can receive the J31.1 message but are not able to decipher the cryptovariable portion of the J31.1 message. Each JU in a cryptonet has a unique cryptovariable assigned for decrypting new cryptovariables transmitted to that JU via the J31.1 message.

OTAR allows the Network Manager to change cryptoperiods and to dynamically change net connectivity for operational reasons or in reaction to a compromise situation.

The J31.0 message is used by the Network Manager to transmit an execution time and/or cryptovariable synchronization bits to a receiving JU if required or by a JU to request a new cryptovariable. The sequence and specific use of J31.0 and J31.1 message types is determined by the over-the-air action codes specified within the J31.0 and J31.1 messages.

4.2.6.4 MESSAGES USED IN SUPPORT OF NETWORK INITIALIZATION, ENTRY, MAINTENANCE, AND EXIT

The J0.0 message is used to achieve Coarse Synchronization.

The J0.2 message is used by the NTR to correct for drift of its clock relative to system time.

The J0.6 message is used to request time slot block assignments and to release time slot block assignments.

The RTT Interrogation and Reply messages are used to support the active achievement and maintenance of Fine Synchronization.

The J2 messages are used to support the passive achievement and maintenance of Fine Synchronization.

The J31 messages are used to support over-the-air rekeying.

4.2.6.5 TERMINAL TESTING

The terminal requires the receipt of a predetermined pattern of bits to perform internal, on-line circuit testing. The J0.1 message shall be transmitted when the terminal is operating in one of the test modes or upon receipt of a request for a J0.1 message when operating in the Normal or Polling mode. The J0.1 message consists of the J0.1I Test initial word, the J0.1E0 Test extension word, and the J0.1C21 Test continuation word. The bit pattern in the test message's extension and continuation words allows the terminal to check its bit processing circuit for both the 0 and 1 conditions of every bit in the 70 information bits. Parity bits are not checked. The J0.1 message pattern is used to check the number and location of error corrections in the Reed-Solomon decoder. This J0.1 message is also used in either of the test modes to flood the JTIDS/MIDS network with messages. In Test Mode 1, the JU transmits J0.1 messages in all time slots assigned for the Dedicated Access mode and in all time slots that would ordinarily be used for Contention Access except for Initial Entry time slots and RTT time slots. In Test Mode 2, the JU transmits J0.1 messages only in the Dedicated Access time slots, except for time slots in common blocks assigned to Control and Voice PGs, that are not used to transmit other messages.

4.2.7 CRYPTOGRAPHIC NETWORK DESCRIPTION, OPERATION, AND COMPROMISE

4.2.7.1 CRYPTONET FUNDAMENTALS

The purpose of the cryptonet structure is to maintain communications security while permitting the exchange and distribution of operationally required data on a need-to-know basis. Individual cryptonets may contain one or more PGs based on operational data exchange requirements. The data exchange requirement is established by analysis of the following:

a. Operational need of each participating JU for the overall data content of the net.

b. Operational impact of compromise of the data content of the net.

c. Vulnerability of the net to compromise either by capture of one of the participating JUs or by compromise of the network cryptovariable by other means.

4.2.7.1.1 CRYPTONET PLAN

The communications plan identifies each cryptonet by its Cryptovariable Logical Label (CVLL) (0 through 127) and its cryptovariable short title. This data is used to prepare the mission load parameters for each participating JU and to provide instructions by which cryptovariables will be loaded into the terminal. The mission load references the CVLL and the cryptoperiod designator codes to the Secure Data Unit (SDU) memory locations and defines the current cryptoperiod designator, while the instructions for cryptovariable loading reference the cryptovariable short title of the cryptovariable going into these memory locations.

4.2.7.1.2 DYNAMIC/STATIC CRYPTONET PARTICIPATION

Most JUs can automatically shift cryptonets. The number of cryptonets used is based on authorization, terminal capability, and today/tomorrow operation. The Class 2 terminal can operate on up to eight cryptonets. The Class 1 terminal can operate in only one cryptonet unless manually changed.

4.2.7.1.3 CRYPTOVARIABLE DISTRIBUTION

Initially, the cryptovariables will be supplied to the individual JUs as required in the communication plan using the present manual COMSEC material control system. This system is rigid, time consuming, vulnerable to Human Intelligence (HUMINT) exploitation, and limits the ability to reassign JUs beyond their communication plan assignments. OTAR is planned for later use to enhance operational capability and responsiveness while reducing the HUMINT vulnerability.

4.2.7.2 CRYPTONET OPERATION

4.2.7.2.1 CRYPTONET INITIALIZATION, ENTRY, AND MAINTENANCE

In order for a JU to establish or operate on a secure data net it must first be provided with specific initialization data.

Required data consists of two parts. The first part deals with the technical characteristics of the assignment of specific time slot blocks to the PGCs. It is discussed in detail in Paragraph 4.2.6. The second part of this initialization data deals with the assignment of specific cryptovariables that the JU will require in order to conduct operations in designated secure nets. The Network Manager implements the communication plan by assigning JUs to JTIDS/MIDS Nets. The Cryptonet Manager will then assign cryptovariables to specific JUs based on their operational needs. With the implementation of OTAR, the Cryptonet Manager must also assign each individual JU with a unique cryptovariable required to process the OTAR messages.

The Cryptonet Manager must assign a specific cryptovariable to the Net Entry PG (Set A with ISN equal to 0 and RRN equal to 6). This net entry assignment is built into each Class 2 terminal and requires only the assignment of the required cryptovariable to initialize and enter the net.

Only the TRANSEC cryptovariable is required to initially enter or establish the net. Once coarse synchronization is achieved, the MSEC cryptovariable will be required to complete the process.

4.2.7.2.2 CRYPTONET PARTICIPANT ASSIGNMENT, AUTHORIZATION AND VALIDATION

Based on several factors, a JU is assigned to a single or multiple cryptonet by the Cryptonet Manager. The basic and most important consideration is the need for the JU to have access to the PGCs served by the cryptonets. The second consideration is the sensitivity of the data access that the JU requires in order to complete the operational mission. All JUs operating together will require access to the large scale PPLI net and the Initial Entry net. Their assignment to other nets, however, will be based on their need for access to each of the cryptonets. The Initial Entry cryptonet and the PPLI cryptonet will normally utilize the same TRANSEC variable. These cryptonets, however, may be divided into separate cryptonets, or they may be subnetted using different MSEC variables to achieve separate cryptosubnets in order to reduce the number of JUs that participate on a single cryptonet.

The authority for assigning JUs to a cryptonet rests with the Cryptonet Manager.

4.2.7.3 CRYPTONET COMPROMISE

A cryptonet compromise is the loss or exposure of the cryptovariables being used by a net for communications security. Containment and prevention are the only protective measures against compromise. Containment means reducing the impact of compromise on operating cryptonets. Prevention includes the protective measures used to prevent the loss or exposure of cryptovariables during distribution and use.

Although several PGCs may use the same cryptonet, a compromise of any JU using any of these PGCs would compromise the data on all of the PGCs on that cryptonet. A degree of protection against compromise is provided by the implementation of different cryptonets, since different sets of messages are transmitted using different cryptovariables and only a subset of system information can be compromised when a single cryptonet is compromised.

4.2.7.3.1 IMPACT OF COMPROMISE

Compromise of a cryptonet can have serious consequences to the physical security (e.g., Targeting) of the JUs operating on that network as well as to the content of data passed on that net. Compromise may or may not be detected at the time of compromise. If a compromised unit remains completely passive, it may gain useful intelligence for the period that the cryptonet continues using the same cryptovariable. A compromised terminal can actively be used to defeat net management, relay, time reference, and other system services.

4.2.7.3.2. DETECTION OF A COMPROMISE

Detection of a compromise can be accomplished:

a. By verification of an actual overrun or evidence of a penetration.

b. If a JU requests access to a cryptonet that it should not be in.

c. By any sudden disruptions resulting from jamming or any other loss of operational effectiveness.

d. By the detection of data that is incorrect in style and/or content.

e. By recognition of a false unit reporting on the PPLI net.

4.2.7.3.3 REACTION TO COMPROMISE

When the Cryptonet Manager suspects a compromise of a given JU, the Cryptonet Manager will isolate the given JU from other PGs on the cryptonet by changing cryptovariable(s). With OTAR, the rekeying facility accomplishes this by sending the J31.1 message to the given JU. This should be followed by changing the cryptovariable(s) of the remaining PGs on the cryptonet (via transmission of J31.1 messages) to a set of cryptovariable(s) that differs from the cryptovariable(s) of the compromised JU. If it is later verified that the suspected JU is not compromised, the JU can be returned to the cryptonet by the transmission of a J31.1 message. Without OTAR, the uncompromised JUs must be manually changed to a different cryptovariable(s).

4.2.7.4 OVER-THE-AIR REKEYING

OTAR is an alternative means of cryptovariable distribution. From the network management point of view, the particular means used for distribution of the cryptovariables is usually unimportant in terms of structuring the network. However, there are important differences in Cryptonet Management and in resource utilization. Since a cryptovariable can be loaded into the SDU by the terminal in response to an OTAR message, rekeying can be accomplished without direct physical access to the SDU. This provides the capability: (a) to issue new cryptovariables in connection with dynamic restructuring of the network, (b) to rapidly recover from compromise situations, and (c) to facilitate routine changing of cryptovariables without the use of rollover. In order to accomplish OTAR, two storage locations in the SDU must be reserved. One is for a unique cryptovariable and the other for temporary storage of the new cryptovariable while processing. This reduces the number of storage locations available for use by a JU. If OTAR is used for routine changing of cryptovariables instead of rollover, there is a gain in the number of cryptovariables which can be used during a given cryptoperiod.

OTAR requires assignment of communications capacity, including relay capacity, for the transmission of OTAR messages. The amount of capacity required is determined by the number of participants in each cryptonet and the time required for assigning cryptovariables. Once the time limits and number of participants have been determined, the capacity requirements can be calculated (See paragraph 4.2.1.2).

4.2.7.4.1 OVER-THE-AIR REKEYING SYSTEM PARTICIPANTS

OTAR system participants include the OTAR rekeying facility(ies) and remote JTIDS/MIDS Units.

a. The OTAR rekey facility shall include the System Controller, a rekey JU, and the KOK-11/TSEC. The System Controller interfaces with the KOK-11 to obtain new cryptovariables. It formats J31.0 and J31.1 OTAR messages and provides these messages to the rekey JU which transmits these messages to a remote JU. The rekey facility maintains a database of the cryptographic status of each JU operating under its control.

b. A remote JU is any unit capable of operating with OTAR.

4.2.7.4.2 OVER-THE-AIR REKEYING MESSAGES

The OTAR messages are J series messages used for the distribution of the cryptovariables. They consist of the J31.0 and J31.1 messages. The J0.6 message may be used in conjunction with the OTAR messages to dynamically control the use and assignment of cryptonets. The Network Management messages are discussed elsewhere in this section. The J31.1 message is used as a rekeying message while the J31.0 message is used as a Change Cryptovariable at Time Specified message, Packed OTAR message, Packed Over-the-MUX Rekeying (OTMR) message, Cryptovariable Status Request message, Cryptovariable Status Report message, Direct Cryptovariable Request message, and Indirect Cryptovariable Request message. In addition, Receipt/Compliance messages are required to indicate the status of received messages.

a. The J31.0 (ACT = 1) Change Cryptovariable at Time Specified message is generated by the System Controller and is always used in conjunction with a J31.1 message, transmitted in a different time slot, to deliver a new cryptovariable to a remote JU. Execution time is always other than immediate.

b. The J31.0 (ACT = 2) Cryptovariable Status Report message is generated by a remote JU in response to a J31.0 (ACT = 5) message. It incorporates the cryptovariable status of the queried JU.

c. The J31.0 (ACT = 3) Direct Cryptovariable Request message is generated by a remote JU to request a new cryptovariable.

d. The J31.0 (ACT = 4) Indirect Cryptovariable Request message is generated by an authorized remote JU to request a new cryptovariable for a remote JU other than itself.

e. The J31.0 (ACT = 5) Cryptovariable Status Request message is generated by the System Controller to obtain the cryptovariable status of a remote JU to enable the System Controller to generate a new cryptovariable for that JU.

f. The J31.0 (ACT = 6) Packed OTAR message is generated by the System Controller and is used in the same time slot with a J31.1 (ACT = 6) message to deliver a cryptovariable to a remote JU. Execution time is always other than immediate. The terminal will provide an R/C response to the J31.0 (ACT = 6) message, and in the same time slot will include the J31.1 (ACT = 6) message with values in each field of the J31.1 which are unchanged from those received.

g. The J31.0 (ACT = 7) Packed OTMR message is generated by the System Controller and is used in the same time slot with a J31.1 (ACT = 7) message to deliver a cryptovariable to its own terminal. Execution time is always other than immediate. The terminal does not provide an R/C response to this message or to the subsequent J31.1 (ACT = 7) message.

h. The J31.1 message is generated by the System Controller. It conveys the data necessary to deliver a new cryptovariable to a JU. The J31.1 can be used alone to rekey a remote JU but not to rekey the System Controller's own terminal. Further, it can be used alone to rekey a remote JU only if the new cryptovariable is to be loaded immediately and the special condition defined in the T/R rules of the J31.1 message is satisfied.

i. The J31.0 and J31.1 messages use standard Receipt/Compliance procedures. However, an additional J31.1 Receipt/Compliance message is required to indicate successful or unsuccessful loading of the cryptovariable. As noted above, the terminal provides an R/C response to the J31.0 (ACT = 6) Packed OTAR message, and in the same time slot includes the J31.1 (ACT = 6) message with values in each field of the J31.1 which are unchanged from those received. The terminal does not provide an R/C response for the J31.0 (ACT = 7) Packed OTMR message or for the J31.1 (ACT = 7) that follows it in the same time slot.

4.3 PRECISE PARTICIPANT LOCATION AND IDENTIFICATION

The PPLI function uses J2 PPLI messages to provide network participation status, identification, and position of JUs, PUs, and RUs on the Link 16 interface. The J2 messages also contain information on relative navigation that allows JUs to accurately determine their position. The J2.0 Indirect Interface Unit PPLI messages on PUs and RUs shall not be used for relative navigation computation.

The J2 messages shall be transmitted on the PPLI Network PG using the specified access mode and relayed using paired slot relay (conditional or unconditional) as assigned to participating platforms (see paragraph 4.2.3.10.4).

The PPLI function must be implemented by all JUs.

4.3.1 UNIT PARTICIPATION STATUS ON LINK 16

Each IU may need to know, on a dynamic basis, the participation status of any other units on the interface, i.e., JUs, PUs, or RUs. The J2 messages provide the means for exchanging participation status information on Link 16. The NPS IND shall be set appropriately as described in paragraph 4.2.6.3.

4.3.2 PARTICIPANT IDENTIFICATION

The identification of an IU is provided by the following information in the J2 messages:

a. Environment/Category of an IU.

b. Classification of the unit as a nonC^2 JU, C^2 JU, PU, or RU.

c. Type of indirect IU.

d. Identification Friend or Foe/Selective Identification Feature (IFF/SIF) information on the IU when available.

e. Platform and Platform Activity of the IU when available. Platform Activity will be that which is currently being conducted.

f. Strength of an IU.

g. Mission Commander status. Transmitted in the J2.2I word by a nonC^2 JU participating in an ASO mission, and assigned as Mission Commander.

4.3.2.1 ENVIRONMENT/CATEGORY OF AN INTERFACE UNIT

In the PPLI message, the environment/category of an IU is indicated by the message sublabel as follows:

a. Sublabel 0 - Indirect Interface Unit (Link 11/11B).

b. Sublabel 2 - Air.

c. Sublabel 3 - Surface (Maritime).

d. Sublabel 4 - Subsurface (Maritime).

e. Sublabel 5 - Land (Ground) Point.

f. Sublabel 6 - Land (Ground) Track.

4.3.2.2 CLASSIFICATION OF AN INTERFACE UNIT

The classification of an IU as either a nonC^2 JU or a C^2 JU is indicated by the C^2 indicator.

4.3.2.3 TYPE OF INDIRECT INTERFACE UNIT

For indirect interface units, the J2.0 message provides the Originator Environment/Category (Surface (Maritime), Subsurface (Maritime), Land (Ground) Air) type of site (PU, RU, FPU/FRU), and Unit Type (e.g., Tactical Air Operation Center (TAOC), Message Processing Center (MPC), Control and Reporting Center (CRC), etc.). The Source TN field in the Header word that accompanies each J2.0 message will contain the TN associated with the forwarded unit.

4.3.2.4 TRANSPONDER DATA

For those IUs capable of responding to IFF/SIF interrogations, the applicable J2 IFF/SIF continuation word shall contain the same IFF/SIF modes and codes transmitted by the IU's transponder.

4.3.2.5 STRENGTH OF AN INTERFACE UNIT

The strength of an IU is provided in the Strength field, which indicates the number of similar units/objects (which could include other JTIDS/MIDS-equipped units not currently reporting their own PPLI) that are located with the reporting IU, including the reporting IU.

4.3.2.6 EXERCISE INDICATOR

In the PPLI message, the Exercise Indicator is used to provide the capability to distinguish IUs that are participating in an exercise from those with a nonexercise mission. When the Exercise Indicator field is set to value 1 in the J2 series PPLI message, it shall be interpreted to mean that all data concerning the IU must be considered artificial, for exercise purposes, except that the following data shall not be artificial:

a. Track Number.

b. Position and Movement: Latitude, Longitude, Altitude/Elevation/ Depth, Course, Speed.

c. Simulation Indicator.

d. Network Management Data: All J0, J1, and J31 data, the J2.XI Active Relay Indicator and Network Participation Status Indicator, and the two Active Relay Indicators in the J2.X Mission Information continuation words.

e. RELNAV Data: RTT messages, all J2.XC3 data, and J2.XI RTT Reply Status Indicator, Time Quality, and Geodetic Position Quality.

f. Environment/Category: As expressed by the sublabel of the J2 series message.

g. Fuel Function, Fuel, Time Report Function, Minute and Hour in the J13.2 Air Platform and System Status message.

h. Flight Deck Status, Landing/Approach Condition, and associated Time Report Function, Minute and Hour, in the J13.3 Surface (Maritime) Platform and System Status message.

4.3.3 PARTICIPANT LOCATION

The location of all IUs and, if applicable, the altitude/elevation of the JTIDS/MIDS antenna shall be provided by geodetic coordinates in the J2 messages. If the unit is a JU, the location and altitude/elevation reported shall be that of the JTIDS/MIDS antenna. Additionally, mobile IUs shall report course and speed.

PU or RU locations are reported in J2.0 messages by FJUs.

The location of the JU's antenna is contained in that JU's J2 message in the extension word. This is normally the location of the JU. If the JU is not collocated with the antenna, the Displaced Position Indicator shall be set in that JU's J2 message and the applicable J2 Displaced Position continuation word shall indicate the JU's actual location.

The applicable J2 UTM/UPS Position continuation word shall be used by JUs appropriately equipped to transmit Universal Transverse Mercator (UTM)/Universal Polar Stereographic (UPS) grid coordinates. The geodetic position in the extension word may be used for Relative Navigation.

4.3.3.1 PPLI REPORTING BY JUs

Each JU shall transmit an appropriate J2 PPLI message on the PPLI Network PG, in the specified access mode, at least once per time interval. The time interval is defined as the maximum time differential between PPLI reports that allows C^2 JUs to maintain other JUs with active status. The location of moving JUs shall be extrapolated to the time of transmission. To maintain an active status on a JU, at least one PPLI must be received every 40-60 seconds, or the JU will be considered inactive. In the latter case, C^2 JUs may delete the track or begin transmitting a surveillance track (based on own sensor data, or as a nonreal-time track). For surveillance purposes (see paragraph 4.4.2.2.1), J2.x messages shall be transmitted periodically in accordance with the appropriate J2.x message Transmit Rules.

4.3.3.2 PPLI REPORTING OF FORWARDED IUs

An FJU shall transmit a J2.0 message on the PPLI Network PG, using the specified access mode, at least once per time interval for each IU which is being forwarded. The time interval for the reporting of forwarded units shall be the same as specified in paragraph 4.3.3.1 above. The TN, Identity (ID), location, and amplifying information shall be identical to the latest information received from the forwarded unit on the other link. The location of moving forwarded units may be extrapolated to the time of transmission.

4.3.4 RELATIVE NAVIGATION

Relative Navigation is a terminal function that provides JUs with accurate position information within a common frame of reference. The function incorporates two basic coordinate systems, the standard geodetic system using latitude and longitude coordinates as defined by the WGS-84 Standard, and a relative rectilinear planar (U, V) grid tangent to the earth's surface at a selectable grid origin point. Accurate relative position data are developed in the U, V grid by the JTIDS/MIDS terminal. When two or more of these terminals have an accurate, independently derived knowledge of their geodetic position, the Relative Navigation function provides all terminals with accurate geodetic position.

A Beta Angle is computed by each JU participating in the Relative Navigation grid. Each JU's relative navigation algorithm shall determine its best estimate of the angular difference between the V axis of the grid and true north. This estimate will be based on the information presented to the algorithm via received PPLI messages and the individual platform's navigation information provided to the algorithm. Each JU (including NCs and PRs) shall transmit its own estimate of Beta Angle in accordance with the T/R rules established.

4.3.4.1 ORGANIZATION

For purposes of operating the Relative Navigation function, the JTIDS/MIDS network consists of the following types of JUs forming an organizational hierarchy as follows:

a. Network Time Reference.

b. Position References.

c. Navigation Controllers.

d. Primary Users.

e. Secondary Users.

Every JU implementing the Relative Navigation function is capable of operating as one or more of these types of elements.

4.3.4.1.1 NETWORK TIME REFERENCE

A single JU is designated to be the time reference for the network. The NTR serves as the basic reference for system time, as specified in the JTIDS/MIDS technical characteristics, Section 3, Terms and Definitions. The NTR may also be designated simultaneously as a PR and/or a NC.

4.3.4.1.2 POSITION REFERENCE

One or more JUs that maintain a geodetic position accuracy of 50 feet, l sigma, over long periods of time, including the NTR and the NC, may be designated as a PR. PRs may be fixed, ground based elements whose geodetic positions have been surveyed accurately; fixed or mobile surface or airborne elements that derive geodetic position accurately through independent navigation systems, e.g., GPS and inertial navigation; or fixed elements that have determined geodetic position accurately after participating in the system for some period of time below the level of the PR and whose designation is changed manually to that of the PR. PRs are not essential to the operation of the Relative Navigation function. In the absence of PRs, the function continues to provide geodetic position based upon a weighted best fit computation of own unit's navigation system input, RELNAV TOA measurements, and remote unit's geodetic positions reported in PPLI messages. When a PR is present the computed Q_{pg} of own unit may have a higher quality than when there is no PR.

4.3.4.1.3 NAVIGATION CONTROLLER

To establish the relative grid coordinate system (U, V), at least one JU is designated as a NC. If the navigation controller is a moving JU, there may or may not be one other navigation controller either stationary or moving. If a stationary JU is selected as the navigation controller, one other stationary or moving JU that knows its distance accurately relative to the first JU must also be designated as a navigation controller. The NTR or a PR may be designated simultaneously as a NC. The NCs establish the origin of the relative U, V grid and the north orientation of the grid. If there is a single airborne NC, the north orientation of the grid is referenced to the dead reckoner of the NC. If there are two stationary NCs, the north orientation of the grid is determined by the relative positions of the two NCs.

4.3.4.1.4 PRIMARY AND SECONDARY USERS

All system JUs not assigned as the NTR, PRs, or NCs shall be either Primary or Secondary Users.

a. Primary Users use the Active mode to achieve and maintain fine synchronization as specified in the JTIDS/MIDS technical characteristics, Section 3, Terms and Definitions. Since this procedure requires transmission of RTT Interrogations, the particular JUs to be designated as Primary Users and the number of JUs so designated in the total environment must consider the availability of time slots to be used for this purpose. A JU cannot be designated as a Primary User if operating in the Radio Silence mode.

b. Secondary Users normally use the Passive mode to achieve synchronization as specified in the JTIDS/MIDS technical characteristics, Section 3, Terms and Definitions. However, this does not preclude the use of the Active mode under conditions of poor geometry.

4.3.4.2 CAPACITY

The subscriber capacity of the Relative Navigation function is unlimited. JUs determine position solely on the basis of the received position, the TOA information, and available dead reckoner inputs, as illustrated in Figure 4.3-1. RTT Interrogation by limited numbers of elements (PRs, NCs, and Primary Users) is acceptable; however, the use of RTT Interrogation is not a requirement for operation of the JTIDS/MIDS Relative Navigation function. Purely passive relative navigation, as well as initial network entry and synchronization, are possible.

4.3.4.3 POSITION ACCURACY

Position accuracy achieved through Relative Navigation is a complex function of measurement and computation of errors (source time and position errors), geometrical dilution of precision, and dead reckoner accuracy. Under optimum conditions, a JU is capable of position location to an accuracy of 100 feet root mean square.

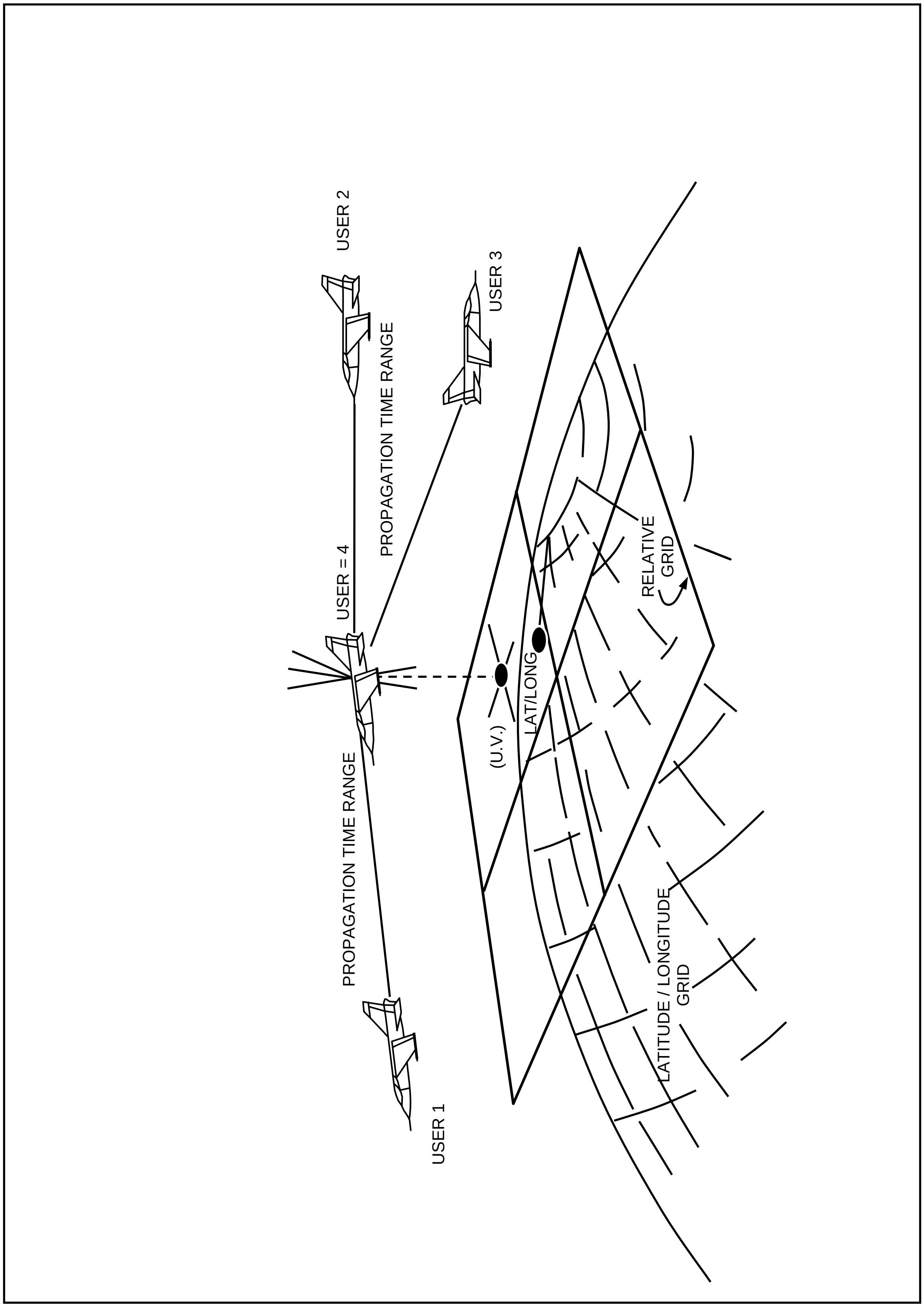

Figure 4.3-1. Position Location Using Time-of-Arrival Data

4.3.4.4 INPUT REQUIREMENTS

The Relative Navigation function performs all computations necessary for synchronizing and determining a JU's position and velocity using J2 and RTT messages received from the Link 16 interface and inputs from altimeter and dead reckoner equipment, e.g., barometric altimeter, inertial navigation systems, Doppler radar, attitude and heading reference, airspeed, and magnetic compass.

4.3.4.5 GRID ACQUISITION AND CONVERGENCE

It is possible for a terminal to begin Relative Navigation with an initial position estimate error of 25 nautical miles or less. With a 12-second J2 message reporting cycle by three sources providing good geometry, the time to converge to the accuracy specified in paragraph 4.3.4.3 is less than five minutes.

4.3.4.6 GEODETIC REFERENCE

All geodetic computations use WGS-84 geoid parameters for equatorial radius (6,378,137 meters) and flattening (1/298.257223563). Coordinate conversions to WGS-84 from geodetic references that use other coordinate systems are as specified in the individual system segment specifications.

4.3.4.7 FUNCTIONAL ORGANIZATION

Control of source-user relationships is based on the estimated accuracy of synchronism and position derived within the filter algorithms of each terminal and reflected in the J2 messages by the four data fields denoted Time Quality (Q_t), Geodetic Position Quality (Q_{pg}), Relative Position Quality (Q_{pr}), and Relative Azimuth Quality (Q_{ar}). These fields indicate the terminal's accuracy in its latest estimate of system time and the accuracy of its estimate of position reported in that J2 message.

The NTR transmits a Q_t of 15 and does not adjust its local terminal clock. Any terminal, except those in the Conditional Radio Silence or Polling mode, is capable of operating as the NTR. PRs transmit a Q_{pg} of 15 and do not perform adjustments to their geodetic position on the basis of TOA observations. NCs transmit a Q_{pr} set to value of 15, Q_{ar} set to value 7, and define the origin and orientation of the relative rectilinear planar (U, V) grid tangent to the grid at the origin and do not perform adjustments to relative grid position on the basis of TOA observations. The NC adjusts its geodetic position and velocity on the basis of messages received from terminals having higher values of Q_{pg}, including, but not limited to, PRs. Primary and Secondary User distinction is related to the methods of synchronization and associated source selection rules.

4.3.4.8 FINE SYNCHRONIZATION

Each terminal is capable of achieving Fine Synchronization by three modes designated Active RTT, Passive I and Passive II.

Initial Entry and Coarse Synchronization precede Fine Synchronization. Choice of the Active RTT, Passive I, or Passive II mode is determined by assignment of the JU as an NTR, PR, NC, Primary User, or Secondary User. In the Active RTT mode of synchronization, the interrogated unit responds with an RTT Reply containing the information required to allow the synchronizing unit to perform radio link time corrections. A continuing series of such RTT events is used to maintain clock offset, drift rate (frequency error), and estimated accuracy of synchronization. The Active RTT mode of synchronization is used exclusively by PRs, NCs and Primary Users and, under certain conditions, by Secondary Users.

In the Passive I mode of synchronization, the local clock offset and drift rate are computed by passive observations of the TOAs of J2 messages from other terminals. The Passive I mode of operation compensates for signal propagation time by computation of distance from the source J2 message and own unit positional data. The Passive I mode of operation requires a knowledge of own unit position independent of Relative Navigation and allows a terminal to achieve Fine Synchronization.

In the Passive II mode of synchronization the local clock offset and drift rate are computed from passive observations of a set of J2 message TOA values from geographically separated sources. The Passive II mode of synchronization shall not require prior knowledge of own unit position other than an approximate initial estimate required to start recursive filter operations.

4.3.4.9 SOURCE SELECTION AND QUALITY FIELD VALUES

Each terminal determines and transmits in its J2 messages the following quality fields as defined in the JTIDS/MIDS characteristics, Section 3, Terms and Definitions.

a. Time Quality.

b. Geodetic Position Quality.

c. Relative Position Quality.

d. Relative Azimuth Quality.

The values of the quality fields transmitted in the terminal J2 messages are as a direct function of the variances computed by the recursive filter operations of the Relative Navigation function. The source selection criteria, observation weighting functions, filter gains and time constants, and own-unit quality setting computations are such that each navigating unit tends to advance in quality so as to operate on the minimum set of highest quality sources capable of supplying the geometrical requirements necessary to support own unit quality. Increases in variances caused by deterioration of geometry or loss of observations will cause a decrease in quality and subsequent selection of previously inferior sources to restore geometry and stability at a new, lower quality.

The source selection algorithms are fully automatic and adaptive, requiring no prior knowledge or preloading of source identities, and provide a hierarchical structure to prevent circulation (feedback) of errors. Units of inferior time or position accuracy do not degrade the accuracy of superior units. The source selection algorithms specified in the terminal are intended to define the maximum set of allowable sources. They are not intended to be sufficient to assure optimum performance in all platforms.

More restrictive criteria are used when necessary for the maintenance of performance in communities of units of divergent performance capabilities. If unable to process inputs from all sources acceptable under the basic source selection rule, e.g., through lack of computer program operating time, additional source selection logic may be used to choose a subset of those inputs. However, this additional logic does not result in time and position qualities inferior by more than one quality level to that obtainable by processing the best equal-sized subset. In addition to the quality-based source selection criteria, all terminals reject from relative navigation and synchronization processing all relayed and simulated messages. Relayed J2 messages, however, may be used for direct acquisition of the U, V grid origin.

4.3.4.9.1 NETWORK TIME REFERENCE

The JU designated as the NTR sets Q_t to value 15 and performs no radio link time corrections. The NTR, if not also a PR or NC, selects as sources for relative and geodetic updates those satisfying at least the following criteria. Letting ${}_sQ_t$, ${}_sQ_{pr}$ and ${}_sQ_{pg}$ denote source qualities in received J2 messages, and Q_t, Q_{pr} and Q_{pg} denote own unit qualities, the first level selection criterion for relative filter update by ranging is the satisfaction of the following two conditions:

a. ${}_sQ_t$ is greater than or equal to Q_{pr}.

b. ${}_sQ_{pr}$ is greater than or equal to Q_{pr}.

Geodetic filter updates are made by either of two techniques, ranging or direct acquisition of grid origin data. Source data are processed for geodetic update by ranging only if the following three conditions are satisfied:

a. ${}_sQ_{pg}$ is greater than or equal to Q_{pg}.

b. ${}_sQ_t$ is greater than or equal to Q_{pg}.

c. ${}_sQ_t$ is not equal to 0.

Sources for direct acquisition of grid origin data are selected only if either of the following sets of conditions is satisfied:

a. ${}_sQ_{pg}$ is greater than Q_{pg}.

b. ${}_sQ_{pr}$ is greater than Q_{pg}.

c. Q_{pr} is greater than Q_{pg}.

Or

d. ${}_sQ_{pr}$ is greater than Q_{pr}.

e. ${}_sQ_{pg}$ is greater than Q_{pr}.

f. Q_{pg} is greater than Q_{pr}.

Direct acquisition of the improved grid origin estimate is used to update geodetic position if Q_{pg} is less than Q_{pr} or to update relative position if Q_{pg} is greater than Q_{pr}. In either case, the inferior own unit position quality shall be set no greater than the least of the other three position qualities following the update.

4.3.4.9.2 POSITION REFERENCE

Units designated as PRs must have a geodetic position accuracy of less than or equal to 50 feet, set Q_{pg} to value 15 and do not make geodetic updates. PRs use the Active RTT mode of synchronization. RTT Interrogations are transmitted in the next available transmit opportunity following that time update cycle in which the computed time variance exceeds a threshold computed from the time quality of the best available time source. The time variance threshold is computed each update cycle from the following relationship or by the equivalent interpolation in Table 4.3-TBD.

$$\sigma 2_{th} = 5000 \quad 2^{14-({}_sQ_t-A)}$$

where:

$\sigma 2_{th}$ = threshold time variance

$_{s}Q_{t}$ = the highest time quality observed in any PPLI message received during the preceding time filter cycle time

A = 0.5, a variable parameter, (0.1-0.9, 0.1)

The RTT Interrogation is addressed to the source used in the threshold computation. Upon completion of clock update, time quality is determined as specified in the JTIDS/MIDS technical characteristics, Section 3, Terms and Definitions, for the updated value of time variance. In time filter cycles not requiring an RTT Interrogation, the time variance increases according to the filtering and estimation algorithm model of the expected clock error. Failure to receive an RTT Reply to three consecutive interrogations of the same source causes that source to be rejected from the threshold computation. In any event, no more than 10% of total assigned capacity is used for RTT Interrogations.

PRs may acquire grid origin information by direct acquisition from sources satisfying the selection criteria specified for the NTR in paragraph 4.3.4.9.1. For PRs, these criteria automatically result in updates to relative position and relative position quality only. Relative position update may also be derived from range measurements using the same source selection criteria specified for the NTR in paragraph 4.3.4.9.1.

4.3.4.9.3 NAVIGATION CONTROLLER

The NC sets Q_{pr} to value 15 and Q_{ar} to value 7 and performs no relative grid navigation computations from TOA observations. If not also the NTR, the NC synchronizes with RTT Interrogations using the same source selection, threshold and time quality logic specified for PRs in paragraph 4.3.4.9.2. Initially, the NC may arbitrarily specify the geodetic coordinates of the relative grid origin. The NC may refine the estimate of grid origin by either of two means of geodetic update. Geodetic update may be performed by ranging on other elements satisfying the following three source selection criteria:

a. $_{s}Q_{pg}$ is greater than or equal to Q_{pg}.

b. $_{s}Q_{t}$ is greater than or equal to Q_{pg}.

c. ${}_sQ_t$ is not equal to 0.

Q_{pg} is updated each cycle in accordance with the quality and variance relationships as specified in the JTIDS technical characteristics, Section 3, Terms and Definitions. The NC is also capable of receiving improved grid origin estimates by direct acquisition from other units navigating in the relative grid. These sources are selected by the logic specified for the NTR in paragraph 4.3.4.9.1.

4.3.4.9.4 PRIMARY USERS

Primary Users synchronize by RTT using the same source selection and threshold logic as that specified for Position References in paragraph 4.3.4.9.2. Primary Users select for Relative Navigation ranging observations those sources that satisfy the following two conditions:

a. ${}_sQ_t$ is greater than or equal to Q_{pr}.

b. ${}_sQ_{pr}$ is greater than or equal to Q_{pr}.

Primary Users select sources for geodetic update using the same logic as the NC as specified in paragraph 4.3.4.9.3. Primary Users select sources for grid origin acquisition by the same criteria as those of the NTR, as specified in paragraph 4.3.4.9.l. Primary users compute and report own unit position qualities in the same manner as the NTR.

4.3.4.9.5 SECONDARY USERS

Secondary Users normally perform synchronization and Relative Navigation passively. Users operating in the Radio Silence mode shall automatically perform as Secondary Users; however, use of the passive modes of synchronization and Relative Navigation is not limited to the Radio Silence mode and is selectable at any time by operator entry.

Secondary Users select as sources for passive update of both time and relative position qualities JUs having better than own unit time and greater than own unit relative position qualities. Combined passive time and geodetic position updates are made only with J2 messages having better time and greater geodetic position qualities greater than own unit. Selection of operation as a Secondary User does not, except when operating in the Radio Silence mode, preclude the use of RTT to augment the basic passive modes under conditions of poor geometry or for initial entry. Sources for position updates include only those having both time and position qualities greater than the lesser of own unit time or position quality.

As with Primary Users, the addressee of the RTT Interrogation shall be the unit of highest time quality. When in poor geometry, Secondary Users shall generate RTT Interrogations only as often as required to maintain own unit time variance as a negligible contribution to the position variance. RTT Interrogations by Secondary Users shall occur no more frequently than once per epoch. Secondary Users shall select sources for direct acquisition of grid origin by the same criteria as the NTR, as specified in paragraph 4.3.4.9.1.

4.3.4.9.6 TIME OF ARRIVAL ONLY

Mobile JUs having no dead reckoner inputs shall employ filter algorithms that are capable of determining relative position solely on the basis of TOA measurements and J2 messages from other JUs. They shall otherwise comply with paragraphs 4.3.4.9 and 4.3.4.9.1. The design of the terminal logic is such that the reported position quality reflects a conservative estimate of position accuracy.

4.3.4.10 RELATIVE NAVIGATION CORRECTION TO HOST SYSTEM

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4.4 SURVEILLANCE

There is a requirement to exchange surveillance information on the Link 16 network. This section describes the exchange of surveillance information using fixed format messages.

C^2 JUs participating in the exchange of J3 Surveillance messages shall transmit surveillance information in Network PGs as defined in paragraph 4.2.3.10.5. NonC^2 JUs shall receive situational awareness information from the Surveillance NPG including track and Reference Point data necessary to support the platform mission. NonC^2 JUs shall not transmit on the Surveillance NPG. The following paragraphs specify the general rules and conventions necessary to satisfy the exchange requirements for surveillance data.

4.4.1 SURVEILLANCE DATA

Surveillance information includes the following data:

a. Point surveillance data included in the J3.0 Reference Point message and the J3.1 Emergency Point message.

b. Air and Surface (Maritime) surveillance data included in the J3.2 Air Track message and the J3.3 Surface (Maritime) Track message.

c. Subsurface (Maritime) surveillance data included in the J3.4 Subsurface (Maritime) Track message.

d. Land (Ground) surveillance data included in the J3.5 Land (Ground) Point/Track message.

e. Space and Ballistic Missile surveillance data included in the J3.6 Space Track message.

f. Electronic Warfare surveillance data included in the J3.7 EW Product Information message.

Surveillance information may be amplified by the following data:

a. J5.4 Acoustic Bearing/Range Message.

b. J6.0 Amplification message.

c. J15.0 Threat Warning message.

The following Information Management data are also used to insure correct exchange of surveillance data:

a. J7.0 Track Management (ACT = 0) Drop Track Report message.

b. J7.0 Track Management (ACT = 1) Difference Report message.

c. J7.0 Track Management (ACT = 2) Change Data Order message.

d. J7.0 Track Management (ACT = 3) Emergency Status Change message.

e. J7.0 Track Management (ACT = 4) Force Tell Status Change message.

f. J7.0 Track Management (ACT = 5) Strength Change message.

g. J7.0 Track Management (ACT = 6) Exercise Status Order message.

h. J7.1 Data Update Request (ACT = 0) Data Update Request by Request Indicator message.

i. J7.1 Data Update Request (ACT = 1) Data Update Request by Track Number message.

j. J7.1 Data Update Request (ACT = 2) Ballistic Missile Update Request message.

k. J7.2 Correlation message.

l. J7.4 Track Identifier message.

m. J7.5 IFF/SIF Management (ACT = 0) Clear IFF/SIF message.

n. J7.5 IFF/SIF Management (ACT = 1) IFF/SIF Difference Report message.

o. J7.5 IFF/SIF Management (ACT = 2) IFF/SIF Update Request message.

p. J7.5 IFF/SIF Management (ACT = 3) Special Code message.

q. J7.6 Filter Management (ACT = 0) Filter Implementation Request message.

r. J7.6 Filter Management (ACT = 1) Filter Description Report message.

s. J7.6 Filter Management (ACT = 2) Delete Filter Request/Report message.

t. J7.7 Association (ACT = 0) Associate Data message.

u. J7.7 Association (ACT = 1) Terminate Association message.

Paragraph 5.7.1 describes the requirement for initial transmission and explains the way message redundancy is specified. Each message contains the special rules required for the transmission and reception of that message.

The general rules and conventions common to the entire Surveillance function are defined in paragraph 4.4.2. Subsequent paragraphs describe the rules and conventions for reporting Point surveillance data (paragraph 4.4.3), Air, Surface (Maritime), and Land (Ground) surveillance data (paragraph 4.4.4), Subsurface (Maritime) surveillance data (paragraph 4.4.5), Space and Ballistic Missile surveillance data (paragraph 4.4.6), and EW surveillance data (paragraph 4.4.7).

4.4.2 GENERAL RULES AND CONVENTIONS

The general rules and conventions for reporting surveillance data are described in the following paragraphs.

4.4.2.1 IDENTITY

Standard identity is provided in terms of the following definitions:

a. Pending - A track which has not been subjected to the identification process.

b. Unknown - An evaluated track which has not been identified.

c. Assumed Friend - A track which is assumed to be a friend because of its characteristics, behavior, or origin.

d. Friend - A track belonging to a declared friendly nation.

e. Neutral - A track whose characteristics, behavior, origin, or nationality indicate that it is neither supporting nor opposing friendly forces.

f. Suspect - A track which is potentially hostile because of its characteristics, behavior, origin or nationality.

g. Hostile - A track declared to belong to any opposing nation, party, group, or entity, which by virtue of its behavior or information collected on it such as characteristics, origin or nationality contributes to the threat to friendly forces.

These standard identity terms are further amplified by the Special Interest Indicator, Exercise Indicator and Identity Amplifying Descriptor, Specific Type, Platform, Platform Activity, and Identity Confidence fields.

4.4.2.1.1 EXERCISE TRACKS

There is a requirement to distinguish between live tracks that are involved in an exercise and other live tracks being reported. This is accomplished by setting the Exercise Indicator in the J3 track messages. Only tracks with standard identity of Friend can be modified by the exercise identity. When the Exercise Indicator is set to value 0, Non-Exercise Track, the standard identity of the track shall be specified in the Identity field. When the

Exercise Indicator is set to value 1, Exercise Track, the standard identity of the track shall be Friend and the exercise identity shall be specified in the Identity Amplifying Descriptor field. The Identity Amplifying Descriptor field shall not be set unless the Exercise Indicator field is set to value 1, Exercise Track. In particular, a track with the Exercise Indicator set to value 1, Exercise Track, and the Identity Amplifying Descriptor set to value 6, FAKER, shall be identified as a friendly track acting as a hostile for exercise purposes. Also, a track with the Exercise Indicator set to value 1, Exercise Track, and the Identity Amplifying Descriptor set to value 5, JOKER, shall be identified as a friendly track acting as a suspect for exercise purposes. For any track with Exercise Indicator set to value 1, Exercise Track, data concerning the track must be considered artificial, for exercise purposes, except that the following shall not be artificial:

a. Track Number.

b. Tracking Data: Latitude, Longitude, Altitude/Elevation/Depth, Course, Speed, Minute, Hour, and Track Quality.

c. Simulation Indicator.

d. Environment/Category.

e. Status Data on Air Tracks: Fuel Function, Fuel, Time Report Function, Minute, and Hour.

f. Status Data on Surface (Maritime) Tracks: Flight Deck Status, Landing/Approach Condition, and associated Time Report Function, Minute and Hour.

4.4.2.1.2 SPECIAL INTEREST TRACKS

A track's identity can be further amplified by designating it as a track of special interest. This is accomplished by setting the identity field as appropriate and by setting the special interest indicator. Examples of employment of this indicator are:

a. Kilo/Yoke - A friendly track of special interest.

b. Zombie - A SUSPECT air track conforming to ATC rules or outside NATO airspace following a recognized traffic pattern.

c. Traveller - A SUSPECT surface track following a recognized traffic route.

4.4.2.1.3 PLATFORM AND PLATFORM ACTIVITY

The Platform and Platform Activity fields are Environment/Category dependent and serve to further amplify the identity of the reported track in specific terms, such as fighter, close air support.

4.4.2.1.4 IDENTITY CONFIDENCE

Identity Confidence (ID CON) criteria are yet to be determined (baseline to be determined by common agreement between Allied Nations).

4.4.2.1.5 SPECIFIC TYPE

Specific type is Environment/Category dependent and serves to further amplify platforms in each Environment/Category. Specific type is normally provided by status report from interface units or by intelligence amplification reports on surveillance tracks, or in the J3.2, J3.3, J3.4, J3.5, and J3.6 messages.

4.4.2.1.6 SHIPBORNE MISSILE SYSTEMS

The surface-to-air (SAM) and/or surface-to-surface (SSM) missile systems fitted in surface (maritime) units may be reported in the J3.3 Surface (Maritime) Track message or the J6.0 Amplification message.

4.4.2.2 REPORTING RESPONSIBILITY

Surveillance data reporting is initiated by the JU which first detects or initiates a track/point and makes it available for reporting on the interface. Each track/point initiated and reported shall be assigned a TN from the JU's allocated block. At that time, the JU shall have R^2 for the track/point. R^2 procedures for Air, Surface (Maritime), and Land (Ground) surveillance tracks are discussed in paragraph 4.4.4.11. The general R^2 rules for points are discussed in paragraph 4.4.3.2, the R^2 rules for Ballistic Missile surveillance tracks are discussed in paragraph 4.4.6.15, and the R^2 rules for EW Surveillance are discussed in paragraph 4.4.7.2.

4.4.2.2.1 INTEGRATION OF PPLI REPORTS WITH SURVEILLANCE DATA

PPLI data available from J2 messages shall be used by C^2 JUs to reduce the redundancy of surveillance track reporting.

a. A surveillance JU will accept the PPLI information into its surveillance database and perform the applicable correlation and conflict processing necessary to ensure that duplicative information is not being transmitted on the Surveillance Network PG.

b. A C^2 JU participating on the Surveillance Network PG shall attempt to correlate received PPLI reports with data being received from local sensors. If a correlation is found with a track for which the C^2 JU has R^2 the J7.2 Correlation message shall be transmitted with the Response Value (RV) field set to value 1 (Reverse Correlation Not Acceptable), and with the Source TN in the Header word of the J2 PPLI message as the Retained TN and the surveillance TN as the Dropped TN. The C^2 JU shall cease reporting the track and transmit a J7.0 (ACT = 0) Drop Track message on the surveillance TN.

c. If a correlation is found with a track for which another C^2 JU has R^2 and the TNs are different, the J7.2 (RV = 1) Correlation message shall be transmitted, with the Source TN in the Header word of the J2 PPLI message as the Retained TN and the surveillance TN as the Dropped TN.

d. If a correlation is found with a track for which another C^2 JU has R^2 and the TNs are the same, the JU receiving the J2 shall accept the PPLI information into its surveillance database and shall disregard the J3 surveillance data on the specified track except when Geodetic Position Quality in the PPLI message is set to value 0, in which case the surveillance track is accepted and the PPLI message shall be discarded.

e. Subsurface tracks shall not be correlated with IUs.

f. If a correlation is not found, the C^2 JU shall integrate the received J2 PPLI report into its surveillance database as part of the surveillance picture. If J2 messages are not received subsequent to this action and the receiving C^2 JU still has no local data, the C^2 JU assumes no responsibility for reporting the subject JU on the Surveillance Network PG.

g. If the position or other data in a PPLI meet a system's decorrelation criteria, the PPLI and local track data shall be decorrelated. After decorrelation, the C^2 JU shall initiate a surveillance track report with locally held data using a new track number. The PPLI Track Number and Identity Indicator field and the PPLI IFF/SIF Indicator field shall both be reported as No Statement.

4.4.2.2.2 REPORTING OF INACTIVE AND LIMITED STATUS INTERFACE UNITS

A C^2 JU shall assume R^2 of an IU (including C^2 and nonC^2 JUs and forwarded PUs and RUs) in accordance with the reporting rules for a real-time track if the C^2 JU has correlated local sensor data, when:

a. A J2 PPLI message is not received for 40 to 60 seconds, or

b. A J2 PPLI message, other than J2.0, is received with the NPS Indicator set to Inactive or Conditional Radio Silence, or

c. A J7.0 (ACT = 0) Drop Track message is received from the FJU for a PU, RU, or other IU, or

d. The Geodetic Position Quality in the J2 PPLI message is set to value 0.

A C^2 JU assuming R^2 of an IU reports it as a track or point on the Surveillance Network PG. The type of surveillance message will depend upon the Environment/Category of the IU being reported. The Identity shall be reported as Friend. The Track Number, Platform and Platform Activity values received in previous PPLI messages shall be reported. The PPLI Track Number and Identity Indicator shall be reported as value 1, and shall be maintained if another C^2 JU assumes R^2 of the IU.

The PPLI Track Number and Identity Indicator, when set to value 1, serves several useful purposes. For example, in addition to the uses defined in Paragraph 4.7, it may displayed to operators to give an extra measure of confidence in the track identification data being reported.

The most current IFF/SIF data shall be reported. If all IFF/SIF nonzero mode codes were obtained from or are the same as the codes received in the J2 message for the subject TN, the PPLI IFF/SIF Indicator in the J3 message shall be reported as value 2. Otherwise, if the Mode II code was obtained from or is the same as the Mode II code received in the J2 message, the PPLI IFF/SIF Indicator shall be reported as value 1. Otherwise, the PPLI IFF/SIF Indicator shall be reported as value 0. The Mode IV Indicator value reported shall be based on actual responses received and shall not be based on the fact that the TN was previously received in a PPLI message.

If locally derived IFF/SIF data differs from IFF/SIF data that was being reported in the PPLI message, the locally derived data shall be reported.

4.4.2.3 SIMULATED TRACKS

There is also a requirement for a capability to indicate that a surveillance track is not derived from any sensor data but is a simulated track being provided solely for training or test. This is accomplished by setting the Simulation Indicator in the appropriate J3 message as well as in the J2 message when applicable. JUs have the option of implementing simulated tracks. JUs also have the option of filtering simulated tracks. The Simulation Indicator in the J2 and J3 messages shall be set on all simulated tracks when both live and simulated tracks are simultaneously being exchanged on the interface. Simulated tracks may be originated from simulated video mixed with live video, from message input provided by previously recorded or generated messages, or from a TDS's internal simulation program. When the Simulation Indicator is set in a J2 or J3 message, all data associated with that track are simulated and should not be associated with a live track. Simulated tracks will not be correlated with live tracks. Prior coordination with all interface participants is required when transmitting simulated tracks on the interface to insure that simulated tracks are not assigned TNs from other systems' TN blocks. If a system displays both simulated and live tracks simultaneously, the tracks should be readily distinguishable from each other. The Simulation Indicator shall not change. If for any reason, such as operator error, it is desired to change the simulation status of a track, the track shall be dropped using the J7.0 (ACT = 0) message, and a new track shall be reported. The one exception to this rule is that a change from live to simulated shall be accepted if the track is being received from an FJU.

4.4.2.4 SPECIAL PROCESSING AND HANDLING OF SURVEILLANCE DATA

Special processing of surveillance data may be required in accordance with paragraph 4.1.6.

4.4.2.5 TRACK ALERTS

Track alerts consist of force tell and emergency alerts. Force Tell and Emergency Indicators are provided in the J3 messages to indicate force tell and/or emergency conditions. These indicators, when set, allow these messages to override all operator controllable data filters. A system with a limited track capacity (e.g., F-15) should manage its database to insure that it shall not be saturated by force tell and emergency alerts. These indicators are set and cleared as specified in paragraph 4.7.1.4.

4.4.2.6 PURGING

A JU may have the capability to purge remote tracks/points, i.e., automatically drop a remote track/point after a specified time interval has elapsed since the track's/point's last report. The JU shall not transmit a J7.0 (ACT = 0) message on a purged remote track/point. See paragraph 4.4.3.7 Purging of Reference and Land (Ground) Points, paragraph 4.4.3.8 Purging of Emergency Points, paragraph 4.4.4.13.2 Purging of Remote Tracks for additional information on purging of points and tracks, and paragraph 4.4.7.6 Termination of Electronic Warfare Surveillance Data, which explains purging of EW product information.

4.4.2.7 RULES FOR "NO STATEMENT" AND "RESET TO NO STATEMENT" VALUES

Various fields in the J-series messages contain both No Statement and Reset to No Statement values. No Statement means the report includes no data for that field. It implies nothing about the validity of previously reported non-No Statement data for that field. The Reset value provides a means to specifically declare that the currently reported value is incorrect, but the correct specific value has not been ascertained. The following rules apply:

a. When a JU implements the No Statement value and at least one other defined value for a field that has a Reset to No Statement value, the Reset to No Statement value must also be implemented.

b. A message reporting the Reset to No Statement value shall be transmitted one time.

c. When a system receives a No Statement value for a field which has a Reset to No Statement value and for which a value other than No Statement is locally held, the locally held value shall be retained regardless of whether it was locally or remotely derived.

d. When a system receives a Reset to No Statement value, it shall automatically revert the locally held value of that field to No Statement.

e. The Reset to No Statement value may be originated automatically or by operator action.

f. Paragraph 4.6.2 contains amplifying rules for use of the Reset to No Statement value in the J6.0 Amplification message.

4.4.2.8 TRACK NUMBER CONTINUITY

A particular surveillance entity may be eligible to retain its original Track Number on change of report type, Table 4.7-1 specifies those cases when the same TN is to be retained and those when a new TN is to be assigned. In cases when a new TN is required, the JU with R^2 shall transmit a Drop Track Report on the old TN.

4.4.3 POINT SURVEILLANCE DATA

Point surveillance data are exchanged as follows:

a. J3.0 - Used to exchange tactical information about geographic references. (Nonphysical points such as waypoints, Combat Air Patrol (CAP) stations, Forward Edge of the Battle Area (FEBA), etc.)

b. J3.1 - Used to report the existence of an emergency condition that requires search and rescue efforts.

c. J3.5 - Used to report the location of fixed ground units or objects. (Physical points such as troop concentrations, bridges, airbases, etc.)

4.4.3.1 POINT, LINE, AND AREA REPORTING

The J3.0 Reference Point, J3.1 Emergency Point, and the J3.5 Land (Ground) Point/Track messages are used to report points, e.g., waypoints, downed aircraft, SAM sites, etc. Each point, line, or area reported on the interface shall be assigned a TN(s) by the reporting JU, and the position shall be reported using geodetic latitude/longitude values. Also, the J3.0 and J3.5 messages provide the capability to report the altitude/elevation of the point, line, or area if required. The capability to report the time associated with a reported point, line, or area is provided in all three point messages. Time is reported in hours/minutes, and the time meaning is defined by the Time Function field. The J3.5 message also provides the capability to describe a circle/ellipse about a ground point. This would normally be used in reporting a SAM site, but could be used with any J3.5 point. In addition to reporting points, the capability is provided for the J3.0 message to transmit lines such as FEBAs, roads, etc.; areas such as search areas, exercise areas, etc.; and volumes such as corridors, etc. Protocols for use of the time and Time Function fields for moving points, lines, and areas are contained in paragraph 4.4.3.1.3.

The J3.0 message word sequences required for support of various point type values are provided in the ASW point reporting procedures and associated message T/R rules (see paragraph 4.4.5.2.3).

It is a system option to retain the TN and last reported position of a fixed land (ground) IU that has reverted to an inactive status. If the point is required for tactical situation reporting, the JU shall transmit a J3.5 message on the IU, using the assigned address of the inactive IU.

There is no interface track-to-point or point-to-point correlation and the J7.2 message shall not be used to correlate one track/point with any other point. The J7.7 message shall be used to indicate any association between a track/point and another track/point.

It is illegal to change a reference or emergency point to any other type of surveillance entity; i.e., the Reference TN used to identify a particular reference or emergency point shall not be used for any other type of entity reported on the interface except in the normal course of TN reuse. Moreover, it is illegal to change the Point Type and/or Point Amplification value of a reference point while retaining the same Reference TN. As an exception to this rule a Point Amplification value of No Statement may be changed to a non-No Statement value and retain the same Reference TN.

Emergency points are transmitted as J3.1 messages. Emergency points may be related to a previously reported track/point. In these cases the J3.1 message shall contain, as amplifying information, the TN, Previously Reported that is associated with the emergency point. The emergency point shall have a TN, Reference different from the TN, Previously Reported. When the Exercise Indicator is set to value 1 in the J3.1 message, the report is for exercise purposes and is not an actual emergency.

When the J3.0 message is used to report a point, the Point/Line/Area Descriptor, 1 field shall be set to value 0, Point, in the initial word.

4.4.3.1.1 ALTITUDE REPORTING

When altitude is specified, Altitude, 100 Ft 1 and, if appropriate Altitude, 100 Ft 2, shall be reported in each J3.0E0 word transmitted. If only one altitude is to be reported, the Altitude, 100 Ft 1 shall be used and Altitude, 100 Ft 2 shall be set to value 1023, No Statement. When only one altitude is provided it is a designated altitude and not at or below and not at or above. An altitude range is reported with both Altitude, 100 Ft 1 and Altitude, 100 Ft 2. For example, if the altitude to be reported is at or below 10,000 feet, then Altitude, 100 Ft 1 is set to value 0, 0 Altitude and Altitude, 100 Ft 2 is set to value 100, 10,000 Feet. If the altitude to be reported is at or above 20,000 feet, then Altitude, 100 Ft 1 is set to value 200, 20,000 Feet and Altitude, 100 Ft 2 is set to value 1022, 102,200 Feet (the maximum setting). Altitudes and altitude ranges apply only to a single word sequence, i.e., a single track number. This is to allow different altitudes to be applied to different segments of the same line.

4.4.3.1.2 LINES AND AREAS

The J3.0 message provides for the description of segmented lines, multisided areas, squares, rectangles, circles, or ellipses. Volumes are obtained by including maximum and minimum altitude values when describing multisided areas, squares, rectangles, circles, or ellipses in the J3.0 message.

a. Segmented Line and Multisided Area Definition. A single J3.0 message is used to define a segmented line with either 2 or 3 points. Multiple J3.0 messages, each with a unique TN, are used to define segmented lines or multisided areas described by more than 3 points. In either case a J3.0I/J3.0E0/J3.0C1 word sequence is used for each message. A J3.0C2 word is added to the first message if the line or area is moving.

(1) When 2 or 3 points are joined together to form a segmented line, the following conditions are used:

(a) The Line/Area Continuation Indicator is set to No Statement in the initial word of the word sequence.

(b) The End Point field associated with the appropriate coordinates described by one of the two sets of Delta Latitude/Delta Longitude fields of the continuation word is set to value 1, End Point.

(c) The Point/Line/Area Descriptor, 1 field is set to value 2, Line, in the initial word.

(d) The designated reference point from which Delta Latitude 1, Delta Longitude 1, Delta Latitude 2, and Delta Longitude 2 are measured is that given by the Latitude and Longitude fields in the J3.0E0 word.

(2) When more than 3 points are joined together to form a segmented line or a multisided area, the following conditions are used:

(a) The second and all subsequent messages transmitted have the Line/Area Continuation Indicator in the initial word set to value 1, Line/Area Continuation.

(b) The point location described in the extension word of the second and all subsequent messages must be the same point location as the last point location described in the previous message. This assures a receiving unit that it, in fact, received all messages and did not miss a transmission.

(c) The appropriate end point field in the continuation word will be set to value 1 to indicate the associated point is the last point to be transmitted.

(d) When describing a multisided area, the last point location transmitted must be the same location as the initial point transmitted in the first word sequence. This, in effect, closes the figure to form an area.

(e) The designated reference point from which Delta Latitude 1, Delta Longitude 1, Delta Latitude 2, and Delta Longitude 2 are measured is that given by the Latitude and Longitude fields in the J3.0E0 word.

(f) When joining three or more points to form a segmented line, the points are first plotted as specified above, then the segments are connected in sequence, i.e., the first segment is drawn from the point described in the Latitude and Longitude fields in the J3.0E0 word, to the point established by the Delta Latitude, 1 and Delta Longitude, 1 fields in the J3.0C1 word. The second segment is drawn between the point established by the Delta Latitude, 1 and Delta Longitude, 1 fields to that established by the Delta Latitude, 2 and Delta Longitude, 2 fields. This process is repeated to connect multiple segments.

(g) To prevent confusion and possible misunderstanding, any change to data concerning any point comprising a portion of a segmented line or multisided area, shall cause the entire line or area to be transmitted by the reporting JU. Receiving units shall purge the previously held segmented line or multisided area and replace it with the new report.

(h) The TNs used to initiate the segmented line or multisided area shall be transmitted for every report of the segmented line or multisided area, including a change of R^2.

(i) The Reference TN of the first J3.0 message with Line/Area Continuation Indicator set to value 0 shall be used as the only legal identifier for all subsequent references to the segmented line or multisided area, except when dropping the line or area (refer to paragraph 4.4.3.6), setting/clearing the Force Tell Indicator (refer to paragraph 4.7.1.4.3), or responding to a Data Update Request by TN (refer to paragraph 4.7.2.1.1).

(j) The Point/Line/Area Descriptor, 1 field in the initial word shall be set to value 2, Line, when describing a segmented line and shall be set to value 3, Multi-point Area, when describing a multisided area.

b. Square, Rectangle, Circles and Ellipse Definition. When defining an area that is a square, rectangle, circle, or ellipse a J3.0I/J3.0E0/J3.0C2, J3.5I/J3.5E0/J3.5C3, or a J3.7I/J3.7C1/J3.7C2 word sequence is used. The Point/Line/Area Descriptor, 1 field in the J3.0I word shall be set to value 1, Single Point Area. The Square/Circle Switch field indicates that either a square or rectangle is being described when set to value 1 or indicates either a circle or ellipse is being described when set to value 2. A square or circle is being described, depending on the value of the Square/Circle Switch, when the Area Major Axis and Area Minor Axis fields are equal. When the axes are not equal, a rectangle or ellipse is described, depending on the value of the Square/Circle Switch. The orientation of the major axis with respect to True North is provided by the Axis Orientation Field.

When defining EW AOPs (refer to paragraph 4.4.7.1.3) the J3.7I/J3.7C1/J3.7C2 word sequence, as a minimum, is used. The same procedures described above are used to define AOPs.

c. Corridor and Low Level Transit Route (LLTR) Definition. Corridors are reported using Point Type value 4, Line and Point Amplification value 3, Corridor. LLTRs are reported using Point Type value 4, Line and Point Amplification value 6, Low Level Transit Route. Both of these lines are center lines and may be single or segmented with altitude(s) associated with each segment. Width is reported in the Area Major Axis, 4 field in the J3.0C5 word. All other fields in the J3.0C5 word shall be set to No Statement.

4.4.3.1.3 <u>SLAVED POINTS AND AREAS</u>

a. Certain reference points and areas may be slaved in a constant position in relation to a Related TN. The position of a slaved point or area is established as Delta Latitude, 1/Delta Longitude, 1 from the Related TN at the time of the report when the Slaved Indicator is set to value 1. This establishes the constant true or relative bearing and range of the slaved point or area from the Related TN. The absence or presence of the J3.0C4 word indicates whether slaving is on a true or relative bearing, as described in paragraph 4.4.3.1.2e below. If the J3.0E0 word is included in a report of a slaved point or area, Latitude, 0.0103 Minute and Longitude, 0.0103 Minute shall be set to No Statement. An example of a slaved point is a marshall point used during aircraft recovery operations aboard an aircraft carrier.

b. When a square or rectangle (Square/Circle Switch = 1) or a circle or ellipse (Square/Circle Switch = 2) is slaved, the position established by the Delta Latitude, 1/Delta Longitude, 1 is the center of that area.

c. Lines and irregular multisided areas, i.e. other than squares, rectangles, circles, and ellipses, shall not be slaved.

d. The slaved point or area center is plotted as the difference in Latitude and Longitude from the position of Related TN at the time of the report, regardless of whether slaved true or relative, and regardless of the course of Related TN. If slaved true, the constant true bearing is then determined as the azimuth between True North and the position of the slaved point or area center, measured clockwise from the position of Related TN. If slaved relative, the constant relative bearing is determined as the angle between the course of Related TN and the position of the slaved point or area center, measured clockwise from the position of Related TN. For relative slaving, the azimuth (true bearing) of the point or area center from the Related TN changes by an amount identical to any reported change of course of the Related TN subsequent to receipt of the slaved point or area message. For slaved ellipses, squares, and rectangles, the Axis Orientation shall also change by an amount identical to the course change of Related TN (-180 degrees if the Axis Orientation exceeds 179 degrees).

e. The absence or presence of the J3.0C4 continuation word indicates whether a point or area center reported in a J3.0 message with Slaved Indicator = 1 is slaved by true or relative bearing to the Related TN. For both true and relative slaving, the range between the slaved point or area center and Related TN remains constant. If the J3.0C4 word is not included, the bearing established by Delta Latitude, 1/Delta Longitude, 1 is a constant true bearing from the J3.0C2 Related TN. If the J3.0C4 word is included, the bearing is relative to the course of the J3.0C4 Related 1 TN. When the J3.0C4 word is transmitted, either the J3.0C2 Related TN field shall be set to No Statement for a slaved area, or the J3.0C2 word shall not be transmitted for a slaved point.

f. ASW Areas of Probability (AOP) reported in a J3.0 message with Point Type = 7 and Point Amplification = 12 shall not be slaved. To relate or associate an ASW AOP to a track or point, e.g., a subsurface track for which contact has been lost, a J7.7 Association message may be transmitted.

4.4.3.1.4 NONSLAVED MOVING POINTS, LINES, AND AREAS

The rules for nonslaved moving points, lines, and areas are provided as follows:

a. Moving points, lines, and areas are reported by setting Course and Speed in the J3.0C2 word to other than No Statement. Moving points, lines, and areas shall be extrapolated by the host to the time of transfer to the terminal. Time (Hour and Minute) and Time Function may also be reported as amplifying information, independent of the reported position, Course, and Speed. If time is reported as other than No Statement, Time Function shall also be other than No Statement. The Axis Orientation field is not affected by changes in Course.

b. A point, line, or area shall not be reported as moving if it has an Activation Time in the future, i.e., if Time Function = Activation Time and the Time has not yet arrived, Course and Speed shall be set to No Statement. To cause a point, line, or area to commence moving at the Activation Time, Course, and Speed may be reported commencing at Activation Time.

c. Position and Intended Movement (PIM) and Submarine Position and Intended Movement (SIM) points (Point Type = 1, Point Amplification = 4 and 9, respectively) which are not yet active are exceptions to the above rules. Such future PIM and SIM points shall be reported with the position, Course, and Speed that will be effective at the Activation Time.

d. Land (Ground) Points shall not move, i.e., Course and Speed shall be set to No Statement in a J3.5 (PTI = 0) message. The J3.5 (PTI = 0) Track Quality field shall be set to 0. Course, Speed, and Track Quality shall not be processed upon receipt of a J3.5 (PTI = 0) message.

4.4.3.2 REPORTING RESPONSIBILITY FOR POINTS, LINES, AND AREAS

The following subparagraphs amplify the general R^2 rules specified in paragraph 4.4.2.2. Both the general rules and the amplification of those rules for points, lines, and areas, detailed below, shall be followed.

4.4.3.2.1 REPORTING RESPONSIBILITY FOR REFERENCE POINTS, LINES, AND AREAS AND GROUND POINTS

The originator of a J3.0 or J3.5 (PTI = 0) point, line, or area retains R^2 as long as the originator remains active and reports the point, line, or area. However, if a J7.0 (ACT = 0) message is received, the R^2 unit is declared inactive, or if no periodic update is received for three consecutive update intervals, another JU may, by operator action only, assume R^2 for the point, line, or area using the same Reference TN(s). The latest IU to report on a reference or land (ground) point, line, or area has R^2 for the point, line, or area. If a JU without R^2 desires that a specific point, line, or area be transmitted immediately without awaiting the next periodic update, it should transmit a J7.1 (ACT = 1) Data Update Request for the desired TN.

4.4.3.2.2 REPORTING RESPONSIBILITY FOR EMERGENCY POINTS

Any JU may report, through operator action only, on a previously reported emergency point when that JU has additional or more current information on the point. In addition, if a J7.0 (ACT = 0) message is received on an emergency point, the unit with R^2 is declared inactive, or if no periodic update is received for three consecutive update intervals, another JU may, by operator action only, assume R^2 for the point. A JU assuming R^2 for an emergency point shall use the same TN Reference and the same value of TN Previously Reported as those reported by the previous reporting unit. The latest JU to report a point has R^2 for that point.

4.4.3.3 DATA UPDATE REQUESTS FOR POINTS, LINES, AND AREAS

Paragraphs 4.7.2 through 4.7.2.3 provide information on Data Update Requests for points, lines, and areas.

4.4.3.4 TRACK ALERTS FOR POINTS, LINES, AND AREAS

Paragraphs 4.7.1.4.3, 4.7.1.4.4, and 4.7.1.4.6 provide information on track alerts for Reference Points, Emergency Points, and Land (Ground) Points, respectively.

4.4.3.5 REPORTING TRANSPONDER DATA ON POINTS

IFF/SIF data (Modes I, II, and III Codes) are transmitted in the J3.1 and J3.5 (PTI = 0) messages when available. The IFF/SIF data in the J3.1 message shall contain the IFF/SIF modes and codes of the previously reported track for which the emergency point was initiated.

4.4.3.6 TERMINATION OF A POINT, LINE, OR AREA

When a JU ceases reporting a point, line, or area for which it had reporting responsibility, it shall transmit a J7.0 (ACT = 0) message. To drop a segmented line or multisided area defined by more than one Reference TN, a J7.0 (ACT = 0) message shall be transmitted for each Reference TN.

A JU shall not transmit a J7.0 (ACT = 0) message on a point when the point becomes an Active IU on the interface with the same TN.

A JU receiving a J7.0 (ACT = 0) message on a point, line, or area shall not be required to purge the point, line, or area. However, if the JU does not purge a point, line, or area on which it has received a J7.0 (ACT = 0) message, it shall assume R^2 for the point, line, or area to ensure that it remains active on the interface.

4.4.3.7 PURGING OF REFERENCE POINTS, LINES, AND AREAS AND LAND (GROUND) POINTS

JUs may purge remote reference points, lines, and areas and land (ground) points if they are no longer required. When a remote point, line, or area is purged from a system by local options, a J7.0 (ACT = 0) message shall not be transmitted.

4.4.3.8 PURGING OF EMERGENCY POINTS

Emergency points are periodically updated and are normally terminated via the J7.0 (ACT = 0) message when the emergency ceases. If a JU fails to receive the J7.0 (ACT = 0) message and further updates are not received, the JU may purge those points after a specified time period has elapsed with no updates.

4.4.3.9 TIME

Time may be associated with the reported point, line, or area. This "time" may represent establishment, acquisition, activation, deactivation, etc. For segmented lines and multi-sided areas defined by more than one Reference TN, time and Time Function, if applicable, shall be reported for the first Reference TN, and shall be considered to apply to the entire line or area. If time and Time Function are transmitted with any of the subsequent line segments or area sides, they shall be the same as the time and Time Function transmitted in the first line segment or area side. In those cases when more than one time is required (i.e., activation, deactivation) for the same reported point, line or area, additional J3.0 messages shall be transmitted for that point, line or area with the appropriate Time Function value set.

4.4.3.10 EXERCISE INDICATOR IN THE REFERENCE POINT MESSAGE

The Exercise Indicator in the J3.0 message is only used to amplify J3.0 messages with the Point Type field set to value 6, Area (Hazard), and the Point Amplification field set to value 3, Allied Missile Engagement Zone (MEZ), or value 4, Hostile MEZ. An exercise MEZ is one which is being reported for exercise purposes only, i.e., the IU, track, or point to which the MEZ is related may not be able to actually engage targets in that MEZ, nor is it necessary to remain clear of the exercise MEZ for actual operational purposes. For all other values of the Point Type and Point Amplification fields in the J3.0 message the Exercise Indicator field shall be set to value 0.

4.4.3.11 PERIODIC REPORT INDICATOR FOR POINTS

When a JU transmits a J3.0 or J3.5 (PTI = 0) original message or a retransmission due to data change, the Periodic Report Indicator (PER IND) shall be set to value 1. Periodic updates following the original or retransmitted message shall be transmitted with the Periodic Report Indicator set to value 2 thereby providing each JU with the option to process the periodic updates of points. Responses to Data Update Requests for multi-point areas or multi-segmented lines (defined by more than one J3.0 message) shall be transmitted with the PER IND set to value 0 and the Response Indicator set to value 1. A change of positional information for a point, line, or area with independent course and speed does not, in itself, constitute a change of data for the purpose of setting the Periodic Report Indicator to value 1.

4.4.4 AIR, SURFACE (MARITIME), AND LAND (GROUND) TRACK SURVEILLANCE

The rules and conventions applicable to reporting Air, Surface (Maritime), and Land (Ground) surveillance information are based upon the requirements for exchanging these data among JUs. Since the requirements are similar for Air, Surface (Maritime), and Land (Ground) surveillance reporting, these subfunctions are discussed within this subsection. Specific differences, when applicable, are included in the appropriate paragraphs.

The specific messages used to report Air, Surface (Maritime), and Land (Ground) surveillance data are the J3.2, J3.3, and J3.5 (PTI = 1) messages, respectively. These messages are monitored by nonC^2 JUs, such as fighter aircraft, for situational awareness and early warning information.

Discussed in this subsection are the various requirements associated with Air, Surface (Maritime), and Land (Ground) surveillance data exchange. The topics covered are:

a. Track Reporting Criteria.

b. Track Reporting.

c. Track Correlation.

d. Positional Data.

e. Velocity.

f. Identity/Identity Confidence/Strength.

g. Transponder Data.

h. Track Quality.

i. Nonreal-time Reports.

j. Reporting Inactive Sites as Air and Surface (Maritime) Tracks and Land (Ground) Track Data.

k. Reporting Responsibility.

l. Information Difference Recognition and Resolution.

m. Termination of Air, Surface (Maritime), and Land (Ground) Track Data.

4.4.4.1 TRACK REPORTING CRITERIA

Track reporting criteria are based on the requirements for the exchange of surveillance information and data usable in providing threat warning information among systems involved in joint operations. The reporting of surveillance track information on the interface shall insure that:

a. The information on the track is as complete, accurate, and timely as possible.

b. Data are correlated and dual designation is minimized.

c. The proper rules for reporting a track are followed.

4.4.4.2 TRACK REPORTING

Track reporting requires a set of rules which are general in nature and which may be adapted to a specific interface configuration to provide an optimum exchange of data. The rules are:

a. The source of track data shall be provided (Source TN).

b. C^2 JUs that have the capability to automatically initiate tracks for release to the interface without operator action shall also have the capability to deactivate this automatic capability.

c. A JU reporting a real-time track shall report the position of the track extrapolated to the time of transmission.

d. Nonreal-time data shall be identified as such and time tags shall be provided. Nonreal-time track positions shall not be extrapolated.

Procedures for reporting J3.2, J3.3, and J3.5 (PTI = 1) messages are provided in the following paragraphs. Section 5 provides the detailed message transmission rules.

4.4.4.3 COMMON TRACKING

a. Common tracking is defined as sharing of a common track number and shifting R^2 between C^2 JUs. Each air, surface (maritime), land (ground), and space tracked object normally will be reported by one C^2 JU while other C^2 JUs withhold their reports to prevent cluttering the tactical plot. Determination of the C^2 JU responsible for reporting the tracked object shall be in accordance with the procedures in the Air, Surface, Land, and Space Surveillance sections. In this section and in section 4.7.3, Resolution of Air and Surface Track Dual Designations, a track for which positional data has been locally derived by a C^2 JU but is currently being reported by another C^2 JU is referred to as a "common local track", and a track for which positional data has been locally derived and is not currently being reported by another C^2 JU is referred to only as a "local track". In order for common tracking to function properly, all C^2 JUs shall perform correlation and decorrelation of their local track data with respect to the remote data which they are receiving. Failure to properly correlate can result in a dual designation. The protocols in this section are to be followed in order to minimize occurrences and duration of dual designations.

b. Each C^2 JU which has a capability to originate and report real-time air, surface (maritime), land (ground), or space tracks shall have a capability to perform common tracking in accordance with the correlation and decorrelation procedures and criteria which follow. The rules for correlation and decorrelation differ depending on the E/C of the tracks. The rules in paragraphs 4.4.4.3.1, 4.4.4.3.2, and 4.7.3 apply to the correlation and decorrelation of both air tracks and surface tracks, unless otherwise stated. The rules for correlation of land and space tracks are to be determined.

4.4.4.3.1 AIR AND SURFACE TRACK CORRELATION

The correlation process commences with comparing locally derived sensor data (position, velocity, and altitude) with the data received on the interface, in order to prevent or eliminate dual designations. All C^2 JUs that originate real-time air or surface tracks shall have an automatic correlation capability. The following subparagraphs apply to the correlation of any two air tracks and any two surface tracks unless otherwise specified.

a. Local Correlation. The method used for internal correlation of local sensor data is a system design option, irrespective of any of the rules herein.

b. New Local Tracks. New local tracks shall not be reported to the interface until an automatic correlation has been attempted and failed on an initial correlation test or on the next test following an initial tentative correlation (see paragraph 4.4.4.3.1h). If no tentative correlation is found on the initial test, the new local track shall be transmitted. If the new local track tentatively correlates on the initial test but fails correlation on the next test, the new local track shall be transmitted. A new local track that correlates with another track on each of the first two correlation tests shall be correlated and held as a common local track. Thereafter, the decorrelation rules (see paragraph 4.4.4.3.2) apply to the track. Correlation tests shall include active IUs, remote real-time tracks, and other local tracks. If an operator action has been taken which selectively released a new local track for reporting, it shall be transmitted, regardless of the results of correlation testing.

c. Automatic Correlation.

(1) C^2 JUs shall make an automatic correlation test either:

(a) Upon receipt of each remote real-time J3.2 or J3.3 track or J2.0 (Originator E/C = 0 or 3), J2.2, or J2.3 PPLI report which is not confirmed to have an existing correlation to a local track. Such tests shall compare the received remote track or IU to local tracks of the same E/C, including previously common local tracks for which own unit has R^2.

---OR---

(b) Immediately prior to each transmission of a local track. Such tests shall compare the local track to remote tracks and IUs of the same E/C.

(2) As a system option, common local tracks may be included in the above tests. If a correlation of a common local track to another remote

TN is determined, it shall be reported in a J7.2 message in accordance with paragraph 4.7.3.1.

d. Manual Correlation. A manual capability shall be provided to initiate the correlation of any two tracks irrespective of the correlation test criteria in paragraph 4.4.4.3.1f, the correlation restrictions in paragraph 4.4.4.3.1g, or the requirements in paragraph 4.4.4.3.1h, except that two tracks shall not be manually correlated if they are of a different E/C, or one is simulated and the other is live, or both are remote.

e. Response to Correlation Request. C^2 JUs shall perform correlation tests in response to correlation requests from other units in accordance with the requirements of paragraph 4.7.3.2.

f. Correlation Tests. Correlation testing shall consist of the position, velocity, and altitude tests specified in this paragraph. These tests are summarized in Table 4.4-1 and specified in detail in the remainder of this paragraph. Positions of all tracks and IUs tested for correlation shall be extrapolated to the same time. The correlation test shall occur no more than 6 seconds after the extrapolation time. A local track shall be considered to correlate to the closest remote track or IU that meets all of the correlation tests, subject to the correlation restrictions in paragraph 4.4.4.3.1g and the requirement to pass two correlation tests in paragraph 4.4.4.3.1h.

Table 4.4-1. Summary of Correlation Tests

Positional Test
$D \le [a*SQRT(L^2+R^2)+b]$dm, where: D = Distance in dm between two tracks; a = "window size multiplier" parameter; $L = MIN([MAX(E(TQ_L),E(d))],E(c))$; $R = MIN([MAX(E(TQ_R),E(d))],E(c))$; $E(TQ_L)$ = positional error associated with local track quality TQ_L, from Table 4.4-2; $E(TQ_R)$ = positional error associated with remote track quality TQ_R, from Table 4.4-2, or remote geodetic position quality Q_{pg} from Table 4.4-4; E(c) = positional error associated with TQ = c, "MIN TQ" parameter, from Table 4.4-2, or Q_{pg} = j, "MIN Q_{pg}" parameter, from Table 4.4-4; E(d) = positional error associated with TQ = d, "MAX TQ" parameter, from Table 4.4-2, or Q_{pg} = k, "MAX Q_{pg}" parameter, from Table 4.4-4; b = "minimum window size" parameter.
Course Test
If both tracks have speed ≥ 10 dmh: $MIN(\|C_R-C_L\|, 360-\|C_R-C_L\|) \le f$, where: C_L = local course in degrees; C_R = remote course in degrees; f = "course differential" parameter; Otherwise course is not used in the correlation test.
Speed Test
$\|1-S_S/S_F\|$ X 100% ≤ $MAX(g,[g(k/S_F)])$, where: S_S = speed of slower track in dmh; S_F = speed of faster track in dmh; g = "speed differential" parameter; k = alternate speed test factor: = 200 dmh for air tracks; = 20 dmh for surface tracks.
Altitude Test
For air tracks, if both tracks have an Altitude Source = 1 or 3, or if the local track Altitude Source is 1 or 3 and the remote track is an IU reported in a PPLI message: $\|A_R-A_L\| \le h$, where: A_L = local altitude in kft; A_R = remote altitude in kft; h = "altitude differential" parameter; Otherwise altitude is not used in the correlation test.

(1) Correlation Test Prohibitions: The following shall not be tested for correlation:

(a) A track with TQ ≤ e (see paragraph 4.4.4.3.1f(2)), or a JU with Q_{pg} = 0 (see paragraph 4.4.4.3.1f(8)(b)). This prohibition does not apply to new local real-time tracks, but does apply to nonreal-time (TQ=0) tracks.

(b) Tracks of different E/C, and tracks with existing E/C conflicts.

(c) Simulated tracks with live tracks, and live tracks with simulated tracks.

(2) Variable Parameters: Variable parameters are used to specify the default, range, and increments of values to be used in correlation tests. They are expressed in the form "default (range, increment)". The intent is to enable rapid change of the standard correlation tests as experience and conditions dictate. It is anticipated that the parameters to be used will be specified in the OPTASK LINK. Systems shall be capable of using any value within the specified range and increments upon system initialization, and shall set the parameter to the default value if no other value is specified. The default values are the same for air and surface track correlation. However, the actual value to be used for air tracks may be specified differently than that used for surface tracks. The variable correlation parameters are defined as follows:

a = 1.0(0.5-3.0, 0.1)	"Window size multiplier". Allows increasing or decreasing the standard TQ-based window sizes to be used by all IUs in an interface.
b = 0.5(0-2.0, .25) dm	"Minimum window size". A value applied to all calculated windows to insure that windows are not so small as to prevent valid correlations, e.g., due to minor errors introduced by extrapolation.

c = 7(3-7, 1)	"Min TQ". The minimum TQ to be used in positional correlation calculations. Lower TQs shall be treated as if they were c. This prevents correlation windows from being unrealistically large. Note: The value used for c can never be less than or equal to the value used for e.
d = 10(8-15, 1)	"Max TQ". The maximum TQ to be used in positional correlation calculations. Higher TQs shall be treated as if they were d. This prevents correlation windows from being unrealistically small.
e = 4(2-6, 1)	"Restricted TQ". Tracks with TQ less than or equal to e are not eligible for correlation, except for new local real-time tracks (see paragraphs 4.4.4.3.1f(1)(a) and 4.4.4.3.1f(4)).
f = 45(15-90, 15) degrees:	"Course Differential". The maximum difference between the reported course of the remote track and the calculated course of the local track allowable for correlation. If the speed of either track is less than 10 dmh, "course differential" shall not be applied in the correlation test.
g = 40(10-100, 10) percent	"Speed Differential". The maximum percentage by which the speed of the faster track may differ from the speed of the slower track for correlation.
h = 10(5-50, 5) thousand feet (kft)	"Altitude Differential". The maximum altitude difference between two air tracks allowable for correlation. (Not applicable to surface track correlation.)
j = 2(1-5, 1)	"Min Q_{pg}". The minimum value of Q_{pg} to be used in positional correlation calculations. Lower values shall be treated as if they were j. This prevents correlation windows used in testing correlation of PPLI positions from being unrealistically large.
k = 11(1-15, 1)	"Max Q_{pg}". The maximum value of Q_{pg} to be used in positional correlation calculations. Higher values shall be treated as if they were k. This prevents correlation windows used in testing correlation of PPLI positions from being unrealistically small.

(3) Position Test: Two tracks shall be eligible for correlation, subject to the other tests, prohibitions, and limitations of this paragraph, if they pass the following positional test:

$D \leq [a*SQRT(L^2 + R^2) + b]$ dm, where

D is the distance (in dm) between the tracks;

a = "window size multiplier" parameter;

b = "minimum window size" parameter;

L = Positional error associated with the TQ of the local track (restricted by Min TQ and Max TQ); and,

R = Positional error associated with the TQ of the remote track (restricted by Min TQ and Max TQ).

L and R are derived from the formula for the area of a circle, $A = \Pi r^2$, with L and R equating to r, the radius of the circle. Thus, L (or R) = SQRT(A/Π), where A is the circular area in dm^2 within which it is assessed that there is a 95% probability that the track lies, as defined by Track Quality [DFI 280 DUI 001] for the local (or remote) TQ. Table 4.4-2 specifies the values of L and R for each TQ.

Table 4.4-2. Positional Errors Represented by TQ

TQ	L, R
15	0.003 dm
14	0.006 dm
13	0.01 dm
12	0.02 dm
11	0.05 dm
10	0.10 dm
9	0.59 dm
8	1.18 dm
7	2.93 dm
6	5.92 dm
5	8.87 dm
4	11.82 dm
3	14.78 dm
2	29.61 dm

(4) TQ Limitations: Tracks with TQ less than or equal to the restricted TQ value e shall not be automatically correlated, since their positional accuracy is not sufficient to support valid correlation decisions. Furthermore, the range of TQs used in determining correlation windows may be

limited, since use of lower TQs could result in excessively large windows, and use of higher TQs could result in unrealistically small windows. Therefore, TQs less than c shall be treated the same as TQ c, and TQs greater than d shall be treated the same as d, for purposes of calculating D, the correlation window.

(5) Default Correlation Windows: For the default values of Min TQ = 7, Max TQ = 10, minimum window size = 0.5 dm, and restricted TQ = 4, the values of L and R in Table 4.4-2 result in the correlation windows shown in Table 4.4-3.

Table 4.4-3. Correlation Windows (Value of D in dm) for Default Parameter Values

		Remote TQ			
		≥10	9	8	5-7
Local TQ	≥10	0.64	1.10	1.68	3.43
	9	1.10	1.33	1.82	3.49
	8	1.68	1.82	2.17	3.66
	5-7	3.43	3.49	3.66	4.64

(6) Velocity Test: The reported course of the remote track shall be within f degrees of the calculated course of the local track. The speed of the slower track shall be within g percent of the speed of the faster track, or within $g*200/S_F$ percent for air tracks or $g*20/S_F$ percent for surface tracks, whichever is greater. Velocity comparisons shall use the last reported course and speed of remote tracks and the course and speed calculated for local tracks at the common time to which the tracks are extrapolated at the time of comparison.

(7) Altitude Test: If the Altitude Source of both air tracks is either 1 (Sensor) or 3 (Aircraft Automatic Altitude Report), or if the local track Altitude Source is 1 or 3 and the remote track is an IU reported in a PPLI message, the altitude differential between the two tracks shall not be greater than h. If the Altitude Source of either track is 0 (No Statement/Estimated) or 2 (Aircraft Report), Altitude shall not be used in the correlation test.

(8) PPLI Tests:

(a) When the remote report being tested for correlation is a J2.2 Air or J2.3 Surface PPLI message, the maximum positional error associated with the reported Geodetic Position Quality (Q_{pg}) shall be used for the value of R in the position test. Q_{pg} less than j shall be treated as Q_{pg} = j, and Q_{pg} greater than k shall be treated as Q_{pg} = k. The values of R for JUs are shown in Table 4.4-4, and the resultant correlation windows for the default Max Q_{pg} value 11 and the default Min Q_{pg} value 2 are shown in Table 4.4-5. (The positional errors associated with each Q_{pg} specified in the Data Element Dictionary are calculated by the JTIDS/MIDS terminal at the .39 level of probability. They have been converted to the .95 level of probability in the tables below, for consistency with the requirements for correlation and TQ calculation.)

Table 4.4-4. Values of R for PPLI

Q_{pg}	R
15	0.02 dm
14	0.03 dm
13	0.04 dm
12	0.06 dm
11	0.08 dm
10	0.12 dm
9	0.16 dm
8	0.23 dm
7	0.33 dm
6	0.46 dm
5	0.65 dm
4	0.92 dm
3	1.85 dm
2	3.69 dm
1	7.38 dm

Table 4.4-5. Correlation Windows (Value of D in dm)
when Remote Track is a JU for Default Parameter Values

		Remote PPLI Q_{pg}									
		≥11	10	9	8	7	6	5	4	3	2
Local TQ	≥10	0.63	0.66	0.69	0.75	0.84	0.97	1.16	1.43	2.35	4.13
	9	1.10	1.10	1.11	1.13	1.18	1.25	1.38	1.59	2.44	4.18
	8	1.68	1.69	1.69	1.70	1.73	1.77	1.85	2.00	2.69	4.32
	5-7	3.43	3.43	3.43	3.44	3.45	3.47	3.50	3.57	3.97	5.16

(b) If the received J2.2 or J2.3 Q_{pg} = 0, the PPLI shall not be correlated automatically. However, if a J2.2 or J2.3 with Q_{pg} = 0 is received for a JU held as a common local track, R^2 for the common local track may be assumed in accordance with paragraph 4.4.2.2.2d.

(c) When the remote report being tested for correlation is a J2.0 Indirect PPLI message with the Originator E/C field set to value 0 (Surface) or 3 (Air), it shall be processed for correlation like a J3.2 air or J3.3 surface (maritime) track with TQ = 7.

g. Correlation Restrictions. C^2 JUs shall not automatically correlate two tracks if local/remote data held indicates any of the following conditions exist. The restrictions do not apply to manual correlation. No other correlation restrictions shall be applied for two tracks which pass the correlation tests specified in paragraph 4.4.4.3.1f.

(1) The two tracks have an Identity (ID) difference which constitutes a conflict (see paragraph 4.4.4.3.1i). Systems shall have an initialization parameter and an operator selectable capability to inhibit this automatic restriction. (Use of this capability will be subject to interface coordination and must be promulgated to all C^2 IUs. If the use of this capability changes, all participating C^2 IUs will be informed through voice communication or other communications media. In lieu of specific interface direction, all IUs will restrict automatic correlation by default.)

(2) The two tracks have different Mode II codes, and the local Mode II code is current. Systems shall have an initialization parameter and an operator selectable capability to inhibit this automatic restriction. (Use of this capability will be subject to interface coordination and must be promulgated to all C^2 IUs. If the use of this capability changes, all participating C^2 IUs will be informed through voice communication or other communications media. In lieu of specific interface direction, all IUs will restrict automatic correlation by default.)

(3) Both tracks are locally derived real-time tracks, i.e., being updated with local positional data.

(4) Either track has the Strength field set to a value greater than 1. Systems shall not inhibit correlation if either track has Strength set to No Statement.

(5) One track is a common local track and the other is a remote, and the same unit has R^2 for both tracks.

(6) Either track is currently the subject of a dual designation resolution action involving another TN.

(7) Each track is subject to one or more (not necessarily the same) of the below operational contingency constraints (OCC).

(a) The TN is the subject of a current engagement status message; i.e., the TN is the same TN appearing in a J10.2 Engagement Status message Target TN or Reference TN field.

(b) The TN is the subject of a pending J9.0 Command message originated by or addressed to own unit or a J12.0 Mission Assignment message originated by own unit for which a reply is required and has not been transmitted or received.

(c) The TN is currently a controlled track, i.e., a J10.5 Controlling Unit Report message has been transmitted or received.

(d) The TN is an active or inactive IU.

(8) JUs may apply one exception to the restriction in paragraphs 4.4.4.3.1g(1) and 4.4.4.3.1g(7)(a) above. If either subject track is the Target TN in a J10.2 Engagement Status message originated by the unit attempting correlation, and that track has an ID of Unknown or Hostile, and the other subject track has an ID of Friend, then automatic correlation may be allowed. The Unknown/Hostile track shall be the dropped Track Number (TN-2). This exception allows breaking the engagement and/or destroying missile(s) in flight. This exception shall not be applied by any JU upon receipt of a J7.2 Correlation message. Thus, any JU receiving a J7.2 Correlation message and also holding OCCs on both tracks or conflicting IDs on the two tracks (if the ID conflict correlation restriction is enabled (see paragraph 4.4.4.3.1g(1)) shall reject the correlation in accordance with paragraph 4.7.3.2a(1).

h. Number of Correlation Tests. Two tracks shall pass the correlation tests and restrictions in paragraphs 4.4.4.3.1f and 4.4.4.3.1g 2(1-2,1) times before the correlation is executed. When two tracks pass the correlation tests and restrictions once, they shall be deemed a tentative correlation. The same two tracks shall be tested again upon the next correlation stimulus (see paragraph 4.4.4.3.1c). If the two tracks successfully pass the second correlation test and there is no correlation restriction, they shall be processed for dual designation resolution in accordance with paragraphs 4.4.4.3.1j and k.

i. Correlation of Tracks With Conflicting IDs.

(1) Two tracks shall be considered to have conflicting IDs for correlation processing if:

(a) The ID difference is indicated by the code "1" in Table 4.7-2.

(b) The ID difference is indicated by the code "1*" in Table 4.7-2 and the system processes these differences as conflicts, except that Hostile vs. Pending shall not be considered a conflict for correlation processing.

(c) One track has the Exercise Indicator set to value 0 and the other has it set to value 1.

(2) If conflicting IDs is the only correlation restriction, the operator shall be alerted. The purpose of this alert is to cue the operator to take one of the following actions:

(a) Change the local ID or the Exercise Indicator and ID, thereby allowing automatic correlation, or

(b) Transmit an ID Difference Report, thereby allowing automatic correlation if the remote ID or Exercise Indicator and ID is changed, or

(c) Confirm the restriction, thereby inhibiting the correlation, or

(d) Conduct voice coordination to resolve the situation.

(3) If the above actions result in resolution of the ID conflict, the TN to be retained shall be tested for decorrelation in accordance with paragraph 4.4.4.3.2a before executing the correlation, except the test shall be conducted only once.

j. Dropped Track Number Selection. C^2 JUs shall not automatically select as the TN to be dropped a TN which has any of the OCCs listed in paragraph 4.4.4.3.1g(6 7). In the absence of such a selection constraint, JUs shall select the higher TN as the TN to be dropped. For a track that has both a TN greater than 07777 and a TN less than 07777, as reported in a J7.4 message, the track with TN greater than 07777 shall be used in this comparison.

k. Execution of the Correlation. The following rules apply to the disposition of the Dropped TN and the retention of data from the Dropped TN upon origination or receipt of a J7.0 (ACT = 0) message for the Dropped TN. The correlation shall be deemed to have failed if no J7.0 (ACT = 0) is received for the dropped TN after a period of 60 seconds from the transmission of the correlation request and all associated processing for the correlation shall be cancelled.

(1) Disposition of the Dropped Track Number:

(a) If own unit holds the Dropped TN as a local or common local track, the Retained TN shall be designated as a common local track.

(b) If own unit has R^2 for the Dropped TN, a J7.0 (ACT = 0) Drop Track message shall be transmitted for the Dropped TN. If the Dropped TN is reported by another IU after transmission of the J7.0, own unit shall retain the Dropped TN as a remote track and shall not reattempt to correlate the Retained TN and the Dropped TN for a period of 60 seconds after transmission of the J7.0.

(c) When a J7.2 message is initiated by own unit and a Drop Track message has not yet been received for the Dropped TN, it shall be retained as a remote track.

(2) Dropped TN Data Retention: Data specified below shall be transferred from the Dropped TN to the Retained TN when the correlation is executed. No other Dropped TN data shall be transferred to the Retained TN. It is expected that normal reporting protocols will result in the establishment of the appropriate data for the Retained TN.

(a) Kinematic Data. If the Dropped TN is a local or common local track, the Dropped TN Latitude, Longitude, Course, Speed, Altitude, Altitude Source, TQ, and Strength shall be transferred to the Retained TN.

(b) Identification Data. Retention of identification data is dependent upon whether the ID conflict correlation restriction is inhibited (see paragraph 4.4.4.3.1g(1)):

1 Restriction Not Inhibited: If the Identity (ID) (or Identity Amplifying Descriptor (IAD) of two exercise tracks) of retained TN and Dropped TN are different and the difference would result in automatic acceptance of the Dropped TN ID/IAD in accordance with Table 4.7-2, the Dropped TN ID/IAD and Special Interest Indicator, Platform, Platform Activity, and Specific Type shall be transferred to Retained TN.

2 Restriction Inhibited: When the Identity of Retained TN and Dropped TN are the same, associated identification data (Platform, Platform Activity, Specific Type, Exercise Indicator, and Special Interest Indicator) reported for the Retained TN shall be retained. When the Identity of Retained TN and Dropped TN are different, the last Identity reported for Dropped TN shall be considered equivalent to a J7.0 (ACT = 1) Identity Difference Report for the Retained TN. It shall be processed in accordance with paragraph 4.7.1.2.2 immediately after the correlation is executed.

(c) IFF/SIF Data. Any Dropped TN nonzero Mode I, II, or III IFF/SIF data for a mode for which the Retained TN data is zero shall be transferred to the Retained TN. If the Dropped TN Mode IV data is a higher value than the Retained TN Mode IV data, it shall be transferred to the Retained TN.

(d) Force Tell and Emergency Indicators. If the Dropped TN had the Force Tell Indicator set to value 1, the Retained TN shall have the Force Tell Indicator set to value 1. If the Dropped TN had the Emergency Indicator set to value 1, the Retained TN shall have the Emergency Indicator set to value 1.

4.4.4.3.2 AIR AND SURFACE TRACK DECORRELATION

The following subparagraphs apply to the decorrelation of any two air tracks or any two surface tracks.

a. Decorrelation Requirements. All C^2 JUs that initiate real-time air or surface tracks shall have an automatic decorrelation capability. C^2 JUs may also perform manual decorrelation, and may have a capability to require manual confirmation of automatic decorrelations. Implementation of automatic and manual functions shall adhere to the following requirements:

(1) Automatic decorrelation tests shall be performed for each common local track upon receipt of each J2 or J3 message on the track.

(2) Common local tracks shall be decorrelated if, on receipt of 2(1-5, 1) consecutive remote track reports, the remote track falls outside a distance of 1.5(1.0-2.0, 0.1) times the maximum correlation distance calculated in accordance with paragraph 4.4.4.3.1f(3).

b. Execution of the Decorrelation. After it has been determined that a common local track (TN A) satisfies the criteria of an automatic or manual decorrelation, the decorrelation shall be executed as follows:

(1) The local track shall be automatically tested once for correlation against remote tracks (not common local tracks) in accordance with paragraphs 4.4.4.3.1f and g. If the automatic correlation test fails, assign a new TN (TN B) to the local track and report TN B in a J3.2 or J3.3

message, with an initial ID of Pending. For manual decorrelation the Pending ID may be overridden by operator action.

(2) Establish TN A as a remote track.

c. Decorrelation Considerations. If local or remote data held indicates one of the following conditions exist, action shall be taken as indicated:

(1) TN A is the Target TN of a J10.2 Engagement Status message for a current engagement reported and conducted by own unit, or is the Reference TN or Target TN of a J10.2 message for a current engagement reported by own unit and conducted by another unit. Decorrelate and alert an operator as a cue to transmit the J10.2 message with the Weapon Engagement Status field set to value 8 (Engagement Broken) if appropriate. Another J10.2 message with the new TN shall be transmitted only if initiated by operator action, by a WILCO response to a J12.0 Mission Assignment against TN B, or by receipt of a J12.6 Target Sorting message reporting an engagement against TN B.

(2) TN A is the subject of a pending J9.0 Command message which own unit originated or to which own unit is preparing a reply. Execute the decorrelation and provide operator display of new track status on TNs A and B before release of the J9.0 reply. The reply shall be relative to TN A only.

(3) TN A is controlled by own unit; i.e., is the subject of own unit reported J10.5 Controlling Unit Report message. Do not automatically decorrelate. If manually decorrelated, alert the operator as a cue to report termination of control TN A if appropriate. Report commencement of control of TN B using the J10.5 message only if initiated by operator action. If the controlled track is a nonC^2 JU, then decorrelate and continue reporting control of TN A.

(4) TN A has been paired by own unit; i.e., is the subject of own unit originated J10.6 message. Decorrelate and alert an operator as a cue to terminate the pairing on TN A and initiate the pairing on TN B if appropriate.

(5) TN A has been correlated with an Index Number by own unit, i.e., is the subject of own unit originated J12.5 message. Assess whether the Index Number should remain with TN A or B, and transmit J12.5 messages as appropriate.

(6) TN A is the subject of a handover which is in progress; i.e., a TN in a J10.3 Handover message. The decorrelation shall be delayed until the handover process is completed or terminated, then the decorrelation shall be executed and an operator alerted as a cue to report control in the J10.5 Controlling Unit Report message as appropriate. Operator display of the pending decorrelation shall be provided.

4.4.4.4 POSITIONAL DATA

The geodetic latitude and longitude for each Air, Surface (Maritime), and Land (Ground) track shall be reported in the respective Air, Surface (Maritime), and Land (Ground) Point/Track messages. In addition, Air surveillance reporting shall include Altitude and Altitude Source when available.

4.4.4.5 VARIANCE AND TIME STAMP ON NEEDLINE PGs

The J12.6C7 Kinematic Data 1 continuation word is used by nonC^2 JUs on Needline PGs to report kinematics estimated errors on the track when it is necessary to have more accurate data than the target position quality indicator.

4.4.4.5.1 VARIANCE EVALUATION ON NEEDLINE PGs

The estimation of error is needed independently on each measurement axis. For instance for a BEARING, ELEVATION, and DISTANCE independent measurement and estimation, the variance of error in bearing, elevation and distance is required. This is described with a diagonal covariance matrix of estimation error (three elements). Seeing that the transmitted track or target position is in geodetic reference axes it is logical to transmit the location error in the same coordinates. In that case the errors are no longer independent and the transmission of the cross terms of error is necessary too. This is described with a symmetric 3D matrix with 6 relevant data elements.

In what follows X = LATITUDE, Y = LONGITUDE, Z = ALTITUDE.
If Xe (or Ye, Ze) designates the estimated location, X (or Y, Z) the actual location and E the mathematical mean then:

Var XX = E $(Xe - X)^2$

Var YY = E $(Ye - Y)^2$

Var ZZ = E $(Ze - Z)^2$

Var XY = E (Xe - X) (Ye - Y)

Var XZ = E (Xe - X) (Ze - Z)

Var YZ = E (Ye - Y) (Ze - Z)

Those data are the results of common filters (Kalman, mean square filter, ...).

4.4.4.5.2 VARIANCE MATRIX

The variance matrix shall be used when accurate data on the track quality (or target position quality) is available in the transmitting center. The matrix elements which can not or are not computed by the transmitting center shall be set to NO STATEMENT. Each diagonal element can be set to a significant value or to NO STATEMENT independently of one another. It is useful to set the cross elements only if the diagonal elements are set (for instance Var XY shall be set only if Var XX and Var YY are set to a significant value).

Elements of the covariance matrix of error in estimated track or target location defined as follows:

$$\begin{bmatrix} \text{Var XX} & \text{Var YX} & \text{Var XZ} \\ \text{Var YX} & \text{Var YY} & \text{Var YZ} \\ \text{Var ZX} & \text{Var ZY} & \text{Var ZZ} \end{bmatrix}$$

4.4.4.5.3 TIME STAMP ON NEEDLINE PGs

The SECOND, HUNDREDTHS fields shall be used to specify the best estimated date of kinematics elements (LATITUDE, LONGITUDE, ALTITUDE, VELOCITY) transmitted in the J12.6I and J12.6E0 basic Words. In case the accuracy cannot be better than 500 ms, a NO STATEMENT shall be set in the HUNDREDTHS field. In case the accuracy cannot be better than a minute, a NO STATEMENT shall be set in the SECOND field.

4.4.4.6 VELOCITY

The velocity of Air, Surface (Maritime), and Land (Ground) tracks shall be reported as course and speed. The speed shall be reported in data miles per hour of ground speed. The course shall be reported in degrees with respect to true north.

4.4.4.7 IDENTITY DATA

Track identity as defined in paragraph 4.4.2.1 is exchanged. The platform and platform activity fields are defined in the message section of this volume.

For each of the Platform, Platform Activity, Specific Type, and Special Interest Indicator fields which are implemented by a C^2 JU, the JU shall accept all defined field values for retransmission and operator appreciation, in the event of assuming R^2 for a previously-reported track. This requirement is independent of the actual values implemented by the C^2 JU for transmission origination.

Values accepted for retransmission shall be retransmitted if the JU assumes R^2, unless the JU holds locally derived data other than No Statement (non-NS) for the field which differs from the value accepted for retransmission. In the latter case, the JU shall report the locally derived data. As an exception, non-NS data for the Platform, Platform Activity, and Specific Type fields received from the controlling unit for the track shall be retransmitted regardless of locally derived data. If the Special Interest Indicator is set to value 1, it shall be retransmitted as value 1 by any JU assuming R^2.

4.4.4.8 STRENGTH

The strength of the reported Air, Surface (Maritime), or Land (Ground) track shall be exchanged to indicate the number of aircraft, ships, ground units, or objects comprising the reported track.

For Land (Ground) tracks, when the J3.5C3 word is implemented, the J3.5I word Strength field shall be computed from the Strength, Total Number of Vehicles field. The J3.5C3 Strength, Total Number of Vehicles; Strength, Percent of Tracked Vehicles (Vehicle Strength fields); and the J3.5I word Strength field are all transmitted. For reception, the J3.5C3 Vehicle Strength fields and the J3.5I word Strength field are received as sent. If the J3.5C3 word is not implemented, then only the J3.5I word Strength field is transmitted or received.

When the Strength field is computed from the Strength, Total Number of Vehicles field, the following translation shall be used:

Strength, Total Number of Vehicles	Strength
NS	NS
1 Vehicle	1 Unit
2 Vehicle	2 Units
3 Vehicle	3 Units
4 - 5 Vehicles	5 Units
6 - 7 Vehicles	7 Units
8 - 10 Vehicles	10 Units
11 - 15 Vehicles through Greater Than 200 Vehicles	Greater Than 12 Units

4.4.4.9 IFF/SIF DATA EXCHANGE

The exchange of IFF/SIF modes and codes consists of five functional areas:

a. IFF/SIF Surveillance Data Reporting (this paragraph).

b. Unique Mode II Code Protection (paragraph 4.7.6.1).

c. Clearing IFF/SIF Data (paragraph 4.7.6.2).

d. IFF/SIF Difference Resolution (paragraph 4.7.6.3).

e. IFF/SIF Update Request (paragraph 4.7.6.4).

Each of the functional areas are described in the paragraphs indicated above. The J2.XC1, J3.XC1, and J7.5 messages are used for this purpose as summarized in Table 4.4-6.

TABLE 4.4-6. IFF/SIF Message/Function Summary

MESSAGE / FUNCTION	SURVEILLANCE DATA REPORTING	DIFFERENCE RESOLUTION	DATA UPDATING	CLEARING IFF/SIF DATA
PPLI J2.0C1, J2.2C1 J2.3C1, J2.4C1 IUs OWN UNIT IFF/SIF DATA	TRANSMITTED PERIODICALLY WITH J2.XB MESSAGE	NA	NA	NA
J3.XC1 TRANSMITTED ONLY BY JU WITH R^2	TRANSMITTED AT NEXT OPPORTUNITY FOR NEW TRACKS WHEN ASSUMING R^2 OR WHEN DATA CHANGE. PERIODICALLY - AT 1/8 THE BASIC MESSAGE RATE FOR REALTIME TRACKS AND WITH EACH NRT TRACK REPORT	TRANSMITTED AT NEXT OPPORTUNITY AFTER ACCEPTING OR REJECTING REMOTE DATA RECEIVED IN J7.5 (ACT = 1) MESSAGE.	TRANSMITTED AT NEXT OPPORTUNITY IN RESPONSE TO J7.1 (ACT = 1) DATA UPDATE REQUEST AND TO A J7.5 (ACT = 2) IFF/SIF UPDATE REQUEST.	NA
J7.5 (ACT = 0) CLEAR IFF/SIF TRANSMITTED BY ANY JU	NA	NA	NA	INITIATED BY OPERATOR ACTION
J7.5 (ACT = 1) DIFFERENCE REPORT TRANSMITTED ONLY BY NONR^2 JUs	WHEN LOCALLY ENTERED DATA CHANGES FROM ZERO TO NONZERO OR NONZERO TO ANOTHER NONZERO VALUE. IN RESPONSE TO A J3.XC1 "NO DATA" REPORT ON ONE OR MORE MODE/CODE WHEN LOCAL NONZERO IFF/SIF IS HELD.	TRANSMITTED TO REPORT A DIFFERENCE IN ACCORDANCE WITH TABLE 4.7-5 IFF/SIF, DIFFERENCE RESOLUTION MATRIX. MAY BE INITIATED BY OPERATOR ACTION ANYTIME.	TRANSMITTED IN RESPONSE TO RECEIVED J7.5 (ACT = 2) FROM THE R^2 JU.	NA
J7.5 (ACT = 2) IFF/SIF UPDATE REQUEST TRANSMITTED BY ANY JU	NA	NA	INITIATED BY OPERATOR ACTION	NA

4.4.4.9.1 IFF/SIF SURVEILLANCE DATA REPORTING

The reporting of IFF/SIF surveillance data in the J3.2C1 and J3.3C1 words for Air and Surface tracks, respectively, is the responsibility of the JU with R^2 while all other JUs without R^2 are responsible for monitoring such data and only reporting if they hold different data with the J7.5 message. In this way the JU with R^2 can be assumed to be reporting the most current data available in the interface. Surveillance reporting rules are as follows:

a. R^2 units shall report all IFF/SIF valid data locally held for that track in accordance with the transmit rules for the J3 messages. Validity of codes for established tracks will be determined as either "Valid Data" or "No Data" using the following criteria:

(1) No Data: No valid code is currently held for the subject local or remote track/mode. (This condition is reported as zeroes in the applicable Mode Code field of the J3 continuation word.)

(2) Valid Data: Valid code responses are those codes which have been received from own sensors on two or more successive interrogations for Modes I, II, and III with the same value, one interrogation for Mode IV, manually entered codes, or codes accepted in accordance with the IFF/SIF Difference Resolution Matrix, Table 4.7-5. This condition will be reported by entering the nonzero code in the applicable Mode Code field of the J3 continuation word.

b. Any change in the IFF/SIF code values from a No Data status to Valid Data or changes from Valid Data to other Valid Data will be reported as occurring. Changes from a Valid Data value to a No Data status as a result of the clearing function (J7.5 (ACT = 0)) will not cause the transmission of a change report. Changes derived from both local and remote sources shall be considered for reporting in accordance with this rule.

c. Tracks with Valid Data which subsequently fail to respond to interrogations shall not be changed to the No Data status unless a Clear action is taken.

4.4.4.10 TRACK QUALITY

a. Track Quality is a measure of the reliability of the positional information of a reported Air, Surface (Maritime), or Land (Ground) track determined by the unit transmitting the track. It is a numerical value of 0 through 15 which is included in the J3.2, J3.3, and J3.5 (PTI = 1) messages. A value of 0 indicates a nonreal-time report and the values 1 through 15 indicate different degrees of reliability of the positional data, with 15 being the most reliable.

b. The reliability of the positional information is expressed in terms of the positional accuracy associated with each TQ value. The positional accuracy associated with each TQ value is defined as the area (dm^2) within which there is a 0.95 probability that the track is actually located at the time of the report.

c. TQ algorithms shall be designed to ensure that reported TQ accurately reflects the reporting unit's best estimate of positional accuracy, at the 0.95 level of probability, in conformance with the positional accuracy values associated with each TQ. TQ computations shall take the following factors into account, as a minimum:

(1) Design accuracy of the sensor which is tracking the reported track.

(2) Elapsed time since the last sensor update on the reported track.

(3) Most recently calculated velocity of the track.

(4) Own unit's current geodetic position quality as supplied by the JTIDS/MIDS terminal.

d. A JU shall not report a TQ value which has an associated positional accuracy better than the design accuracy of the JU'S tracking sensor and processing gain.

e. A JU shall not report a TQ value which has an associated positional accuracy which is better than that associated with own unit's current geodetic position quality.

f. A JU shall not artificially increase TQ between sensor inputs.

g. When reported on the Surveillance NPG by a C^2 JU, a TQ value as specified in Table 4.4-7 shall be initially assigned to a track not locally acquired but obtained via a J12.6 Target Sorting message from a nonC^2 JU. The C^2 JU shall extrapolate the received target's position to the time of transmission. If the C^2 JU has correlated local sensor data for the track, this paragraph need not be applied with regard to TQ.

Table 4.4-7. Target Position Quality (TPQ) to TQ Translation

TPQ	NOTES	TQ
0	No Statement	6
1	< or = 4.4 Square Data Miles	8
2	< or = 1.10 Square Data Miles	9
3	< or = 0.0281 Square Data miles	10

4.4.4.11 VARIANCES AND COVARIANCES

Following transformations are elaborated for track or target data issuing from needline PGs.

4.4.4.11.1 TRANSFORMATION OF VARIANCES AND COVARIANCES TO TPQ

a. If S is the area within which there is a 95% probability that a target is actually located at time of report, we get the following relationship between S and variances/covariances:

$$S = -2.\pi.\ln(0.05)\ k\ (\text{var XX} + \text{var YY})/(1+k^2)$$
$$S \cong 18.8227\ k\ (\text{var XX} + \text{var YY})/(1+k^2)$$

with $k^2 = (\text{var XX} + \text{var YY} + \sqrt{\Delta})/(\text{var XX} + \text{var YY} - \sqrt{\Delta})$
and $\Delta = (\text{var XX} - \text{var YY})^2 + 4\ \text{cov}^2\ (X, Y)$

b. The relationship between S and TPQ is the following:

S (sdm)	S (km^2)	TPQ
> 4.4	> 14.7	0
∈]1.1, 4.4]	∈]3.7, 14.7]	1
∈]0.0281, 1.1]	∈]0.094, 3.7]	2
< or = 0.0281	< or = 0.094]	3

4.4.4.11.2 TRANSFORMATION OF TPQ TO VARIANCES AND COVARIANCES

The variance matrix in cartesian referential (x, y, z) is the following:

$$P = \begin{pmatrix} S/18.8227 & 0 & 0 \\ 0 & S/18.8227 & 0 \\ 0 & 0 & \text{var ZZ} \end{pmatrix}$$

where:

S is the maximal area within there is a 95% probability that a target is actually located at time of report and var ZZ takes into account source of altitude:

- var ZZ = 685.9 sdm ($2294*10^6$ m^2) if information about altitude is unknown,
- var ZZ = S/18.8227 if information about altitude is provided by a sensor.

4.4.4.12 VARIABLE TRACK QUALITY

A variable track quality (VTQ) function may be implemented by individual units to override normal TQ processing. If this function is implemented, the operator shall be able to manually enter a TQ value of 3 through 6 to be used as the maximum TQ reported by the unit while VTQ is activated. Once VTQ is activated, TQ values shall be calculated normally but any calculated value exceeding the entered value shall be reported as the entered value. Using the entered value as the maximum TQ value shall continue until VTQ is deactivated or a new value is entered. When VTQ is deactivated, normal TQ processing shall resume.

4.4.4.13 NONREAL-TIME REPORTS

A track report is identified as a nonreal-time report with the TQ field set to value 0 if any of the following conditions are true:

a. The track data originate from other than a TDS or JTIDS/MIDS equipped aircraft.

b. The track data have been relayed from another system by other than a real-time data link interface.

c. The track data have been derived from other than integrated sensors.

4.4.4.13.1 TIME

The time reported shall be the time the positional data reported on the interface are valid. This time shall be reported in the hour and minute fields of the J3 Amplification continuation word.

4.4.4.14 REPORTING RESPONSIBILITY

R^2 procedures for Air, Surface (Maritime), and Land (Ground) tracks are contained in this paragraph. These rules are designed to ensure that only the JU having the best positional data available is reporting the track on the interface. The R^2 rules are as follows:

a. The first JU to report the track has R^2 on that track.

b. A JU transmits a track report for an Air, Surface (Maritime) or Land (Ground) track only when it has R^2 for that track.

c. A JU assumes R^2 on a common track if its local TQ at the time of transmission exceeds the received TQ by 2 or more.

d. A JU assumes R^2 if it has local real-time data and nonreal-time data were received.

e. A JU assumes R^2 if it has not received a remote report on a locally held Air or Surface (Maritime) track for approximately 40 seconds, or on a locally held Land (Ground) track for approximately 120 seconds.

f. A JU receiving a J7.0 (ACT = 0) message on a locally held track shall assume R^2 at the next opportunity to transmit the track if local reporting eligibility remains and a remote report has not been received on that track. Immediately prior to assuming R^2 for an air or surface track after receipt of a Drop Track message, a JU shall test the track for correlation in accordance with paragraphs 4.4.4.3.1f and g, except the test shall be conducted only once.

g. A JU without R^2 for a nonreal-time track with the TQ field set to value 0 shall assume R^2 for that track when the track is locally updated by a new nonreal-time report. A JU reporting a nonreal-time track has R^2 regardless of the time value in the track report. The time value in the track report is not a criterion for an R^2 shift.

h. A JU receiving a J2 PPLI message (with the NPS Indicator set to Inactive, Conditional Radio Silence, or TDS Failure) from a JU that has R^2 of a locally held track, may assume R^2 at the next opportunity to transmit the track if local reporting eligibility remains and a remote report has not been received on that track.

i. A JU relinquishes R^2 for a real-time Air, Surface (Maritime) or Land (Ground) track upon reception of a remote track report in which remote TQ is greater than the local TQ, or upon reception of a remote track report for the track which contains a TQ equal to the local TQ from a JU whose STN is greater than the local STN.

j. A JU with R^2 on a track retains the responsibility until it is relinquished in accordance with the above rules or until the track is dropped.

4.4.4.15 INFORMATION DIFFERENCE RECOGNITION AND RESOLUTION

The exchange of Air, Surface (Maritime), and Land (Ground) surveillance information on the interface requires procedures to recognize and resolve detected information differences between local data and data being reported on the interface. Detection and resolution of Identity, Special Interest Indicator, Exercise Indicator, Platform, Platform Activity, Environment/ Category, IFF/SIF, and Strength differences are resolved by transmitting the appropriate J7 message. The specific procedures applicable to the resolution of those differences are discussed in paragraph 4.7, Information Management.

4.4.4.15.1 SURVEILLANCE DATA DIFFERENCE (POSITION/VELOCITY/ALTITUDE OR ELEVATION)

Differences in position, velocity, or altitude/elevation recognized by a JU are not resolved through conflict processing and shall not generate a J7.0 (ACT = 2) message. However, differences in these elements may cause a JU to assume that one TN represents two different tracks or different TNs are being used to report the same track. (Refer to Resolution of Duplicate Track Number, paragraph 4.1.3.7.)

4.4.4.16 TERMINATION OF AIR, SURFACE (MARITIME), AND LAND (GROUND) TRACK DATA

The following subparagraphs describe the termination of Air, Surface (Maritime), and Land (Ground) tracks.

4.4.4.16.1 TRANSMISSION OF THE DROP TRACK REPORT MESSAGE

The J7.0 (ACT = 0) message is transmitted when a JU ceases reporting a track for which it currently has R^2, except in the following cases:

a. When a JU ceases reporting a track because it has relinquished R^2 to another JU.

b. When that track becomes an Active IU on the network with the same TN.

4.4.4.16.2 PURGING OF REMOTE TRACKS

There may be cases when a system does not receive a J7.0 (ACT = 0) message and receives no further updates on the remote track. Each system should have the capability to automatically purge those tracks after a specific time interval. The time interval is a system-selected parameter and should consider the irregular reporting of nonreal-time tracks. Under this condition, a J7.0 (ACT = 0) message shall not be transmitted.

4.4.4.17 MINIMUM WAIT BEFORE TRANSMITTING TRACKS

After initially achieving Active status, or after returning to Active status from Inactive status or TDS Failure, C^2 JUs capable of assuming R^2 for air, surface, or land tracks shall not transmit air, surface, or land tracks until sufficient reporting responsibility checks, correlation, and data registration are performed (this also applies to a C^2 JU that is deactivating a receive filter). The minimum wait before reporting air and surface tracks is 12 seconds and for land tracks is 48 seconds. This may be either an automatic or manual function. System design should allow for longer wait times as well as an override in cases where operational necessity requires a shorter wait time or none at all.

4.4.5 SUBSURFACE (MARITIME) SURVEILLANCE

The rules and conventions applicable to reporting Subsurface (Maritime) surveillance information are based upon the requirements for exchanging these data between JUs but differ from those for Air, Surface (Maritime), and Land (Ground) reporting due to the nature of the source of the information. The specific message used to report Subsurface surveillance tracks is the J3.4 Subsurface (Maritime) Track message. The relationship of acoustic and ASW point to Subsurface track reports is described in paragraphs 4.8.4 and 4.8.4.2. Discussed in this subsection are the various requirements associated with Subsurface surveillance data exchange.

4.4.5.1 TRACK REPORTING CRITERIA

Track reporting criteria are based on the requirements for the exchange of Subsurface surveillance information and data useable in providing threat warning information between systems involved in joint operations. The reporting of Subsurface surveillance track information on the interface shall ensure that:

a. The information on the track is as complete, accurate, and timely as possible.

b. The proper rules for reporting a track are followed.

4.4.5.2 SUBSURFACE (MARITIME) SURVEILLANCE REPORTING

The J3.0, J3.4, and J5.4 messages are used to exchange tactically significant information that has been derived from ASW sensors. Within the Subsurface surveillance function these messages are used to report bearings, ranges, and tracks.

4.4.5.2.1 SUBSURFACE (MARITIME) TRACK REPORTING

The rules for Subsurface surveillance track reporting are:

a. The source of track data shall be provided (Source TN).

b. Established local tracks shall be reported with all known parameters at the next reporting opportunity.

c. All data shall be time tagged.

4.4.5.2.2 ACOUSTIC BEARING/RANGE REPORTING

The J5.4 Acoustic Bearing/Range message shall be used to exchange information on bearings (ambiguous and resolved) and/or range derived from ASW sensors. The source frequency is not required to report acoustic information. Bearings shall be reported from the detecting sensor origin.

a. The J5.4E0 Latitude and Longitude fields shall be set to the position of the acoustic bearing origin.

b. If the detecting sensor is integral to the reporting JU, the J5.4C2 Origin TN field shall contain the TN of the reporting JU. A towed array is considered integral to the ship. If the detecting sensor is integral to another unit, track, or point (e.g., non-IU, sonobuoy) being reported, the Origin TN field shall contain the TN of the detecting unit, track, or point.

Otherwise, the Origin TN field shall be set to value zero (No Statement) to indicate the detecting sensor is neither integral to the reporting JU nor to another reported unit, track, or point (e.g., unreported sonobuoy).

c. The position of a bearing origin need not be the same as the position of Origin TN. The origin of a bearing detected by a towed array shall be reported as the actual position based on the length of the array.

When reporting ambiguous passive bearings, Bearing Report Type (BRT) set to value 1, JUs shall report bearings using both the Bearing 1, ASW and Bearing 2, ASW fields of the J5.4E0 and J5.4C1 words, respectively. The origins of both bearings must be the same. When reporting a resolved bearing, BRT set to value 2, JUs shall report the resolved passive bearing in the Bearing 1, ASW field. Upon receipt of a BRT set to value 2, JUs shall not process the Bearing 2, ASW field.

When reporting range to an ASW contact without a bearing, JUs shall set the BRT field to value 3, Range Only. When reporting a bearing and range, JUs shall set the BRT field to value 0, Bearing and Range, the Bearing 1, ASW field to the bearing, and the Range field to the range. The Sensor Indicator field may be set to the sensor holding contact, and the Bearing Accuracy, ASW and Range Accuracy, ASW fields may be set to the accuracies of the reported bearing and range. Upon receipt of a J5.4 message with BRT set to value 0, JUs shall not process the Bearing 2, ASW field. JUs shall discard a message with BRT set to value 0 or 3 if the Range field is received as No Statement.

4.4.5.2.3 REPORTING ASW POINTS, LINES, AND AREAS

The J3.0 Reference Point message with the point type field set to value 7 (ASW) or value 8 (ASW, 1) is used to report ASW points, lines, or areas as specified in paragraph 4.4.3.1. The definitions and use of various ASW point types are provided in appropriate operational doctrine, and they may be reported on the surveillance net.

The following ASW point amplification types are reported to provide a position or approximate location of a possible target of interest when no sensor measurement of course/speed is available for reporting in a J3.4 message:

a. Sinker.

b. Brief Contact.

c. Search Center (ASW).

d. Estimated Position (EP).

e. Fix (ASW).

f. Area of Probability.

Other ASW point amplification types are used in the coordination of ASW assets and mission planning and include the following:

a. NOTACK Area.

b. Moving Haven.

c. Sonobuoy Position.

d. Sonobuoy Pattern Reference Position.

e. Limiting Line of Approach.

f. Friendly Weapon Danger Area (FWDA).

For these ASW points, the time of activation and/or the time of deactivation may be reported. NOTACK Area, Moving Haven, and FWDA will be reported with both times. If both times are not received, the default period for NOTACK Areas is 2 hours and for FWDAs is 155 minutes. For Sonobuoy Position and Sonobuoy Pattern Reference Position, time of deactivation will be reported to specify the time of expiration of deployed assets, or time of activation will be reported to specify the time for the deployment of future assets. Additionally, the sonobuoy RF channel number, depth indicator and transducer depth (optional), sonobuoy type, and holding contact status will be reported as appropriate for a sonobuoy position. For Sonobuoy Pattern Reference position, the pattern type, number of sonobuoys, sonobuoy spacing, sonobuoy row spacing, pattern radius, and/or bearing may be reported as necessary. For Limiting Line of Approach the bearing and time of activation will be reported. For ASW Station, the time of activation will be reported.

Minimum implementation requirements for each ASW point amplification value is specified in Appendix A. Word sequence requirements are specified in T/R rules and message maps.

4.4.5.2.4 ESTABLISHMENT OF SUBSURFACE SURVEILLANCE TRACKS AND POINTS AND FIXES

Further refined information concerning a subsurface fix or one of the other ASW points reported as specified in paragraph 4.4.5.2.3 above may result in a Subsurface surveillance track which would then be reported with a new TN, or the reported Subsurface surveillance fix or other ASW point may be associated with an existing track.

4.4.5.2.5 REPORTING SUBSURFACE SURVEILLANCE TRACK DATUM

C^2 JUs that report subsurface tracks shall have the capability to report a track as a DATUM when contact is lost. The following protocols apply:

a. The decision to report a DATUM shall be an operator function.

b. The DATUM shall be reported in a J3.4 message with the same Reference TN as the track for which contact has been lost, and the other J3.4 fields set as follows:

(1) Data Report Type (DRT) = 4 (DATUM).

(2) ASW Time Function = 3 (Time Contact Lost) or 1 (Time Datum Established).

(3) Hour and Minute: Time (truncated) that contact was lost or DATUM established.

(4) Latitude, Longitude, 15 Meters Depth, and Depth Contact: Last known position.

(5) Course and Speed: Last calculated course and speed.

(6) Sensor: The sensor that held contact.

(7) All other fields: Same as values held before contact was lost unless changed by operator action.

c. Although the last known course and speed are reported, the DATUM shall not move. Last known course and speed are reported only for calculation of the DATUM Error and other data related to ASW search.

d. DATUM Error shall be reported in the J3.4 if calculated. The J3.4 DATUM Error field is used only when DRT = 4.

e. DATUMs shall be updated in accordance with the J3.4 Transmit Rules. However, all data except DATUM Error shall remain the same as reported in the initial DATUM report, unless changed by operator action.

f. A DATUM shall only be dropped or purged by operator action.

g. If contact is regained, a J3.4 with DRT set to value 0, 1 or 2 shall be reported with the same TN as the DATUM, or a new TN depending on operator action.

4.4.5.3 TRACK ASSOCIATION

Because Subsurface (Maritime) surveillance is performed using different information sources than those used for Air, Surface (Maritime), or Land (Ground) surveillance (e.g., Radar or IFF/SIF transponder), the correlation procedures which are specified for Air, Surface (Maritime), or Land (Ground) tracks are not applied to Subsurface tracks. Instead, it is the function of the operator to perform manual correlation of Subsurface surveillance data. In order to provide for a complete compilation of the subsurface situation, the J7.7 Track Association message is used whenever it is determined that two Track Numbers (TNs) are being used to report information for the same target. Procedures to recognize and resolve remote and local track information differences are covered in paragraph 4.4.5.12.

4.4.5.4 POSITIONAL DATA

The geodetic latitude and longitude for each Subsurface surveillance track shall be reported in the J3.4 message. In addition, Subsurface surveillance reporting shall include the capability for specifying depth when available.

4.4.5.5 VELOCITY

The velocity of Subsurface surveillance tracks shall be reported as course and speed. The speed shall be reported in data miles per hour of ground speed. The course shall be reported in degrees with respect to true north.

4.4.5.6 IDENTITY DATA

Track identity, as defined in paragraph 4.4.2.1, is exchanged using the Identity field. Platform and Platform Activity may also be reported in the J3.4I message to further amplify the identity of the reported track in accordance with paragraph 4.4.2.1.3.

4.4.5.7 DISCRETE IDENTIFIER CODE (SPECIAL)

Discrete Identifier Codes (Special) shall be reported in the J7.5 message in accordance with paragraph 4.7.6.5.

4.4.5.8 TRACK QUALITY

Track quality is not applicable to Subsurface surveillance (See paragraph 4.4.5.10.).

4.4.5.9 TIME

The time shall be the time contact was first acquired/time datum established, the time of current positional data, or the time contact was lost. This time shall be reported in the Hour; Minute; and Time Function, ASW fields of the J3.4C1 word.

4.4.5.10 SUBSURFACE TRACK REPORTING RESPONSIBILITY

Subsurface track reporting responsibility procedures are different from those for Air, Surface (Maritime), and Land (Ground) tracks. It is often desirable that more than one JU report the same Subsurface contact using different TNs. This is to ensure continuity of reporting when contact is frequently lost/regained, and to allow comparison of different JUs' data to localize and identify contacts. The following are the R^2 rules for Subsurface tracks:

a. The first JU to report a contact assumes reporting responsibility for that Track Number. No other JU shall report the contact using that track number, unless one of the following occurs:

(1) A J7.0 (ACT = 0) Drop Track message is received containing the TN.

(2) A J3.4 message containing the TN is not received for two consecutive periodic updates.

b. Any other JU may report what it believes to be the same contact using a different TN. When this is done, only locally derived data shall be reported in the J3.4 message, i.e., the J3.4 messages shall not contain data derived only by the reception of remote data from other IU(s) reporting the same contact.

4.4.5.11 REPORTING INACTIVE INTERFACE UNITS AS SUBSURFACE SURVEILLANCE TRACKS

When a JU determines that a Subsurface IU is no longer active on the interface and the JU also holds local data on the IU, it shall assume R^2 by reporting a J3.4 Subsurface (Maritime) Track message using the inactive IU address as the reference TN. No other JU shall report the inactive IU using other than the inactive IU address as the reference TN. Should the inactive IU return to the interface as an Active IU, the JU holding R^2 shall cease reporting the IU, but a J7.0 (ACT = 0) message shall not be transmitted. If a TN has been previously reported on the IU, using other than the IU's address, the J7.2 message may be used to resolve the dual designation to the IU's address.

4.4.5.12 INFORMATION DIFFERENCE RECOGNITION AND RESOLUTION

The exchange of subsurface surveillance information on the interface requires procedures to recognize and resolve detected information differences between local data and data being reported on the interface. Differences are resolved by transmitting the appropriate J7 message. The specific procedures applicable to resolution of those differences are discussed in paragraph 4.7, Information Management. Differences in position, velocity, or depth recognized by a JU are not resolved through automated conflict processing and shall not generate a J7.0 (ACT = 1 or 2) message.

4.4.5.13 TERMINATION OF SUBSURFACE TRACK DATA

The following subparagraphs describe the termination of Subsurface tracks.

4.4.5.13.1 TRANSMISSION OF THE DROP TRACK REPORT MESSAGE

The J7.0 (ACT = 0) message is transmitted when a JU ceases reporting a track except when that track becomes an active IU on the network with the same address as was previously being used as the reference TN. For NOTACK areas, Moving Havens, and FWDAs, a J7.0 (ACT=0) message shall be transmitted at time of deactivation.

4.4.5.13.2 PURGING OF REMOTE TRACKS

There may be cases when a system does not receive a J7.0 (ACT = 0) message and receives no further updates on the remote track. Each system will have the capability to automatically purge those tracks (DRT = 0-3) after a specific time interval. The time interval is a system-selected parameter and should consider the irregular reporting of Subsurface surveillance tracks. Under this condition a J7.0 (ACT = 0) message shall not be transmitted. DATUMS (DRT = 4) shall not be purged automatically.

4.4.6 SPACE AND BALLISTIC MISSILE SURVEILLANCE

The rules and conventions applicable to reporting Ballistic Missile surveillance information are based upon system requirements for exchanging these data between JUs. The J3.6 Space Track message is used to report

Ballistic Missile surveillance tracks. The various requirements associated with Ballistic Missile surveillance data exchange are discussed with the following topics:

a. Track Reporting Criteria.

b. Track Reporting.

c. Launch Point Reporting.

d. Impact Point Reporting.

e. Error Reporting.

f. Track Correlation.

g. Positional Data.

h. Velocity.

i. Covariance Data.

j. Identity.

k. Track Quality.

l. Lost Track Indicator.

m. Time.

n. Reporting Responsibility.

o. Information Difference Recognition and Resolution.

p. Termination of Ballistic Missile Track Data.

4.4.6.1 BALLISTIC MISSILE TRACK/POINT REPORTING CRITERIA

Ballistic missile track/point reporting criteria are based on requirements for exchanging surveillance information to provide targeting and threat warning information among systems involved in joint operations. JUs reporting Ballistic Missile surveillance information on the interface shall ensure the following:

a. The information on the ballistic missile track/point is as complete, accurate, and timely as possible.

b. Data are correlated and dual designation is minimized.

c. The proper rules for reporting a ballistic missile track/point are followed.

4.4.6.2 BALLISTIC MISSILE TRACK/POINT REPORTING

Ballistic missile track/point reporting requires a set of rules that are general in nature and adaptable to a specific interface configuration which provides for optimum exchange of data. The rules are as follows:

a. The source of ballistic missile track/point data shall be provided (Source TN).

b. Established local ballistic missile tracks/points that cannot be correlated with a remote track/point received by the detecting JU shall be reported with all known parameters, except covariance, at the next reporting opportunity.

c. Ballistic missile data shall be time tagged.

d. A JU reporting a real-time ballistic missile track shall report the position and associated parameters of the track valid at the time tagged.

e. If reported, friendly interceptor missile tracks shall be reported on the interface using the J3.2 Air Track message for missiles capable only of endoatmospheric intercepts, and the J3.6 Space Track message for interceptors capable of exoatmospheric intercepts. When reporting an interceptor missile in the J3.2 message, Platform and Platform Activity shall be reported.

f. A JU with R^2 of a ballistic missile track shall maintain R^2 on the related Impact Point.

g. Upon transmission or reception of a Drop Track Report for a ballistic missile, the JU with R^2 of the Launch Point or Impact Point shall transmit the Impact Point and/or Launch Point messages with the Connect/Disconnect field set to value 1, Disconnect. Any subsequent reports of the Impact Point or Launch Point shall be transmitted with the Related 2 Track Number field Of the J3.0C5 message set to value 0, No Statement.

h. A JU shall not transmit an initial surveillance report on a ballistic missile if the predicted time to impact is less than 16 seconds. Similarly, if the altitude of the descending ballistic missile is less than 8 data miles, an initial Ballistic Missile surveillance report shall not be transmitted. Impact points are not subject to this constraint.

4.4.6.3 BALLISTIC MISSILE LAUNCH POINT REPORTING

a. The J3.0 Reference Point message is used to report the actual or expected Launch Point of a ballistic missile. The Launch Point will normally be derived via back azimuth from a missile track or by sensor detection of a launch. The time of the launch is reported to the nearest second with the Time Function field set to value 4, Departure Time. An early warning indication of an expected launch shall be reported by setting the Time Function field to Departure Time and setting the Hour, Minute, and Second fields to either No Statement or to the expected time of launch. If a missile launch point is related to a specific ballistic missile track it shall be identified in the J3.0C5 Related 2 Track Number field. If the actual launcher is detected by sensors, a J3.2, J3.3, J3.4, or J3.5 message shall be transmitted. If the actual launcher is associated with a launch point, it shall be associated using the J7.7 Association message.

b. The originator of a J3.0 Ballistic Missile Launch Point retains R^2 as long as the originator remains active and reports the point. However, if a J7.0 (ACT = 0) Drop Track Report message is received, the R^2 unit is declared inactive, or if no periodic update is received for three consecutive update intervals, another IU may, by operator action only, assume R^2 for the point using the same Reference TN. The latest IU to report on a ballistic missile launch point has R^2 for the point.

4.4.6.4 BALLISTIC MISSILE IMPACT POINT REPORTING

The J3.0 Reference Point message is used to report the actual or expected Impact Point of a ballistic missile. The type of warhead, if known, shall be reported in the J3.0C5 Space Amplification field with a measure of the certainty reported in the Amplification Confidence field. The actual or expected time of impact is reported to the nearest second with the Time Function field set to value 3, Arrival Time. A pre-launch indication of an expected Impact Point shall be reported by setting the Time Function field to Arrival Time and the Hour, Minute, and Second fields to either No Statement or to the expected time of impact. If the Impact point is related to a specific ballistic missile track it shall be identified in the J3.0C5 Related 2 Track Number field. A related TN for Impact Point will be used only by the C^2 JU with R^2 for the related missile track. Therefore a change in R^2 of the ballistic missile track also causes a change in R^2 for the related Impact Point. There is no requirement to continue transmitting a missile impact point after predicted impact.

4.4.6.5 BALLISTIC MISSILE LAUNCH/IMPACT POINT ERROR REPORTING

The reliability of ballistic missile launch/impact information is expressed in terms of location accuracy associated with the J3.0C5 Square/Circle Switch, Axis Orientation, Area Major Axis 4, and Area Minor Axis 4 fields. The positional accuracy associated with these fields is defined as the area (dm^2) within which there is a .95 probability that the point is located within the area reported in the Reference Point Message. The Probability estimate shall include the effects of measurement errors, systematic errors, and known maneuvering capabilities used to project launch or impact points.

4.4.6.6 BALLISTIC MISSILE TRACK CORRELATION

Track correlation prevents/eliminates dual designations. The process of correlation consists of comparing locally derived sensor data, e.g., position, velocity, boost indication, etc., with the data received on the interface. In order to eliminate dual designations, it is imperative that each ballistic missile track reported on the interface represent a single data point. Conversely, track decorrelation should occur when it is determined more than one data point exists for a ballistic missile track currently being reported.

The situations most likely to lead to dual ballistic missile designations are as follows:

a. Initial report on ballistic missile contacts.

b. Track merging.

c. Simultaneous multiple launches.

d. Existence of registration errors.

e. Time of observation differences.

f. High velocity contacts.

The implementation of specific ballistic missile track correlation techniques depends on the system capabilities, i.e., manual versus automatic track initiation systems, two-dimensional versus three-dimensional radars, etc. The considerations that must be taken into account in order to reduce/eliminate ballistic missile dual designations are as follows:

a. Position, time, velocity, boost, and lost track data.

b. Data registration procedures.

c. Periodic correlations on all ballistic missile tracks.

d. Track reporting procedures when entering, departing, and reentering the interface.

Each C^2 JU has the responsibility to determine whether the data points being detected by its local sensors are currently reported on the interface and if there are any conflicts between locally derived information and information reported on the interface. To accomplish this, each C^2 JU must continuously correlate locally derived ballistic missile tracks with ballistic missile tracks reported on the Surveillance NPG. Each C^2 JU shall report on all uncorrelated local ballistic missile tracks and shall assume R^2 for those tracks in accordance with the R^2 rules as specified in paragraph 4.4.6.15. In the event of conflict, the C^2 JU shall resolve the difference by transmitting the appropriate J7 message, by operator procedure, or by voice coordination.

4.4.6.7 BALLISTIC MISSILE POSITIONAL DATA

The positional data for ballistic missile tracks are reported in the Space Track message as X, Y, Z position in earth-centered, earth-fixed (ECF) Cartesian coordinates defined by the World Geodetic System-84 (WGS-84) Reference Frame.

4.4.6.8 BALLISTIC MISSILE VELOCITY

The velocity of ballistic missile tracks shall be reported as the rate of change along the X, Y, Z axis.

4.4.6.9 BALLISTIC MISSILE COVARIANCE DATA

The ballistic missile covariance data related to the reported state vector (consisting of the three position coordinates followed by the three velocity values) shall be reported in accordance with the transmit/receive rules for the Space Track Message. When reported, ballistic missile covariance data shall include the best estimate of both tracking errors and statistical estimates of biases produced by emplacement errors, alignment errors, and other systematic errors. Instead of transmitting the covariance matrix directly, ballistic missile covariance data shall be transmitted with the root variances of the covariance matrix and elements of the Cholesky decomposition of the precompensated correlation matrix as defined and discussed in the following paragraphs. Depending on the sequence of transmitted words, either the covariance matrix, or the spatial covariance submatrix and the velocity covariance submatrix can be constructed from the received data as described in paragraphs 4.4.6.9.10 and 4.4.6.9.11.

The error estimate information of the ballistic missile track, the covariance information, is contained in the J3.6 continuation words. The covariance information can be passed as either full or partial covariance. Full covariance requires the transmitter to perform an encoding process of the full covariance matrix P into the J3.6C1, J3.6C2, J3.6C3, and J3.6C4 words. Partial covariance requires the transmitter to perform two separate encoding processes: (1) The spatial covariance information is encoded into the J3.6C1 word; (2) the velocity information is separately encoded into the J3.6C5 word.

Details of the encoding and decoding process are contained in the follow-on paragraphs. An overview of the encoding/decoding process is as follows (the matrix variables used in the overview are consistent with those used in the detailed explanation):

Overview of Transmitter Encoding.

a. The covariance matrix P is derived from a ballistic missile tracking and error estimation process. Matrix P can be either the full covariance (6 x 6) terms, or a partial covariance matrix (3 x 3). In the case of the partial covariance, this process is applied separately to the spatial covariance information (the 3 x 3 upper left submatrix of P) or the velocity covariance information (the 3 x 3 lower right submatrix of P). The only difference between the full and partial process is in the number of terms in the matrices.

b. The covariance matrix P is converted to the correlation matrix C. This is done by first taking the square root of each diagonal element, that is the root variance, and dividing each element in the same row and column by that value.

c. The correlation matrix C is converted to a precompensated correlation matrix C'. This is done by multiplying each off-diagonal element by a constant slightly less than one. Precompensation is performed to "compensate" for small round-off errors introduced by the transmitting unit during message encoding, which might otherwise result in decoding of physically implausible covariance values at the receiving unit. C' is different from C in that the off-diagonal elements have been multiplied by a constant, 1-ε, where ε is a very small number.

d. The precompensated correlation matrix C' is converted by Cholesky decomposition to matrix U. Matrix U is the upper triangular Cholesky factor (or "matrix square root") of C'.

e. Matrix U is then encoded into the J3.6 continuation words. The root variances are logarithmically encoded, and the elements of U are linearly encoded into the appropriate continuation word fields. For elements in the top row of U, only the signs of the number are transmitted.

Overview of Receiver Decoding.

The receiver reverses the transmitter encoding process except for precompensation. The steps to decoding are as follows:

a. The receiver reconstructs matrix U from the J3.6 continuation words. This is done by reversing the linear encoding to reconstruct all but the first row of an approximate Cholesky factor, matrix U. The first row is calculated using the known vector length of each column of matrix U, together with the transmitted signs, to solve for the elements of the first row. Matrix U is now approximately equal to the transmit matrix U, with some round-off induced by the encoding process into the message fields.

b. An approximate correlation matrix C is then constructed. This is done by multiplying matrix U by its transpose. Note that the decoding process does not attempt to reverse precompensation. Reversing precompensation might make matrix C nonpositive definite, the problem precompensation is adjusting for. This correlation matrix C is therefore approximately equal to the transmitter's correlation matrix C and the transmitter's precompensation correlation matrix C'.

c. The covariance matrix P is then constructed from the correlation matrix C. This is done by reversing the logarithmic encoding to find the root variances, and multiplying each row and column of C by the corresponding root variances to get a covariance matrix P. The resulting matrix P is approximate to the covariance matrix P sent by the transmitter due to truncation and round-off errors from the encoding and decoding process.

4.4.6.9.1 DEFINITION OF A COVARIANCE MATRIX

The covariance matrix P is a symmetric 6 x 6 matrix in the form:

$$P = \left[\begin{array}{ccc|ccc} p_{xx} & p_{xy} & p_{xz} & p_{xu} & p_{xv} & p_{xw} \\ p_{yx} & p_{yy} & p_{yz} & p_{yu} & p_{yv} & p_{yw} \\ p_{zx} & p_{zy} & p_{zz} & p_{zu} & p_{zv} & p_{zw} \\ \hline p_{ux} & p_{uy} & p_{uz} & p_{uu} & p_{uv} & p_{uw} \\ p_{vx} & p_{vy} & p_{vz} & p_{vu} & p_{vv} & p_{vw} \\ p_{wx} & p_{wy} & p_{wz} & p_{wu} & p_{wv} & p_{ww} \end{array}\right]$$

P is symmetric about the diagonal. The upper left 3 x 3 quadrant is the "spatial covariance submatrix," where the subscripts x, y, z indicate positions in the X, Y, Z directions in the ECF WGS-84 coordinate system. The lower right 3 x 3 quadrant is the "velocity covariance submatrix" where the subscripts u, v, w indicate the velocities in the X, Y, Z directions in the ECF WGS-84 coordinate system.

The elements of P include tracking errors and statistical estimates of biases produced by emplacement errors, alignment errors and other systematic errors. The size, shape and orientation of the error ellipsoid for the target reported in the J3.6 Space Track message are defined by a six dimensional error ellipsoid.

Let R_a be the actual target state vector ($R_a^t = [X,Y,Z,V_X,V_Y,V_Z]$), R_e be the tracker's estimate of the target state, and $X = R_e - R_a$ be the track error. Then P shall be a symmetric, positive definite matrix such that the track error is within the following six-dimensional ellipsoid with probability no less than 95 percent:

$$X^T P^{-1} X = 12.5916$$

The value 12.5916 corresponds to the 0.95 quantile of the Chi-squared statistic with six degrees of freedom. Therefore, for normally distributed errors, P is the usual covariance matrix.

If errors are not normally distributed (e.g., if a contribution to the error is uniformly distributed) then P may differ from the covariance matrix (e.g., by linear scaling in the appropriate direction). If the receiver of the message requires a high-confidence region for the target state, it should use an ellipsoid calculated from P under the assumption of normally distributed errors. The intent of the above is that the result will be correct for a confidence of 95 percent.

4.4.6.9.2 DEFINITION OF THE BALLISTIC MISSILE ROOT VARIANCES

The ballistic missile root variances are defined as the square roots of diagonal elements of the ballistic missile covariance matrix defined as follows:

$$\sigma_i = \sqrt{p_{ii}}$$

4.4.6.9.3 DETERMINATION OF THE BALLISTIC MISSILE CORRELATION MATRIX FROM THE BALLISTIC MISSILE COVARIANCE MATRIX

The ballistic missile correlation matrix is a 6 x 6 matrix describing the correlation between the errors of position and velocity. The elements of the ballistic missile correlation matrix are defined as follows:

$$C_{ij} = P_{ij}/\sigma_i\sigma_j$$

where P_{ij} are the elements of the ballistic missile covariance matrix and σ_i and σ_j are the ballistic missile root variances.

4.4.6.9.4 DETERMINATION OF THE BALLISTIC MISSILE PRECOMPENSATED CORRELATION MATRIX FROM THE BALLISTIC MISSILE CORRELATION MATRIX

The ballistic missile precompensated correlation matrix C' is defined as follows:

$$C' = (1.0-2^{-22})C+2^{-22}I$$

where C is the 6 x 6 ballistic missile correlation matrix, I is the 6 x 6 Identity matrix, and C' is the ballistic missile precompensated correlation matrix.

4.4.6.9.5 DEFINITION OF THE CHOLESKY DECOMPOSITION OF THE PRECOMPENSATED CORRELATION MATRIX

Cholesky decomposition is an algorithm which takes the precompensated correlation matrix C' and returns an upper triangular matrix U such that

$$C' = U^TU$$

where U^T is the transpose of U. The matrix U has the form

$$U = \begin{bmatrix} u_{11} & u_{12} & u_{13} & u_{14} & u_{15} & u_{16} \\ 0 & u_{22} & u_{23} & u_{24} & u_{25} & u_{26} \\ 0 & 0 & u_{33} & u_{34} & u_{35} & u_{36} \\ 0 & 0 & 0 & u_{44} & u_{45} & u_{46} \\ 0 & 0 & 0 & 0 & u_{55} & u_{56} \\ 0 & 0 & 0 & 0 & 0 & u_{66} \end{bmatrix}$$

4.4.6.9.6 CONSTRUCTION OF A CORRELATION MATRIX FROM THE INFORMATION CONTAINED IN THE J3.6C1, J3.6C2, J3.6C3, AND J3.6C4

Cholesky decomposition takes a precompensated correlation matrix C' and returns a matrix U such that

$$C' = U^T U$$

J3.6C1 through J3.6C4 contain the encoded values of rows 2 through 6 of U, and the signs of elements 2 through 6 of the first row of U. This information is sufficient to reconstruct U. Once U is determined, the correlation matrix can be reconstructed using this equation.

The elements u_{1j} (j=1,2,...6) of the first row of U are found by using the fact that the sum of the squares of the elements in each column of U are equal to one:

$$C_{jj} = \sum_{i=1}^{j} u_{ij}^2 = 1.$$

Solving for u_{1j},

$$u_{11} = 1.0$$

$$u_{1j} = \mathrm{sign}\,(u_{1j})\sqrt{1 - s_j}\ ,\ j > 1$$

where

$$s_j = \sum_{i=2}^{j} u_{ij}^2.$$

If the expression under the square root is negative for the jth column, then u_{1j} is set to zero and the remaining elements of the column are "renormalized":

$$u_{ij} \leftarrow u_{ij} / \sqrt{s_j}.$$

4.4.6.9.7 DEFINITION OF THE CHOLESKY DECOMPOSITION OF THE BALLISTIC MISSILE PRECOMPENSATED CORRELATION MATRIX

The Cholesky decomposition is an algorithm that returns an upper triangular matrix, U, as follows:

$$C' = U^T U$$

where C' is the ballistic missile precompensated correlation matrix defined above. The matrix U is in the following form:

$$U = \begin{bmatrix} u_{11} & u_{12} & u_{13} & u_{14} & u_{15} & u_{16} \\ 0 & u_{22} & u_{23} & u_{24} & u_{25} & u_{26} \\ 0 & 0 & u_{33} & u_{34} & u_{35} & u_{36} \\ 0 & 0 & 0 & u_{44} & u_{45} & u_{46} \\ 0 & 0 & 0 & 0 & u_{55} & u_{56} \\ 0 & 0 & 0 & 0 & 0 & u_{66} \end{bmatrix}$$

4.4.6.9.8 DEFINITION OF THE SPATIAL AND VELOCITY COVARIANCE SUBMATRICES

The spatial covariance submatrix is the upper left 3 x 3 quadrant of the covariance matrix P below. The velocity covariance submatrix is the lower right 3 x 3 quadrant of P. The covariance matrix follows:

$$P = \left[\begin{array}{ccc|ccc} p_{xx} & p_{xy} & p_{xz} & p_{xu} & p_{xv} & p_{xw} \\ p_{yx} & p_{yy} & p_{yz} & p_{yu} & p_{yv} & p_{yw} \\ p_{zx} & p_{zy} & p_{zz} & p_{zu} & p_{zv} & p_{zw} \\ \hline p_{ux} & p_{uy} & p_{uz} & p_{uu} & p_{uv} & p_{uw} \\ p_{vx} & p_{vy} & p_{vz} & p_{vu} & p_{vv} & p_{vw} \\ p_{wx} & p_{wy} & p_{wz} & p_{wu} & p_{wv} & p_{ww} \end{array}\right]$$

4.4.6.9.9 DEFINITION OF THE SPATIAL AND VELOCITY CORRELATION SUBMATRICES

The spatial correlation submatrix C_x is the upper left 3 x 3 quadrant of the correlation matrix C below. The velocity correlation submatrix C_v is the lower right 3 x 3 quadrant of C. The correlation matrix follows:

$$C = \left[\begin{array}{ccc|ccc} C_{xx} & C_{xy} & C_{xz} & C_{xu} & C_{xv} & C_{xw} \\ C_{yx} & C_{yy} & C_{yz} & C_{yu} & C_{yv} & C_{yw} \\ C_{zx} & C_{zy} & C_{zz} & C_{zu} & C_{zv} & C_{zw} \\ \hline C_{ux} & C_{uy} & C_{uz} & C_{uu} & C_{uv} & C_{uw} \\ C_{vx} & C_{vy} & C_{vz} & C_{vu} & C_{vv} & C_{vw} \\ C_{wx} & C_{wy} & C_{wz} & C_{wu} & C_{wv} & C_{ww} \end{array}\right]$$

4.4.6.9.10 DETERMINATION OF THE PRECOMPENSATED VELOCITY CORRELATION SUBMATRIX FROM THE VELOCITY CORRELATION SUBMATRIX

The precompensated velocity correlation submatrix is defined as follows:

$$C'_v = (1 - 2^{-22})\, C_v + 2^{-22} I$$

where C_v is the 3 x 3 velocity correlation submatrix defined above, and I is the 3 x 3 identity matrix.

4.4.6.9.11 DEFINITION OF THE CHOLESKY FACTOR OF THE PRECOMPENSATED POSITION AND VELOCITY CORRELATION SUBMATRICES

The Cholesky factor of the precompensated position correlation submatrix, C'_x, is the upper left 3 x 3 submatrix of the U matrix which was defined in paragraph 4.4.6.9.5.

To determine the Cholesky factor of the precompensated velocity correlation submatrix, C'_v, an upper triangular matrix U_v is constructed such that:

$$C'_v = U_v^T U_v$$

where C'_v is the precompensated velocity correlation submatrix defined above. U_v is in general different from the lower right 3 x 3 submatrix of U. U_v is of the form:

$$U_v = \begin{vmatrix} uv_{11} & uv_{12} & uv_{13} \\ 0 & uv_{22} & uv_{23} \\ 0 & 0 & uv_{33} \end{vmatrix}$$

4.4.6.9.12 CONSTRUCTION OF THE SPATIAL AND VELOCITY CORRELATION SUBMATRICES FROM THE INFORMATION CONTAINED IN THE J3.6C1 AND J3.6C5

J3.6C1 contains the encoded values of rows 2 and 3 of the Cholesky factor U_x of the precompensated spatial correlation C_x, and the signs of elements 2 and 3 of the first row of U_x. (U_x is the same as the upper left 3 x 3 submatrix of U.) This information is sufficient to reconstruct U_x.

J3.6C5 contains the encoded values of rows 2 and 3 of the Cholesky factor U_v of the precompensated velocity correlation submatrix C_v, and the signs of elements 2 and 3 of the first row of U_v. This information is sufficient to reconstruct U_v.

The same procedure is used to reconstruct either submatrix. Cholesky decomposition takes a precompensated correlation submatrix C and returns a matrix U such that:

$$C \approx U^T U,$$

where U^T is the transpose of U. Once U is determined, the correlation submatrix can be reconstructed using this equation.

The elements u_{1j} (j=1,2,3) of the first row of U are found by using the fact that the sum of the squares of the elements in each column of U are equal to one:

$$C_{jj} = \sum_{i=1}^{j} u_{ij}^2 = 1.$$

Solving for u_{1j},

$$u_{11} = 1.0$$

$$u_{1j} = \text{sign}\,(u_{1j})\sqrt{1 - s_j}\ ,\ j > 1$$

where

$$s_j = \sum_{i=2}^{j} u_{ij}^2.$$

If the expression under the square root is negative for the jth column, then u_{1j} is set to zero and the remaining elements of the column are "renormalized":

$$u_{ij} \leftarrow u_{ij}/\sqrt{s_j}.$$

4.4.6.10 BALLISTIC MISSILE IDENTITY DATA

Ballistic Missile identity is exchanged as defined in paragraph 4.4.2.1. The Space Platform Activity and Space Specific Type fields are defined in the message section of this volume. Operational Commander defined values within the Space Specific Type field are defined at initialization via the OPTASK LINK.

4.4.6.11 BALLISTIC MISSILE TRACK QUALITY

Ballistic missile track quality (TQ) is a measure of the reliability of the kinematic data reported on a ballistic missile track determined by the unit reporting the track. It is a numerical value of 0 through 15 indicating different degrees of reliability of the kinematic data. A value of 0 indicates a nonreal-time report and the values 1 through 15 indicate degrees of reliability with 15 being the most reliable. The algorithm used to derive ballistic missile TQ is as follows:

$$\mathrm{B} = \sum_{i=1}^{3}\left[\sigma_{p_i}^{2}(t) + \sigma_{v_i}^{2}(t)(\Delta t)^{2}\right]$$

where $\sigma^2_{pi}(t)$ represents the positional variance contained in the ballistic missile covariance matrix, $\sigma^2_{vi}(t)$ represents the velocity variance in the ballistic missile covariance matrix, and $(\Delta t)^2$ is a factor that varies the dependence of the computed TQ on the velocity errors of the reported ballistic missile track. The variable Δt is an arbitrary scaling factor expressed in units of seconds and is specified as an OPTASK LINK variable. The default value of Δt is 6 (0-24,1) seconds. B is the table look-up value.

4.4.6.12 LOST TRACK INDICATOR

A ballistic missile track is considered lost when the JU with R^2 does not receive any local sensor data since the last transmitted update, or the JU determines that the track is lost by other system criteria. Subsequent reports on the ballistic missile track will include data held at the time of last sensor contact, and the Lost Track Indicator field will be set to value 1, Lost Track. Ballistic missile track data will not be extrapolated except as specified in accordance with paragraph 4.4.6.13.

4.4.6.13 TIME FOR BALLISTIC MISSILE TRACKS

Ballistic missile tracks are not extrapolated to time of transmission. All ballistic missile tracks will be time tagged to the integer second nearest to the measurement time, and all position, velocity, and covariance data shall be extrapolated or interpolated to the referenced time. The time accuracy of the extrapolation or interpolation shall be at the limit of system performance with an intent to achieve an accuracy of 0.3 milliseconds or less. Truncation of time without extrapolation or interpolation is not acceptable. Systems must be prepared to accept data that may have time fields set to future values.

4.4.6.14 NONREAL-TIME BALLISTIC MISSILE TRACK REPORT

A ballistic missile track report is identified as a nonreal-time report with TQ field set to value 0, Non-real Time Track.

4.4.6.15 BALLISTIC MISSILE REPORTING RESPONSIBILITY

R^2 procedures for ballistic missile tracks are contained in this paragraph. These rules are designed to ensure that only the JU having the best positional and velocity data is reporting the track on the interface. The R^2 rules are as follows:

a. The first JU to report the ballistic missile track has R^2 on that track.

b. A JU transmits a track report for a ballistic missile only when it has R^2 for that track. A JU with R^2 for a nonreal-time ballistic missile track will relinquish R^2 upon receiving a remote real-time track report for that track.

c. A JU assumes R^2 on a ballistic missile track if its local TQ at or before the time of the remote track time tag exceeds the received TQ by 1 or more.

d. A JU reporting a ballistic missile track with the Lost Track Indicator field set to value 1, Lost Track, is assumed to have a TQ of 5 (1-15,1) less than that being reported, i.e., if a JU is reporting "Lost Track" data with a TQ of 15, a JU holding "Tracking" data may assume R^2 with a TQ of 11 (regardless of the time tag on the remote track).

e. A JU assumes R^2 if it has not received a remote report on a locally held track for 25 seconds. This rule only applies when the last remote report was received with Lost Track Indicator set to value 0, Tracking.

f. A JU receiving a J7.0 message with the Track Management Action field set to value 0, Drop Track Report, on a locally held track shall assume R^2 at the next opportunity to transmit the track if local reporting eligibility remains and a remote report has not been received on that track.

g. A JU without R^2 for a nonreal-time track, i.e., TQ field set to value 0, shall assume R^2 for that track when the track is locally updated by a new nonreal-time report. A JU reporting a nonreal-time track has R^2 regardless of the time value in the track report. The time value in a nonreal-time report is not a criterion for an R^2 shift.

h. A JU relinquishes R^2 for a real-time track upon reception of a remote track report with TQ greater than local TQ.

i. A JU with R^2 on a track retains the responsibility until it is relinquished in accordance with the above rules or until the track is dropped.

j. After applying all the above rules, a JU relinquishes R^2 for a real-time track upon reception of a remote track report with TQ equal to the local TQ from a JU whose Source TN is greater than the local Source TN.

k. A unit assuming R^2 for a ballistic missile track need not assume R^2 for the associated launch point. The unit no longer holding R^2 on the ballistic missile track may continue to report the launch point in accordance with the transmit/receive rules.

4.4.6.16 BALLISTIC MISSILE INFORMATION DIFFERENCE RECOGNITION AND RESOLUTION

The exchange of Ballistic Missile surveillance information on the interface requires procedures to recognize and resolve detected information differences between local data and data being reported on the interface. Detection and resolution of Identity, Exercise Indicator, Platform, Platform Activity, and Environment/Category differences are resolved by transmitting the appropriate J7 message. The specific procedures applicable to the resolution of those differences are discussed in paragraph 4.7, Information Management.

4.4.6.16.1 BALLISTIC MISSILE SURVEILLANCE DATA DIFFERENCE (POSITION AND VELOCITY)

Differences in ballistic missile position or velocity recognized by a JU are not resolved through conflict processing and shall not generate a J7.0 message with the Track Management Action field set to value 1, Difference Report. However, differences in these elements may cause a JU to assume that one TN represents two different tracks or different TNs are being used to report the same track. (Refer to Resolution of Duplicate Track Number, paragraph 4.1.3.7)

4.4.6.17 TERMINATION OF BALLISTIC MISSILE TRACK DATA

The following subparagraphs describe the termination of ballistic missile tracks.

4.4.6.17.1 TRANSMISSION OF THE DROP TRACK REPORT MESSAGE FOR BALLISTIC MISSILES

The J7.0 message with the Track Management Action field set to value 0, Drop Track Report, is transmitted when a JU ceases reporting a ballistic missile track for which it currently has R^2, except when a JU ceases reporting a track because it has relinquished R^2 to another JU.

4.4.6.17.2 PURGING OF REMOTE BALLISTIC MISSILE TRACKS

There may be cases when a system does not receive a J7.0 message with the Track Management Action field set to value 0, Drop Track Report, and receives no further updates on the remote ballistic missile track. Each system should have the capability to automatically purge those tracks after a specific time interval. The time interval is a system-selected parameter.

4.4.7 ELECTRONIC WARFARE SURVEILLANCE

Electronic warfare surveillance is the process of developing tactically significant information through the monitoring of the electromagnetic spectrum. The products of the EW surveillance process are lines of bearing (LOBs), fixes, and areas of probability (AOPs). LOBs, fixes, and AOPs are reported via the J3.7 EW Product Information message on the Surveillance Network PG. LOBs, fixes, and AOPs may be amplified by the J6.0 Amplification message on the Surveillance Network PG. This subsection contains the rules and protocols associated with the exchange of EW surveillance information. Topics covered are as follows:

a. EW Reporting.

b. EW Reporting Responsibility.

c. Time Data.

d. Information Management.

e. EW Product Information Correlation.

f. Termination of EW Surveillance Data.

4.4.7.1 ELECTRONIC WARFARE REPORTING

EW-capable C^2 JUs and JUs capable of generating and managing track numbers shall determine which EW detections are eligible for transmission on the Surveillance Network PG. This may be done either manually or through automatic association with predetermined reporting criteria. EW detections may result in the transmission of LOBs, AOPs, or fixes.

The word sequences presented to describe EW reporting are the minimum required. Additional continuation words may be added to these word sequences to amplify EW reports if data are available.

4.4.7.1.1 LINE OF BEARING (LOB) REPORTING

The J3.7 EW Product Information Message shall be used to report LOBs derived from various sources such as ES, jam strobes, or radio direction finding (RDF) equipment. The Fix or Bearing Descriptor (FIX BRG) field in the J3.7I word shall be set as follows:

a. Value 2 - Bearing, Type Not Specified - An LOB for which the reporting JU is unable to specify the bearing as ES, EA, or RDF.

b. Value 3 - Bearing, ES - An LOB of an intercept obtained from ES sources other than RDF.

c. Value 4 - Bearing, EA - An LOB specifying a jam strobe.

d. Value 5 - Bearing, Radio Direction Finding - An LOB of an intercept obtained from RDF sources with no associated parametric data.

e. Value 7 - Bearing, Unknown - The direction of arrival of the signal is unknown.

LOB reports include the time of the intercept in the J3.7I word. Elevation angles shall only be reported by units who are reporting their PPLI.

If the 2 sigma bearing accuracy (95% probability) of the passive system is available, it should be included in the J3.7C1 word to allow receiving systems to generate AOPs. If an LOB results from an evaluated ES intercept (FIX BRG field set to value 3), the Emitter Number and the Emitter Confidence fields should be set.

4.4.7.1.2 ELECTRONIC WARFARE FIX REPORTING

An EW fix results from the crossing of two or more LOBs and is reported using a J3.7I/J3.7C1/J3.7C2 word sequence as a minimum with FIX BRG field set to value 0 in the J3.7I word. The location of the fix is specified by the latitude and longitude fields in the J3.7C2 word. An EW fix may be derived either automatically or manually. An EW fix resulting from previously reported LOBs shall be assigned a new TN, not one of the TNs assigned to the LOBs. The new TN shall be used for all subsequent updates of the fix. However, when an AOP is changed to a fix, the TN of the previously reported AOP shall be used for the new fix.

4.4.7.1.3 AREA OF PROBABILITY REPORTING

A C^2 JU or a JU capable of generating and maintaining track numbers may report an AOP based either on organic data, exchange of LOBs, analysis of EW fix data, or a combination of the above. An AOP is defined as that area in which there is a 95% probability (2 sigma) of a particular emitter being located. An AOP is reported using a J3.7I/J3.7C1/J3.7C2 word sequence as a minimum. The J3.7I word shall be transmitted with FIX BRG field set to value 1. The J3.7I word contains the time the AOP was valid and the J3.7C2 word defines the AOP. Refer to paragraph 4.4.3.1.2b for the procedures and the fields used to describe AOPs with the J3.7 message. An AOP resulting from previously reported LOBs shall be assigned a new TN, not one of the TNs assigned to the LOBs. An AOP resulting from two or more previously reported fixes of differing TNs shall be assigned a new TN, not one of the TNs assigned to the fixes. The new TN shall be used for all subsequent updates of the AOP. However, when a fix is changed to an AOP, the TN of the previously reported fix shall be used for the new AOP.

4.4.7.1.4 PLATFORM EVALUATION CONFIDENCE

The Platform Evaluation Confidence field of the J3.7C1 word reports the degree of confidence that the emitter's platform is as reported in the Environment/Category and/or Platform fields.

4.4.7.2 ELECTRONIC WARFARE PRODUCT INFORMATION REPORTING RESPONSIBILITY

The unit originating a J3.7 EW Fix, AOP, or LOB report always retains reporting responsibility. It is illegal to assume reporting responsibility for another unit's J3.7 EW Fix, AOP, or LOB report. Each unit initiating a J3.7 EW Fix, AOP, or LOB report shall assign a TN not known to be in use on the interface even if it is believed that such a report may concern the same emitter currently being reported in another J3.7 EW Fix, AOP, or LOB report by another unit. The exception is a unit originating a J3.7 EW Fix, AOP, or LOB report on a Fix, AOP, or LOB currently reported by the same unit or received from another unit in a J14.0 message shall assign the same TN, Reference in the J3.7 message as contained in the J14.0 message. The Source TN of these J3.7 messages shall be the Source TN of the unit transmitting the

J3.7 message. J3.7 messages transmitted by nonR^2 JUs with the Response Indicator set to value 1 shall not affect reporting responsibility.

4.4.7.3 TIME DATA

The J3.7I word contains the time the EW product information reported on the interface was valid; time is expressed in hours, minutes, and seconds.

4.4.7.4 ELECTRONIC WARFARE INFORMATION MANAGEMENT

Upon receipt of a J7.1 (ACT = 1) message or upon receipt of a J7.1 (ACT = 0) message with an EA, ES, or EW Fixes Data Request Indicator set, addressed JUs shall respond as follows (see also paragraph 4.7.2.1.5 and Table 4.7-4):

a. If the J7.1 Addressee TN is set to value 00177, JUs with R^2 transmit all J3.7 EW data on the TN or as specified by the Request Indicator set to value 1.

b. If the J7.1 Addressee TN is set to own JU, transmit all J3.7 EW data on the TN or as specified by the Request Indicators, with the J3.7 Response Indicator set to value 1.

EW association shall be reported using the J7.7 message. The J7.2 message may be used to correlate EW AOPs with surveillance tracks, but shall not be used to correlate EW LOBs and fixes with surveillance tracks.

Paragraph 4.7.1.2, Difference Report, may be used for E/C, Identity, and Exercise Indicator data reported in J3.7 messages.

4.4.7.5 ELECTRONIC WARFARE PRODUCT INFORMATION CORRELATION

EW AOPs that are reported to the interface may require correlation when they are known or suspected to be detections of a surveillance track. If the EW AOP can be correlated with a surveillance track, a J7.2 correlation message may be transmitted with the Retained TN set to the TN of the track and the Dropped TN set to the TN of the EW AOP.

4.4.7.6 TERMINATION OF ELECTRONIC WARFARE SURVEILLANCE DATA

The transmission of EW product information shall be terminated when the information is no longer valid or time-related update requirements are not met. The information may be purged in accordance with system design.

When a JU drops or ceases reporting EW information, that it has been reporting on the interface, it shall transmit a J7.0 (ACT = 0) message. The J7.0 (ACT = 0) message shall not be transmitted on remote reports. Remote reports may be automatically purged based on system criteria.

4.4.7.7 BEARING ORIGIN

The origin of an EW LOB may be reported in the following ways:

a. Own Unit: The Bearing Origin field shall be set to value 0; the Origin TN field shall be set to own unit's assigned TN; and the J3.7C2 word shall be transmitted containing the latitude and longitude of the bearing origin.

b. Another existing IU, track, or point: The Bearing Origin field shall be set to value 0; the Origin TN field shall be set to the TN of the designated IU, track, or point; and the J3.7C2 word shall be transmitted containing the latitude and longitude of the bearing origin.

c. A designated position: The Bearing Origin field shall be set to value 1; the Origin TN field shall be set to value 0; and the J3.7C2 word shall be transmitted containing the latitude and longitude of the designated bearing origin.

4.4.8 NONC^2 JU USE OF SURVEILLANCE NPG

To support their missions, nonC^2 JUs shall monitor the Surveillance NPG; however, they are prohibited from transmitting on this NPG.

Remote surveillance track and point data available in the J3 series messages shall provide nonC^2 JUs situational awareness and early warning information.

NonC^2 JUs shall process J7.0 messages with the Track Management Action field set to value 0, Drop Track Report, for locally held remote tracks. Additionally, nonC^2 JUs may have the capability to automatically purge locally held remote tracks, after a specified time interval, when these tracks are no longer being updated. The time interval is a system selected parameter.

4.5 ELECTRONIC WARFARE

The following describes the relationship of EW to command, control, and surveillance. Other portions of the Link 16 interface design that support EW are contained in paragraphs 4.4, Surveillance; 4.7, Information Management; 4.10, Mission Management; and 4.11, Weapons Coordination and Management.

4.5.1 DEFINITIONS

Frequently used terms relating to EW are defined below.

4.5.1.1 ELECTRONIC WARFARE

Military action involving the use of electromagnetic energy to determine, exploit, reduce, or prevent hostile use of the electromagnetic spectrum and action that retains friendly use of the electromagnetic spectrum (Joint Pub 1-02). There are three divisions within EW:

a. Electronic Warfare Support - Actions taken to search for, intercept, identify, and locate sources of radiated electromagnetic energy for the purpose of immediate threat recognition. Thus, ES provides a source of EW information required to conduct electronic attack (EA), electronic protection (EP), avoidance, targeting, and other tactical employment of forces (Joint Pub 1-02).

b. Electronic Attack - Actions taken to prevent or reduce an enemy's effective use of the electromagnetic spectrum. EA includes electronic jamming and electronic deception (Joint Pub 1-02).

c. Electronic Protection - Actions taken to ensure friendly effective use of the electromagnetic spectrum despite the enemy's use of EW (Joint Pub 1-02).

4.5.1.2 ELECTRONIC WARFARE SURVEILLANCE (EWS)

EWS is the reporting of EW information to supplement the general surveillance picture.

4.5.1.3 NONELECTRONIC WARFARE COMMAND AND CONTROL JTIDS/MIDS UNITS (NONEW C^2)

NonEW C^2 JUs are C^2 units which have no organic EW capability other than to:

a. Request EWS product information.

b. Use EWS product information in their own surveillance systems.

c. Coordinate activities of weapon systems with other C^2 JUs.

d. Control nonC^2 JU weapon platforms.

NonEW C^2 JUs do not participate in the EW Network PG and the EW control function.

4.5.1.4 COMMAND AND CONTROL ELECTRONIC WARFARE JTIDS/MIDS UNITS

C^2 EW JUs, in addition to the usual C^2 functions, possess organic EW processing capability. A C^2 EW JU has the capacity to collect, coordinate and analyze parametric ES data from the EW Network PG and derive EWS product information for reporting on the Surveillance Network PG. The C^2 EW JU participates in the EW Network PG to control and coordinate EW activities as well as the Surveillance Network PG(s). Additionally, a C^2 EW JU may participate on the Mission Management/Weapons Coordination Network PG(s).

4.5.1.5 NONCOMMAND AND CONTROL EW JTIDS/MIDS UNITS

A nonC^2 EW JU may be either an ES collecting/reporting unit or an EW weapons platform. NonC^2 EW JUs coordinate with C^2 EW JUs and/or with one another. They will participate on only the EW Network PG to facilitate the control, coordination, and exchange of EW information.

4.5.2 ELECTRONIC WARFARE COORDINATION PROCEDURES

EW control directs actions to be taken by EW Net participants involving radiated electromagnetic energy. Such actions include, among other things, ES, search, direction finding, track evaluation, and jamming. EW coordination includes the sharing of data among the EW net participants to provide the most complete evaluation and fixing of intercepted electronic emissions. The J14.2 EW Control/Coordination message is used to accomplish both objectives.

4.5.2.1 ELECTRONIC WARFARE CONTROL INFORMATION EXCHANGE REQUIREMENTS

The information exchange requirements are shown in Table 4.5-1 in relation to the Link 16 messages that support them.

4.5.3 ELECTRONIC WARFARE CONTROL/COORDINATION MESSAGE DESCRIPTION

Messages used to effect EW control and coordination and to report the results of EW requests are described in the following paragraphs.

4.5.3.1 ELECTRONIC WARFARE CONTROL/COORDINATION MESSAGE

The J14.2 EW Control/Coordination message provides the capability to control EW Net participants, to respond to EW Net participants' requests, and to coordinate EW activities among EW Net participants. Any EW Net participant may use the J14.2 message on the EW network. Coordination will be achieved by operational plans or by local procedures using voice or other means. The J14.2 EW Control/Coordination message contains the EW Action Value field which is used to specify a requested action and to report the results of this action. The code in the R/C field of the J14.2I word specifies the required responses to the J14.2 message. The Request Number field in the J14.2 provides an audit trail to ensure continuity between a request and a response. When the Request Number data element is set to zero in the J14.0 message, it identifies the message as an autonomous report. Refer to the J14.2 Message Summary Section 5.3 for the listing of the J14.2 message words and their respective Data Elements.

4.5.3.2 PARAMETRIC INFORMATION MESSAGE

The J14.0 Parametric Information message contains all of the detailed parametric information that may be the result of an ES action.

The unit originating a J14.0 EW Fix, AOP, or LOB report always retains reporting responsibility. It is illegal to assume reporting responsibility for another unit's J14.0 EW Fix, AOP, or LOB report. Each unit initiating a J14.0 EW Fix, AOP, or LOB report shall assign a TN not currently in use on the interface, even if is believed that such a report may concern the same emitter currently being reported in another J14.0 EW Fix, AOP, or LOB report by another unit. The exception is a unit originating a J14.0 report on an EW Fix, AOP, or LOB which is currently being reported in a J3.7 message by the same or another unit shall assign the same TN, Reference in the J14.0 message as contained in the J3.7 message. The Source TN of these J14.0 messages shall be the Source TN of the unit transmitting the J14.0 message. J14.0 messages transmitted by nonR^2 JUs with Response Indicator set to value 1 shall not affect reporting responsibility.

The J14.0I word contains the time the parametric information reported on the interface was valid; time is expressed in hours, minutes, and seconds.

Table 4.5-1. Electronics Warfare Control/Coordination Information Requirements (Sheet 1 of 2)

EW ACTION VALUE	TECHNICAL FUNCTION/ MESSAGE / EW INFORMATION EXCHANGE	CONTROL/ COORDINATION/J14.2	EW PARAMETER/J14.0	STATUS/J13
0	REQUEST PERIODIC REPORT	X, R*	R	
1	REQUEST AUTOMATIC EVALUATION	X, R*	X, R	
2	REQUEST MANUAL EVALUATION	X, R*	X, R	
3	REQUEST UPDATE AND WATCH	X, R*	R	
4	REQUEST DIRECTED SEARCH	X, R*	R	
5	CANCEL REQUEST	X		
6	CEASE REPORT	X		
7	EMITTER EVALUATION	X		
8	PARAMETER EVALUATION	X		
9	EMITTER ASSOCIATION	X		
10	EMITTER DISASSOCIATION	X		
11	NO FIND	X		
12	RESPONSE TO AN EW REQUEST	X	X	
13	EVALUATE TRACK	X, R*	R	
14	EVALUATE SECTOR	X, R*	R	

LEGEND (U)

(U) X = REQUEST
(U) R = RESPONSE NOT R/C
(U) R* = J14.2 WITH EW ACTION VALUE = 12

TABLE 4.5-1. Electronic Warfare Control/Coordination Information Requirements (Sheet 2 of 2)

EW ACTION VALUE	EW INFORMATION EXCHANGE / TECHNICAL FUNCTION/ MESSAGE	CONTROL/ COORDINATION/J14.2	EW PARAMETER/J14.0	STATUS/J13
15	DF REQUEST	X, R*	R	
16	PROTECT	X		
17	JAMMING REQUEST	X		
18	PARAMETER DATA UPDATE REQUEST BY TRACK NUMBER	X	R	
19	DEPLOY DECOYS	X		
20	PARAMETRIC DATA UPDATE REQUEST	X	R	
21	PARAMETRIC DATA UPDATE ORDER	X, R		
22	REQUEST EW SYSTEM STATUS	X		R
23	SET EMISSIONS CONTROL	X		
24	IMPLEMENT COOPERATIVE COUNTERMEASURES	X		
25	UNDEFINED			
26	TRACK NUMBER, REFERENCE/INDEX NUMBER CORRELATION	X		
27	UNDEFINED			
28	DISUSED			
29	DISUSED			
30	GUARD	X		
31	TABOO	X		
32-63	UNDEFINED			

LEGEND

X = REQUEST
R = RESPONSE NOT R/C
R* = J14.2 WITH EW ACTION VALUE = 12

4.5.3.3 ELECTRONIC WARFARE CONTROL/COORDINATION PROCEDURES

EW Control and Coordination procedures provide for the control of EW Net participants and the exchange of EW information between EW Net participants. These procedures facilitate conduct of traditional EW functions among the EW capable JUs. Procedures specifically designed for EW Control/Coordination are described in the following paragraphs.

In each of the following cases the addressee will respond to the requesting J14.2 message with the appropriate J14.2 message as required by the R/C procedures specified in paragraph 4.1.7. However, any J14.0 message transmitted automatically within 5 (5-15, 5) seconds in response to a J14.2 message shall suffice in lieu of a WILCO response.

In the following cases when a Reference TN is required, and one is not available, an index number may be used by those JUs incapable of assigning track numbers.

Requests and responses to requests shall be uniquely identified by the combination of Source TN, Addressee TN, and Request Number.

The associations reported in J14.2 EWAC=8, 9, 28, and 29 messages, and disassociation reported in J14.2 EWAC=10, message may be implemented for internal system use only. They need not be originated by operator action, nor displayed to operators.

4.5.3.3.1 REQUEST PERIODIC REPORT

A C^2 EW net participant will transmit a J14.2 message to an EW Net participant under its control to request periodic reports (on an EW intercept previously reported by the addressed EW Net participant) by specifying the track number in Reference TN, setting EW Action Value to value 0, and setting Periodicity of the Report to one of the following values:

1 - Once upon detection.

2 - Upon detection and at 1 minute intervals.

3 - Upon detection and at 5 minute intervals.

4 - Upon detection and at 15 minute intervals.

5 - Upon detection and at hourly intervals.

6 - Upon detection and in accordance with normal transmit rules thereafter.

The EW net participant (Addressee TN) will respond with a J14.2 (R/C=7) CANTPRO message if it does not have R^2 for the Reference TN. Otherwise, it will respond with periodic reports using the J14.0 message and the same Reference TN and Request Number value as in the requesting J14.2 message. The C^2 EW Net participant receiving the periodic reports may initiate the J3.7 Surveillance message on the Surveillance Network PG if the data are tactically significant.

The C^2 EW Net participant that requested the J14.0 message may cancel the J14.0 message responses by transmitting a J14.2 message with EW Action Value set to value 6.

4.5.3.3.2 REQUEST AUTOMATIC EVALUATION

The J14.2 message with EW Action Value set to value 1 requests an evaluation of parameters contained in the accompanying J14.0 message. To provide continuity between the requesting J14.2 message, the J14.0 parametric message and the responding J14.2 (EWAC=7) message, a Request Number will be provided in each initial word. Parameters considered in the automatic evaluation are Agile Emitter, Frequency/Frequency Range, Modulation Code, Pulse Repetition Frequency/Pulse Repetition Interval, Pulse Width, Jitter, Scan Type, Scan Rate, and Polarization. The responding J14.2 (EWAC=7) message may include the following data elements: Emitter Function, Emitter Number, Mode Number, and Emitter Confidence. Unreported data elements will be represented by No Statement.

4.5.3.3.3 REQUEST MANUAL EVALUATION

The J14.2 message with EW Action Value set to value 2 requests an evaluation of an EW LOB, AOP, or Fix designated by Reference TN, and its parameters as included in a previously reported, or if not previously reported, accompanying, J14.0 message. Based on information obtained from local sensors, comparison of emitter(s) characteristics to intelligence files, and/or information provided by remote sources, Emitter Number, Emitter Function, Mode Number and/or Emitter Confidence values, if determined, are assigned and reported in the responding J14.2 (EWAC=7) message that contains the emitter data.

EWAC=1 and 2 may be functionally combined. They may be designed as a single action, e.g., "Request Evaluation", for origination and display. All evaluation requests may be transmitted as EWAC=2. Upon receipt of either EWAC=1 or 2, the TN and all parameters for which an evaluation is requested may be made available for operator appreciation, with the receiving operator having the capability to select whether an operator (manual) or computer-derived (automatic) evaluation will be made.

4.5.3.3.4 REQUEST UPDATE AND WATCH

The J14.2 message with EW Action Value set to value 3 requests the addressee to make an initial EW report on the specified Reference TN previously reported by the addressee. The length of time the requested update reporting is to be performed may be indicated by Time Duration. If Periodicity of Report is set to value 0 (No Statement), a single report shall be made, and then the addressee shall watch the intercept and report only tactically significant changes. In this case Time Duration must be set to No Statement. Determination of tactical significance shall be an operator function, i.e., after the initial report subsequent updates must be operator initiated. The addressee shall respond with a J14.2 (R/C=7) CANTPRO message if it does not have R^2 for the Reference TN.

EWAC=3 is a special case of EWAC=0, i.e., it reports at a periodicity of once now and only upon changes considered tactically significant by an operator thereafter. Systems may be designed such that EWAC=0 and 3 are functionally combined. They may be designed as a single action, e.g., "Request Report", for origination and display, or amplified by a periodicity, which may be a watch request as defined above.

4.5.3.3.5 REQUEST DIRECTED SEARCH

A C^2 EW Net participant will transmit a J14.2 message with EW Action Value set to value 4 to request an EW Net participant or all EW Net participants to search designated parameters in a specified sector or area at a specified time, and to report the results. The length of time the requested search is to be performed may be indicated by Time Duration. The word sequences required to designate the search parameters listed below are:

a. Track Number - J14.2I.

b. Emitter Function - J14.2I/J14.2C3.

c. Emitter Number - J14.2I/J14.2C3.

d. Sector - J14.2I/J14.2C1.

e. Frequency - J14.2I/J14.2C4.

f. PRI/PRF - J14.2I/J14.2C8.

g. Bearing - J14.2I/J14.2C1.

h. Area of Probability (AOP) - J14.2I/J14.2E0/J14.2C2.

i. Platform Type - J14.2I/J14.2C5.

j. Latitude/Longitude/Altitude (if available) - J14.2I/J14.2C2.

k. Known Threats - J14.2I/J14.2C5.

The J14.2E0 word shall be sent immediately after the J14.2I word when either the Immediate Action Indicator, Minute, Hour, or Time Duration needs to be specified.

All of the parameters specified in a single J14.2 message with EW Action Value set to value 4 or in sequential J14.2 messages containing the same Request Number, shall be interpreted together, not constituting separate requests. For example, if Emitter Function, Sector, and Frequency are all designated in a single J14.2, the request means "Search the designated sector for an emitter with the indicated function and frequency". Systems must ensure that conflicting or confusing combinations of parameters are not designated.

Reference TN may be set to No Statement, or to the TN of an area to be searched, or to the TN of an existing track or intercept for which a search is directed. The J14.2 message with EW Action Value set to value 4 shall not be used to direct a search for an existing track in a specified area.

When a sector or bearing search is directed, i.e. when the J14.2C1 word is included, the Bearing Origin field shall be set to value 0 and the Track Number, Origin field shall be set to the TN of Track Number, Addressee; when the message is broadcast the Track Number, Origin field set to No Statement and each receiving JU shall use its own position as the origin of its search sector or bearing. The Receipt/Compliance field shall be set to value 0 for a sector or bearing search addressed to an individual JU, and to value 1 for a broadcast sector or bearing search.

If a J14.2 with R/C set to value 0 directs a search against known threats which are not implemented by the addressee, and no other implemented parameters are designated, the addressee shall transmit a J14.2 CANTPRO (R/C = 7) message with EW Action Value set to value 4.

Upon completion of the search with no results, the addressee will transmit a J14.2 message to the requesting unit containing the same Request Number and Reference TN values as were received, the EW Action Value set to value 11, and the Reference EW Action Value set to value 4. If information is available after the search, the addressee will transmit a J14.2 message to the requesting unit containing the same Request Number value received in the requesting J14.2 message. The data acquired during the search by the addressee will be transmitted to the requesting unit in a J14.0 message with the same Request Number value as was received.

4.5.3.3.6 CANCEL REQUEST

A C^2 EW Net participant may cancel a previous request by initiating the transmission of another J14.2 message to the same addressee indicating the request number to be cancelled and EW Action Value set to value 5, and Reference EW Action Value set to the EW Action Value of the previous request.

4.5.3.3.7 CEASE REPORT

The J14.2 message with EW Action Value set to value 6 directs the addressee to cease reporting on an EW LOB, AOP, or Fix specified in Reference TN. If the reports were in response to a previous request, Reference EW Action Value shall be set to the EW Action Value of the previous request. If Time Duration is set to a value other than No Statement, the reporting shall only be interrupted for the specified length of time, beginning either immediately after the reception of the J14.2 (Immediate Action Indicator set to value 1) or at a specified time.

4.5.3.3.8 EMITTER EVALUATION

The J14.2 message with EW Action Value set to value 7 provides an initial evaluation or an alteration to the present emitter evaluation, Mode Number, and/or Emitter Confidence of the Reference TN. If the Electronic Warfare Coordinator Indicator (EWC IND) is set to value 1, the evaluation is as directed by the EWC; otherwise the evaluation is as recommended by a nonEWC unit. The J14.2 message with EW Action Value set to value 7 shall be addressed to the collective address 00177 octal, except in response to a J14.2 (EWAC=20) message or a J7.1 message. In either case, R/C shall be set to value 1.

If the emitter evaluation is in response to a J14.2 (EWAC=1 or 2) evaluation request message, the J14.2 (EWAC=7) Request Number and Reference TN fields shall be set to the same values as in the received J14.2 (EWAC=1 or 2) message, and Reference EWAC field shall be set to value 1 or 2, as appropriate.

4.5.3.3.9 PARAMETER ASSOCIATION

The J14.2 message with EW Action Value set to value 8 reports that there is an association between Reference TN and Associated TN, which have similar parametric information, and the detected emissions are deemed to originate from the same emitter. If the EWC IND is set to value 1, the association is directed by the EWC; otherwise, the association is recommended by a nonEWC unit. The J14.2 message with EW Action Value set value to 8 shall be addressed to the collective address 00177 octal except in response to a J14.2 (EWAC=20) message or J7.1 message. In either case, R/C shall be set to value 1.

4.5.3.3.10 EMITTER ASSOCIATION

The J14.2 message with EW Action Value set to value 9 reports that the EW information identified by Reference TN and Associated TN is deemed to be collocated, i.e., emanating from the same platform but not the same emitter. If the EWC IND is set to value 1, the association is directed by the EWC; otherwise, the association is recommended by a nonEWC unit. The J14.2 message with EW Action Value set to value 9 shall be addressed to the collective address 00177 octal except in response to a J14.2 (EWAC=20) message or J7.1 message. In either case, R/C shall be set to value 1.

4.5.3.3.11 DISASSOCIATION

The J14.2 message with EW Action Value set to value 10 reports the disassociation of Reference TN from all existing parameter and/or emitter associations, leaving the remainder of the associations intact. If the EWC IND is set to value 1, the disassociation is directed by the EWC; otherwise the disassociation is recommended by a nonEWC unit. The J14.2 message with EW Action Value set to value 10 shall be addressed to the collective address 00177 octal.

4.5.3.3.12 NO FIND

When the results from a J14.2 request message with EW Action Value set to values 0 through 4, or 13 through 15 are negative, the EW Net participant (addressee) shall respond to the C^2 EW Net Participant with a J14.2 message containing the same Request Number, Reference EW Action Value, and Reference TN values as received, and EW Action Value set to value 11. When Reference EW Action Value is 0 or 3, No Find reports that contact has been subsequently lost. Otherwise, No Find reports that no detection has been made. This J14.2 message with EW Action Value set to value 11 shall be addressed to the originator of the request, but R/C shall be set to value 1. A J14.2 (EWAC=11) message shall not be transmitted in response to a J14.2 message addressed to the collective addressee $00177_{(8)}$.

4.5.3.3.13 RESPONSE TO AN ELECTRONIC WARFARE REQUEST

EW Action Value set to value 12 in the J14.2 message identifies the accompanying J14.0 message as a positive response to an EW directed action. Request Number and Reference EW Action Value will contain the same values as received in the request message and, if applicable, Reference TN will contain the same value as in the J14.2 request message. If Reference TN in the J14.2 request message was No Statement, Reference TN in this J14.2 and accompanying J14.0 shall be the TN of the data reported. Amplifying data shall be contained in a J14.0 message sequence. The J14.2 message with EW Action Value set to value 12 shall be addressed to the originator of the request, but R/C shall be set to value 1.

4.5.3.3.14 EVALUATE TRACK

A J14.2 message with EW Action Value set to value 13 directs the addressee to evaluate the sector specified in Sector Width, which is centered on the bearing between the receiving JU and the Reference TN, and whose origin is the receiving JU, and to report EA intercepts for the duration of the time specified in Time Duration. If Time Duration is No Statement, a one-time report is requested. If Sector Width is No Statement, a 360° search is requested. A search for specific jammers can be directed by specifying the jammer in Emitter Number, or a search within a particular frequency/frequency range and/or PRF/PRI can be directed by specifying the frequency/frequency range and/or PRF/PRI in the applicable fields. Origin TN in the J14.2C1 word must be set to No Statement, and Bearing and Bearing Origin must be set to their default values and not processed upon receipt. A unit may service multiple track evaluation requests. However, if a servicing unit is limited in capability to one request at a time per requesting unit, and a second track evaluation request is received from the same requesting unit, the servicing unit shall only service that unit's latest request. If the latest request causes the total number of evaluations that the unit can service simultaneously to be exceeded, the oldest request is cancelled and the new request is serviced.

4.5.3.3.15 EVALUATE SECTOR

A J14.2 message with EW Action Value set to value 14 directs the addressee to evaluate the sector specified in Sector Width, which is centered on the bearing specified in the Bearing field, and whose origin is the receiving JU, and to report EA intercepts for the duration of the time specified in Time Duration. If Time Duration is No Statement, a one-time report is requested. If Sector Width is No Statement, a 360° search is requested. Reference TN shall be set to zero. A search for a specific jammer can be directed by specifying the jammer in Emitter Number, or a search within a particular frequency/frequency range and/or PRF/PRI can be directed by specifying the frequency/frequency range and/or PRF/PRI in the applicable fields. A unit may service multiple sector evaluation requests. However, if a servicing unit is limited in capability to one request at a time per requesting unit, and a second sector evaluation request is received from the same requesting unit, the servicing unit shall only service that unit's latest request. If the latest request causes the total number of evaluations that the unit can service simultaneously to be exceeded, the oldest request shall be cancelled and the new request shall be serviced.

EWAC=13 and 14 may be combined. They may be designed as a single action, e.g., "Evaluate Jamming", for origination and display, with the originating operator having the capability to specify a track which is suspected of jamming. If no track is specified, the operator must have the capability to specify a bearing originating from the addressee. If no track or bearing is specified by the operator, the evaluation shall be omnidirectional, and a J14.2 (EWAC=14) message with Bearing = 0 and Sector Width = 180 shall be transmitted.

4.5.3.3.16 DIRECTION FINDER (DF) REQUEST

A C^2 EW Net participant will transmit a J14.2 message with EW Action Value set to value 15 to an EW Net participant under its control to initiate a DF search. Identification of the objective may be specified either by Reference TN or by frequency/frequency range. The specific time to take the DF action shall be specified in Hour, Minute, and Second of the J14.2E0 word. Upon completion of the DF action, a J14.0 message with the same Request Number as the requesting J14.2 will be used to report the bearing information. This J14.0 message shall be preceded by a J14.2 message with EW Action Value set to value 12 containing the same Request Number and with Reference EW Action Value set to value 15. The DF request may be promulgated to a group of EW Net participants via the collective address. Based on bearing information from various reporting units, the C^2 EW JU may report an EW fix in a J3.7 message.

4.5.3.3.17 PROTECT REQUEST

The J14.2 message with EW Action Value set to value 16 and a frequency/ frequency range specified by the J14.2C4 word requests that a friendly frequency/frequency range used for a particular operation shall be protected in order to prevent it from being inadvertently jammed by friendly forces while active EW operations are directed against hostile forces. The time and time duration of this frequency protection may be specified by Hour, Minute, and Time Duration of the J14.2E0 word; if no time and no time duration are specified, the frequency/frequency range protection shall last from the time of reception of the J14.2 message until either an appropriate cancel request is received or until a new protection for this frequency/frequency range is ordered. J14.2 messages containing this EW Action Value may be transmitted on both the EW NPG and the Weapons Coordination and Management NPG.

4.5.3.3.18 JAMMING REQUEST

The J14.2 message with EW Action Value set to value 17 initiates a jamming request against a specified emitter/platform, frequency/frequency range, track, or known threats in a specified sector, area or at a specified position to a specific JU, or directs the cessation of this kind of jamming. The time and time duration of the jamming may be specified in the J14.2E0 word; if no time and no time duration are specified, the jamming shall last from the time of reception of the J14.2 message until either an appropriate cancel request is received or a new jamming request for the specified emitter/platform, frequency/frequency range, track, or known threats in the sector, area, or at the position specified is ordered, or until tactically no longer required.

For jamming requests, the specific jamming to be accomplished is specified in various ways by the setting of the fields in the J14.2 message as follows:

a. Reference TN: "Jam Reference TN".

b. Bearing: "Jam on the bearing" (or if Sector Width is specified, "in the sector" which is centered on the bearing specified in the Bearing field, and whose origin is the receiving JU, or "in the specific direction", if Elevation Angle is included).

c. Position (specified by Latitude, Longitude, and Altitude (if available): "Direct jamming at the specified position."

d. Area (specified in the J14.2C2 word): "Jam in the specified area."

e. Emitter Number: "Jam the specified emitter."

f. Frequency: "Jam the frequency, or frequency range."

g. Specific known threats (as identified in the fields of the J14.2C5): "Jam all threats of the Nationality, Environment/Category, Platform, Activity, and/or Specific Type specified" or "Jam the threat identified by Local Discrete Identifier." Reference TN must be set to No Statement when this method of specifying jamming is used. If Local Discrete Identifier is specified, all other fields of the J14.2C5 must be set to No Statement.

All of the fields of the J14.2 which are specified shall be interpreted together as a single jamming request. For example, if Bearing and Frequency are specified, the addressed JU is requested to jam that frequency on the specified bearing.

The cessation of jamming is ordered by the J14.2 with EW Action Value set to value 17, and Automatic EA Negation set to value 1 and Request Number and Reference TN, if applicable, set to the same values used in a previous jamming request addressed to Addressee TN. The time of cessation can be ordered either by specifying a certain time in Hours, Minutes, and Seconds or by setting the Immediate Action Indicator to value 1. If all of these fields are No Statement, cessation of jamming is ordered immediately. When Automatic EA Negation is set to value 1, none of the J14.2 continuation words shall be transmitted.

4.5.3.3.19 DEPLOY DECOYS

The J14.2 message with EW Action Value set to value 19 orders the deployment of decoys in a specified sector or area. The type of decoys shall be specified in Decoy Type in the J14.2E0 word. The time and time duration of the decoy deployment may be specified in the J14.2E0 word; if no time and no time duration are specified, the decoy deployment shall last from the time of reception of the J14.2 message until either an appropriate cancel request is received or a new request for deployment of decoys for the specified sector or area is ordered, or until tactically no longer required.

J14.2 messages containing this EW Action Value may be transmitted on both the EW NPG and the Weapons Coordination and Management NPG. Other amplifying information about deployment is specified as follows:

a. Position or area in which decoys are to be deployed using the J14.2C2 word.

b. A corridor or sector along which decoys are to be deployed, specified as a line of bearing (with sector width if a sector) using the J14.2C1 word.

c. The frequency or frequency range to be decoyed using the J14.2C4 word.

The cessation of decoy deployment is ordered using the J14.2 with EW Action Value set to value 19 with Automatic EA Negation set to value 1 and Request Number set to the same value used in the previous order for deployment of decoys addressed to Addressee TN. The time of cessation can be ordered either by specifying a certain time in Hours, Minutes, and Seconds or by setting the Immediate Action Indicator to value 1. If all of these fields are No Statement, cessation of decoy deployment is ordered immediately.

4.5.3.3.20 PARAMETRIC DATA UPDATE REQUEST

The J14.2 message with EW Action Value set to value 20 requests that all EW parametric data which is not periodically updated at normal intervals be reported. Addressed units shall respond as follows:

a. If Addressee TN is set to value 00177 octal, transmit all J14.0 data which own JU is reporting in response to a J14.2 (EWAC=0) message with Periodicity of Report set to value 3, 4, or 5, or a J14.2 (EWAC=3) message, with the J14.0 Response Indicator, EWAC set to value 1. These J14.0 messages shall not be preceded by a J14.2 message with EW Action Value set to value 12, nor shall a J14.2 message with EW Action Value set to value 11 be transmitted by JUs which do not have R^2 for any J14.0 data. Transmit all J14.2 messages with EW Action Value set to values 7, 8, or 9 which own JU has originated and for which the evaluation or association is still effective. Those J14.2 messages shall be addressed to the requesting unit, with R/C set to value 1.

b. If Addressee TN is set to own JU's address, transmit J14.0 data which own JU is reporting in response to a J14.2 (EWAC=0) message with Periodicity of Report set to value 3, 4, or 5, or a J14.2 (EWAC=3) message with the J14.0 Response Indicator, EWAC set to value 1. These J14.0 messages shall not be preceded by a J14.2 message with EW Action Value set to value 12. Transmit all locally held EW evaluations and associations in J14.2 messages with the EW Action Value set to values 7, 8, or 9. These J14.2 messages shall be addressed to the requesting unit with R/C set to value 1.

4.5.3.3.21 SET EMISSIONS CONTROL

Upon receipt of a J14.2 message with EW Action Value set to value 23, the addressed JU shall set the EMCON specified in Plan Source and Plan Number, at the time specified, or immediately, as indicated by the Immediate Action Indicator in the J14.2E0 word. The duration of the EMCON may be specified, also. The Addressee TN can be either an individual or a collective address. J14.2 messages containing this EW Action Value may be transmitted on both the EW NPG and the Weapons Coordination and Management NPG.

4.5.3.3.22 TRACK NUMBER, REFERENCE/INDEX NUMBER CORRELATION

A C^2 EW JU will initiate a J14.2 message with EW Action Value set to value 26 to inform an EW Net participant that a track number has been assigned to the index number initiated by that Net participant. Upon receipt of a J14.2 message with EW Action Value set to value 26, the addressee will accept the track number specified in Reference TN for the track that has been identified by the index number specified in the J14.2 message. The Addressee TN shall then transmit a J14.0 containing the Reference TN with all current available data as a means of informing all other JUs on the EW NPG of the correlation.

4.5.3.3.23 GUARD REQUEST

The J14.2 message with EW Action Value set to value 30, and a frequency/frequency range specified by the J14.2C4 word indicates that this frequency/frequency range is currently being exploited for combat information and/or intelligence and therefore shall not be interfered with by friendly forces. The time and time duration of frequency protection may be specified by Hour, Minute, and Time Duration of the J14.2E0 word; if no time and no time duration are specified, the frequency/frequency range protection shall last from the time of reception of the J14.2 message until either an appropriate cancel request is received or until a new guard request for this frequency/frequency range is ordered. J14.2 messages containing this EW Action Value may be transmitted on both the EW NPG and the Weapons Coordination and Management NPG.

4.5.3.3.24 TABOO REQUEST

The J14.2 message with EW Action Value set to value 31, and a frequency/frequency range specified by the J14.2C4 word indicates that this frequency/frequency range is of such importance that it must never be deliberately jammed or interfered with by a friendly force. The time and time duration of frequency protection may be specified by Hour, Minute, and Time Duration of the J14.2E0 word; if no time and no time duration are specified, the frequency/frequency range taboo shall last from the time of reception of the J14.2 message until either an appropriate cancel request is received or until a new taboo request for this frequency/frequency range is ordered. J14.2 messages containing this EW Action Value may be transmitted on both the EW NPG and the Weapons Coordination and Management NPG.

4.5.4 TERMINATION OF ELECTRONIC WARFARE PARAMETRIC DATA

When a JU stops reporting EW information that it has been reporting on the EW NPG, it may transmit a J7.0 (ACT = 0) message on the EW NPG.

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4.6 AMPLIFICATION

Amplification information is exchanged in the J6.0 Amplification message.

The J6.0 Amplification message is used to report information gained by collection techniques; i.e., other than those normally associated with data link information reporting (radar and sonar contacts and EW detections), about surveillance tracks or points that are being reported in other messages. Any unit may use this message to provide amplifying information on an existing track or point.

This amplifying information is transmitted by the JU deriving the information and is independent of track reporting and R^2. The SPI field in the J6.0I Amplification initial word indicates whether the information contained in the J6.0 message requires special processing. The SPI field for this information is independent of the basic track message. Additionally, the SPI field value must be maintained when information received requires special processing and that information is retransmitted, unless all of the retransmitted information is derived by local means and does not require special processing or a determination has been made that special processing is no longer required. R^2, as defined for track messages, is not used for information reported in the J6.0 Amplification message. Any JU having information may report the most current local information and may report the latest data link information received for which no locally derived information is available.

The procedures for reporting amplification information are described below.

4.6.1 AMPLIFICATION INFORMATION

The TN of the track or point which is being amplified is contained in the J6.0I word. The specific type and activity amplification index of that TN are reported in the J6.0E0 word. When reporting the current activity of the track or point, the latest available information is reported redundantly in accordance with the message transmission rules. A change in the current activity shall interrupt the redundant transmissions. The capability exists in the J6.0 message to report pairings or engagements between any two TNs regardless of their environment/category. Even though this capability exists, it shall not be used to report pairings or engagements which are specified for reporting in the J10.6 Pairing message and the J10.2 Engagement Status message. Systems shall not allow the J6.0 messages that report pairings or engagements to overlay or replace pairings or engagements established by the J10.6 and J10.2 messages. When the display of both types of pairings or engagements is implemented, they must be unique so as to avoid operator misinterpretation.

4.6.2 RESET

The Reset To No Statement value is transmitted only as a result of operator action. It is provided to permit operators to change a reported nonzero value, in applicable fields except the TN field, to No Statement when the reported nonzero value is determined to no longer be valid because of erroneous entry; aging of data to such an extent that it is no longer tactically significant; the reporting process is no longer occurring; etc., and no other nonzero value for that particular field is appropriate for transmission. When a system can no longer support the continued reporting of the J6.0 message data due to reasons not associated with the degree of validity of the data, such as dropping the tracks due to display considerations, technical limitations as to number of tracks on which such data can be reported, etc., the Reset To No Statement value shall not be transmitted.

4.6.3 FILTERING OF AMPLIFICATION DATA

Systems implementing the transmission of the J6.0 message should have the capability to filter these messages based upon the setting of the SPI field. If the SPI field is set in the J6.0I word and a security filter exists on a specific link, the J6.0 message shall not be sent on that link even if a track alert exists on the associated track data. If it is determined that the J6.0 message data are to be transmitted or forwarded on a link that has a security filter, the SPI field must be set to zero or the security filter must be removed. The determination to transmit or forward the J6.0 message data will be controlled by the interface operating procedures.

4.6.4 TERMINATION OF AMPLIFICATION DATA

The transmission of Amplification data shall be terminated when the track or point being amplified is no longer being reported on the interface. The information may be purged in accordance with system design.

4.6.5 RESPONSE INDICATOR

When the J6.0 message is being retransmitted as a result of a J7.1 Data Update Request message, the Response Indicator field shall be set to 1.

4.6.6 AMPLIFICATION OF J6.0 AMPLIFICATION REQUIREMENTS

The following paragraphs provide additional clarification of the primary purpose of certain J6.0 data fields.

4.6.6.1 TRACK NUMBERS

All track numbers contained in J6.0 messages must exist on the interface in other than J6.0 messages, i.e., the J6.0 messages shall not be used to originate a track. The primary purposes of the three J6.0 TN fields are as follows:

a. The Reference TN is the track or point about which the amplifying information applies.

b. The Objective TN is a track or point that is being targeted by the Reference TN. The specific targeting action being taken by the Reference TN against the Objective TN may be reported in the Activity Amplification Index field (see paragraph 4.6.6.2).

c. The TN of the Controlling Agency of the Reference TN is a track or point that is controlling or providing direction to the Reference TN.

4.6.6.2 ACTIVITY AND ACTIVITY AMPLIFICATION INDEX (AAI)

The Activity field reports the activity currently being conducted by the Reference TN. The AAI field reports additional information about the current activity of the Reference TN. The meaning of these two fields depends on the Environment/Category (E/C) of the Reference TN. Activity need not be reported when reporting AAI, i.e., Activity may be zero when AAI is nonzero. Note that the first ten values (1-10) of AAI for each E/C report actions normally associated with engagement. Furthermore, the first ten values of Air and Land AAI are specifically designed to represent a normal engagement sequence.

4.6.6.3 LOCAL DISCRETE IDENTIFIER (LDI)

The LDI field is used to report a number between 1 and 4094, the meaning of which has been promulgated separately by Operation Order or other means. The LDI field provides additional amplifying information about the Reference TN. It may be used for any such purpose deemed necessary by the operational commander, although its use will normally be confined to supporting the amplification reporting function. The J6.0 and J14.0 LDI fields are independent of each other, i.e.; the operational commander may promulgate two separate LDI lists, one to support amplification reporting and another to support EW reporting, or the operational commander may specify identical LDI lists for the J6.0 and J14.0. If the Reference TN is being reported in both a J6.0 and J14.0 message, the LDI field reported in each need not be the same. Also, the J6.0 and J14.0 LDI fields are independent of the J7.5 Special Code I, II, III fields. The Special Code fields are used for a similar purpose as the LDI fields, but are normally for general use rather than supporting amplification or EW reporting. However, an operational commander may specify identical Special Code and LDI lists.

4.6.7 CONFLICTS BETWEEN J6.0 DATA AND OTHER DATA

J6.0 information shall be independent of data reported in other messages, except the TNs. There is no intent to protect against or to report conflicts. For example, the Platform and/or Platform Activity of the Reference TN reported in a J6.0 message need not be the same as, or even consistent with, the Platform and/or Platform Activity reported for the Reference TN in J3 series messages. The protocols in paragraphs 4.7.1.2 for Data Differences and 4.7.1.3 for Change Data Orders do not apply to J6.0 data. However, differences between the locally held Surveillance E/C and the locally derived E/C shall be resolved before originating or updating amplification information. If the unit originating amplification information also has R^2 for the reference TN, the reported Surveillance E/C and the E/C reported in the J6.0 message must be the same. If the unit does not hold R^2 for the Reference TN, it shall either change the E/C reported in the J6.0 message to that reported by the R^2 unit, or transmit a J7.0 (ACT = 1) E/C Difference Report, and shall not transmit the J6.0 Amplification message until a track report is received with the same E/C as the locally derived E/C reported in the J6.0 message. If the received J6.0 E/C does not match the E/C of the held TN, the J6.0 message shall be discarded.

4.6.8 PROCESSING AMPLIFICATION DATA FROM MULTIPLE DATA SOURCES

Processing of amplification data upon receipt is a system option, subject to the J6.0 message Minimum Implementation requirements and Receive Rules, and the forgoing rules in this section. Therefore, if remote J6.0 data are received from multiple sources about the same track, systems may choose to store and display the data from any or all of these sources, and select the data to be retained either automatically or manually.

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4.7 INFORMATION MANAGEMENT

Data management procedures are required to insure that all systems can properly exchange information when operationally interfaced. These procedures are accomplished through the use of Information Management messages. These messages are provided to clarify, correct, and control the flow of data when necessary. The Information Management messages are:

a. J7.0 Track Management message.

b. J7.1 Data Update Request message.

c. J7.2 Correlation message.

d. J7.3 Pointer message.

e. J7.4 Track Identifier message.

f. J7.5 IFF/SIF Management message.

g. J7.6 Filter Management message.

h. J7.7 Association message.

i. J8.0 Unit Designator message.

j. J8.1 Mission Correlator Change message.

4.7.1 TRACK MANAGEMENT

The J7.0 message is used to effect the following management actions on the interface:

a. Dropping or ceasing to report a track.

b. Reporting differences in Environment/Category and/or ID.

c. Changing Environment/Category and/or ID.

d. Setting or changing the alert indicators.

e. Changing the Strength fields.

f. Changing of Exercise status.

4.7.1.1 DROP TRACK REPORT

The J7.0 (ACT = 0) Drop Track Report message is transmitted by the JU with R^2 to indicate that the JU with R^2 specified in the Source TN field has dropped or has ceased reporting the track specified in the Reference TN field. A J7.0 (ACT = 0) message shall not be sent when a track is no longer being reported due to a shift in R^2.

4.7.1.2 IDENTITY (ID) AND ENVIRONMENT/CATEGORY (E/C) DIFFERENCE REPORT

The exchange of Surveillance data requires procedures to recognize and resolve differences in ID and Environment/Category. The J7.0 (ACT = 1) Difference Report message indicates that the JU specified in the Source TN field has local Environment/Category, ID, Identity Amplifying Descriptor, or Exercise Indicator data information different from that currently being reported on the track specified in the Reference TN field. The J7.0 (ACT = 1) Difference Report may also indicate that the transmitting JU has different data in the Platform and/or Platform Activity fields; however, differences in these fields shall be included only when differences in the Environment/Category, Identity, Exercise Indicator, or Special Interest Indicator are also being reported for the specified track.

When a JU receives a Surveillance message or a J7.0 (ACT = 1) message in which the air, surface (maritime), or land (ground) Environment/Category and ID are different from the local Environment/Category and ID, the Environment/Category conflict shall be processed and resolved prior to the resolution of the ID conflict. That is, if an Environment/Category conflict is detected, no further processing to detect an ID conflict need occur.

When a JU receives a Surveillance message in which the Exercise Indicator is different from local Exercise Indicator data or a J7.0 (ACT = 1) message in which the Exercise Indicator is different from the local Exercise Indicator, a conflict exists and the operator shall be alerted for manual resolution. Exercise Indicator conflicts will be resolved prior to ID or Identity Amplifying Descriptor Conflict resolution. Identity Amplifying Descriptor conflicts are processed in the same manner as ID conflicts.

4.7.1.2.1 ENVIRONMENT/CATEGORY CONFLICTS

Only the following Environment/Category changes/differences shall be reported on the interface:

a. Space to air.

b. Air to space, surface (maritime), land (ground).

c. Surface to air, subsurface (maritime).

d. Subsurface (maritime) to surface (maritime).

e. Land (ground) to air, surface (maritime).

f. Unknown to space, air, surface (maritime), subsurface (maritime), land (ground) (applicable to EW reports only).

When a JU changes the Environment/Category of a track, as specified above, or when a difference report is rejected by an operator action, the information shall be reported as follows:

a. If a JU has R^2, the local Environment/Category shall be transmitted in the appropriate Surveillance report.

b. If a JU does not have R^2, the local information shall be transmitted in the J7.0 (ACT = 1) message for conflicts.

When an R^2 JU changes the Environment/Category of a surveillance entity, either as a result of operator initiative or acceptance of a J7.0 (ACT=1) Difference Report or (ACT=2) Change Data Order, the decision to retain the original TN or report the entity with a new TN shall be in accordance with paragraph 4.4.2.8 and the rules specified in Table 4.7-1.

If the locally held Environment/Category of a track is different from the Environment/Category received in a J3.X or a J7.0 (ACT = 1) message for that track, the operator shall be alerted (see Table 4.7-1). This alert shall be provided even in those cases where the received Environment/Category is not implemented.

If the local data and the received data differ as to whether the TN is assigned to a point or to a track, the operator shall be alerted.

4.7.1.2.2 IDENTITY DIFFERENCE RESOLUTION

ID differences occur when a JU holds a local ID on a track (local data) which differs from the ID being reported on the interface (remote data). Interface procedures are required to recognize and resolve these ID differences. All IUs should hold the same ID (common ID) for a given track, and any evaluated change by an operator to this common ID should be accommodated by the interface. Table 4.7-2 presents the framework for processing these Identity differences. An ID conflict exists when the ID difference cannot be automatically accepted or rejected. In the case of ID conflicts, these differences must be presented to the operators for their evaluation. These conflicts may also require voice coordination for final resolution. Operator alerts and actions not specifically required by procedures included in this section are system options at any time. Receipt of ID data on a TN for which the receiving JU does not have R^2 and local positional data is not held will automatically be accepted and the remote ID placed in the database for retention.

TABLE 4.7-1. Environment/Category Difference Resolution and Track Number Continuity on Change of Entity Type

Current \ New	SPACE TRK	AIR TRK	SURF TRK	SUB TRK	LAND TRK	LAND PT	EW FIX (1)	EW AOP (1)	ASW R/B	ASW POINTS
SPACE TRK	N/A	S	X	X	X	X	N	N	X	X
AIR TRK	S	N/A	S	X	S	X	N	N	X	X
SURF TRK	X	S	N/A	S	S	X	N	N	N	N(3)
SUB TRK	X	X	S	N/A(4)	X	X	N	N	N	N(3)
LAND TRK	X	S	S	X	N/A	N	N	N	X	X
LAND PT	N	N	N	N	N	N/A	N	N	X	X
EW FIX (1)	N	N	N	N	N	S	N/A	(2)	X	X
EW AOP (1)	S	S	S	S	S	S	S	N/A	X	X
ASW R/B	X	X	S	S	X	X	X	X	N/A	N
ASW POINTS	X	X	N(3)	N(3)	X	X	X	X	N	N/A

LEGEND

S = SAME TN. LEGAL CHANGE OF ENV/CAT; ORIGINAL TN IS RETAINED AND ENTITY IS REPORTED IN THE APPROPRIATE J3.X SURVEILLANCE MESSAGE. RECEIVING JUS SHALL ALERT THE OPERATOR TO THE ENV/CAT CHANGE. IF A CHANGE OF ENV/CAT IS PROPOSED BY J7.0 (ACT=1) MESSAGE, ACCEPTANCE OR REJECTION OF THE RECEIVED DATA BY THE R^2 JU SHALL BE BY MANUAL ACTION. A JU'S DATA SHALL NOT BE CHANGED UNTIL AFTER ACCEPTANCE BY THE R^2 JU OPERATOR.

N = NEW TN. LEGAL CHANGE OF ENV/CAT; NEW TN MANDATORY. IF THE ENV/CAT CHANGE HAD BEEN PROPOSED BY J7.0 (ACT=1) MESSAGE, ACCEPTANCE OR REJECTION OF THE DATA BY THE R^2 JU SHALL BE BY MANUAL ACTION. IF THE PROPOSED ENV/CAT CHANGE IS ACCEPTED BY THE R^2 JU IT SHALL TRANSMIT A J7.0 (ACT=0) DROP TRACK MESSAGE FOR THE ORIGINAL TN AND REPORT THE ENTITY AS A NEW TN IN THE APPROPRIATE J3.X SURVEILLANCE MESSAGE OR J5.4 MESSAGE. A JU'S DATA SHALL NOT BE CHANGED UNTIL AFTER ACCEPTANCE BY THE R^2 JU'S OPERATOR.

X = ILLEGAL ENV/CAT CHANGE SPECIFIED BY PARAGRAPH 4.7.1.2.1. IF RECEIVED REJECT DATA.

NOTES

1. THE EW ENTITIES IN THE TABLE REFER ONLY TO EW PRODUCTS TRANSMITTED IN THE J3.7 MESSAGE.
2. IF AN AOP IS FORMED FROM A SINGLE FIX, THE SAME TN SHALL BE RETAINED; IF AN AOP IS FORMED FROM 2 OR MORE FIXES, A NEW TN SHALL BE ASSIGNED.
3. APPLICABLE ONLY TO ASW POINTS/POINT AMP AS FOLLOWS: POINT TYPE 7, POINT AMPLIFICATION 1 (SINKER), 2 (BRIEF CONTACT), 4 (ESTIMATED POSITION (EP)), 5 (FIX (ASW)) AND 12 (AREA OF PROBABILITY (ASW)); OTHERWISE X.
4. FOR DATA REPORT TYPE 4 (DATUM), THE SAME TN MAY BE USED BY OPERATOR ACTION.

a. Reporting of Local ID data Changes. Changes to local ID data will be reported on the interface in accordance with the following rules.

(1) The R^2 unit will transmit the changed identity in the appropriate surveillance message at the next transmit opportunity. The Identity Difference Indicator shall be set to value 0.

(2) All other interface units will report the changed ID in a J7.0 (ACT = 1) Difference Report message. If the interface unit is in control but does not have R^2 for the Reference TN the resultant J7.0 (ACT = 1) will have the Controlling Unit Indicator field set to value 1.

b. Processing of ID Difference Reported in a Surveillance Message. When the ID reported in a surveillance message is different from local data, interface units shall take the following actions:

(1) Controlling Unit. The controlling unit of the track shall automatically reject the received ID data and transmit a J7.0 (ACT = 1) message with own unit data, and with the Controlling Unit Indicator field set to value 1. These actions are taken without regard to the setting of the Identity Difference Indicator in the surveillance message.

(2) Other NonR^2 Units.

(a) If the Identity Difference Indicator is set to value 0, the difference shall be resolved in accordance with Table 4.7-2. If directed to automatically accept the remote ID, the system shall update the local ID with the remote ID. If directed to automatically reject the remote ID, the system shall transmit a J7.0 (ACT = 1) with local data. In all other cases the nonR^2 unit's operator shall be alerted and the ID conflict will be resolved by operator action.

(b) If the Identity Difference Indicator is set to value 1, the nonR^2 unit may either:

1 Follow the actions in Table 4.7-2, but where a conflict is indicated the unit shall inhibit transmission of the J7.0 (ACT =

1) message until the surveillance message is received with the Identity Difference Indicator reset to value 0, or

2 Take no action with respect to the reported ID; an operator alert may be provided as a system option.

c. Processing of ID Differences Reported in the J7.0 (ACT = 1) Message.

(1) Controlling Unit. A controlling unit receiving a J7.0 (ACT = 1) message which reports an ID of a locally-controlled track different from the local ID data shall automatically reject the received ID and originate a J7.0 (ACT = 1) message containing the local ID data and with the Controlling Unit Indicator field set to value 1. If the controlling unit also has R^2, the next scheduled track update by the appropriate surveillance message shall contain local data and the Identity Difference Indicator shall be set to value 0.

(2) Other Interface Units. All interface units receiving a J7.0 (ACT = 1) message from the controlling unit (Controlling Unit Indicator field set to value 1) shall automatically accept the remote data for database update. The JU with R^2 for the track shall report the updated track information in the appropriate surveillance message at the next transmit opportunity and shall set the Identity Difference Indicator to value 0. The ID received in the J7.0 (ACT = 1) message, with the Controlling Unit Indicator field set to value 0, shall be processed in accordance with Table 4.7-2. Actions by interface units shall be as follows:

(a) R^2 JU.

1 If the R^2 JU is directed to automatically accept the remote ID, the system shall update the local database and the new track data shall be reported in the appropriate surveillance message at the next transmit opportunity.

2 If the R^2 JU is directed to automatically reject the remote ID, the system shall discard the message and the track shall continue to be reported with local data.

3 If the R^2 JU identifies that an ID conflict exists, the operator shall be alerted and the local ID data shall continue to be reported in the appropriate surveillance message, with the Identity Difference Indicator set to value 1. The conflict will be resolved by manual means.

(b) NonR^2 JUs. NonR^2 JUs may either:

1 Follow the actions in Table 4.7-2, but where a conflict is indicated the unit shall inhibit transmission of the J7.0 (ACT = 1) until the surveillance message is received with the Identity Difference Indicator set to value 0, or

2 Take no action with respect to the reported ID; an operator alert may be provided as a system option.

TABLE 4.7-2. Identity Difference Resolution

	REMOTE DATA						
LOCAL DATA	PENDING	UNKNOWN	ASSUMED FRIEND	FRIEND	NEUTRAL	SUSPECT	HOSTILE
PENDING	0	2	2	2	2	2	1*
UNKNOWN	3	0	2	2	2	2	1*
ASSUMED FRIEND	3	3	0	2	2	1	1
FRIEND	3	3	3	0	1	1	1
NEUTRAL	3	1	1	1	0	1	1
SUSPECT	3	3	1	1	1	0	1*
HOSTILE	3	1	1	1	1	1	0

LEGEND
0 = NO ACTION: Take no action on the data link.

1 = OPERATOR ALERT: An Alert requiring the operator to take a MANUAL action to accept or reject the received ID.

2 = ACCEPT: Automatically accept received ID as LOCAL ID.

3 = REJECT: Automatically reject received ID.

* IN THESE THREE CASES ABOVE, SYSTEMS MAY HAVE A FEATURE TO AUTOMATICALLY ACCEPT RECEIVED ID AS LOCAL ID.

4.7.1.2.3 USE OF THE PPLI TRACK NUMBER AND IDENTITY INDICATOR IN THE RESOLUTION OF ENVIRONMENT/CATEGORY, IDENTITY AND EXERCISE INDICATOR DIFFERENCE RESOLUTION

Notwithstanding the requirements of paragraph 4.7.1.2.1 and 4.7.1.2.2, a C^2 JU may elect to accept, automatically, changes in Environment/Category, Identity or Exercise Indicator received in a track report with the PPLI Track Number and Identity Indicator set to value 1, provided the new identity is Friend and the locally held identity is not Hostile.

4.7.1.2.4 PLATFORM/PLATFORM ACTIVITY/SPECIFIC TYPE AND SPECIAL INTEREST INDICATOR DIFFERENCE RESOLUTION

Difference resolution of the Platform/Platform Activity/Specific Type and Special Interest Indicator field values is not mandatory. A change in the ID of a given track shall include the appropriate evaluation of the Platform/Platform Activity/Specific Type and Special Interest Indicator fields, and shall be included in the J3.X or J7.0 (ACT = 1) message. When accepting a remote ID change, C^2 JUs shall also retain the received values of the Platform, Platform Activity, Specific Type, and Special Interest Indicator fields, where those fields are implemented, for retransmission and operator appreciation. The only exceptions to this rule during the resolution of differences are:

a. For controlling units, see paragraphs 4.7.1.2.2b and c.

b. When a Platform, Platform Activity or Specific Type value of 0, No Statement, is received and a non-zero value is held locally.

c. When an Air Platform value of 6, Tanker, 7, Tanker (Boom Only), or 8, Tanker (Drogue Only) is held locally and a different value is received. An operator alert in this situation is optional.

4.7.1.3 CHANGE DATA ORDER

Differences in the Environment/Category, ID, Platform, Platform Activity, Specific Type, Exercise Indicator and Special Interest Indicator field values may also be resolved with the use of the J7.0 (ACT = 2) message. The J7.0

(ACT = 2) message is mandatory for reception and the data must be displayed to the operator. The received data, if implemented, must be accepted for retransmission except as indicated in rule e below. The use of the J7.0 (ACT = 2) message requires the following rules:

a. Transmission of the J7.0 (ACT = 2) message is initiated only by operator action. When a JU transmits this message, the JU shall reject any received data on that track that differ for a 30-second lock-out period, except for ID data from the controlling unit of the track and for processing an Exercise Status Order.

b. Except for processing an Exercise Status Order, once the J7.0 (ACT = 2) message has been received and accepted, a JU shall not transmit or accept any data on the track which differs from the data received in the J7.0 (ACT = 2) message until a 30-second lock-out has elapsed. At that time, normal track position and information conflict message transmission and reception procedures apply. There are two exceptions to the above rule as follows:

(1) After reception of the J7.0 (ACT = 2) message, JUs shall accept different data prior to the completion of the 30-second lockout period provided the different data from the same source that originated the previous J7.0 (ACT =2) message.

(2) After reception of the J7.0 (ACT = 2) message, JUs shall accept different ID data prior to the completion of the 30-second lockout period provided the different ID data from the controlling unit.

c. JUs shall not transmit a J7.0 (ACT = 2) message containing an ID of Pending.

d. Units receiving a J7.0 (ACT = 2) Change Data Order message containing an ID of Pending shall not accept that order.

e. Receiving JUs which do not implement the changed Environment/Category and have R^2 on the track must cease reporting the track and transmit a J7.0 (ACT = 0) message.

f. Controlling units receiving a J7.0 (ACT = 2) message need not accept that order if the data is different from that on the locally controlled aircraft. Rejection of the J7.0 (ACT = 2) message is discussed in paragraph 4.7.1.3.1 below.

4.7.1.3.1 CONTROLLING UNIT RESPONSE TO CHANGE DATA ORDERS ON CONTROLLED TRACKS

Changes in data need not be accepted on tracks by the JU that is controlling the track. If these changes are not accepted, the controlling unit shall transmit its locally held data in a J7.0 (ACT = 1) message with the Controlling Unit Indicator field set. In addition, if the controlling unit has R^2, it shall continue to transmit the locally held ID data in a J3.X message.

4.7.1.4 ALERT INDICATORS

Two types of alert indicators are used on the interface:

a. Force Tell Indicator (FT IND). This indicator provides the capability to designate certain IUs, tracks, points, and EW data as being of particular interest on the interface, and the capability to override all operator controllable filters, including security filters.

b. Emergency Indicator (EMG IND). This indicator provides the same capabilities as the FT IND and also defines a condition which requires immediate attention or assistance, e.g., an aircraft with an emergency or a distressed vehicle.

The use of these alert indicators depends upon the type of message to which they apply, as shown in Table 4.7-3.

TABLE 4.7-3. Alert Indicators

IU/ TRACK/ POINT \ MESSAGE TYPE/ IND	MESSAGE TYPE	MESSAGE CONTAINS EMG IND	EMG IND SET TO 1 BY J7.0 (ACT = 3)	EMG IND SET TO 0 BY J7.0 (ACT = 3)[1]	MESSAGE CONTAINS FT IND	FT IND SET TO 1 BY J7.0 (ACT = 4)	FT IND SET TO 0 BY J7.0 (ACT = 4)[2]
PU/RU	J2.0	X	X	X	X	X	X
JU	J2.2 J2.3 J2.4 J2.5 J2.6	X X X X X	3 3 3 3 3	3 3 3 3 3	X X X X X	X X X X X	X X X X X
REFERENCE POINT	J3.0	4	4	4	X	X	X
AIR TRACK	J3.2	X	X	X	X	X	X
SURFACE (MARITIME) TRACK	J3.3	X	X	X	X	X	X
SUBSURFACE (MARITIME) TRACK	J3.4	X	X	X	X	X	X
LAND (GROUND) POINT/TRACK	J3.5	X	X	X	X	X	X
SPACE TRACK	J3.6	4	4	4	X	X	X
EW PRODUCT INFORMATION	J3.7	X	X	X	X	X	X
ACOUSTIC BEARING/RANGE	J5.4	X	X	X	X	X	X

NOTES

1. AN EMG IND SET TO 1 IS RESET TO 0 THROUGH THE USE OF A J7.0 (ACT = 3) EMERGENCY STATUS CHANGE MESSAGE.
2. AN FT IND SET TO 1 IS RESET TO 0 THROUGH THE USE OF A J7.0 (ACT = 4) FORCE TELL STATUS CHANGE MESSAGE.
3. EMG IND SET/CLEARED BY JU ON ITSELF ONLY IN APPROPRIATE J2 MESSAGE.
4. EMERGENCY ON REFERENCE POINTS OR SPACE/BALLISTIC MISSILE TRACKS SHALL NOT BE INITIATED.

The paragraphs below explain how the EMG IND and FT IND are set and cleared for each message when the appropriate condition exists.

4.7.1.4.1 ALERT INDICATORS FOR PARTICIPATING UNITS/REPORTING UNITS

An FJU shall indicate that an emergency or force tell alert exists on a PU/RU by setting the appropriate indicator in the J2.0 Indirect Interface Unit PPLI message. All receiving JUs shall accept the alert in their databases. The FJU shall terminate an emergency or force tell alert on a PU/RU by transmitting a J7.0 (ACT = 3 or 4) message clearing the alert indicator and forwarding subsequent J2.0 messages with the appropriate EMG IND or FT IND set to 0. All receiving JUs shall clear the alert in their databases upon receipt of the J7.0 (ACT = 3 or 4). Optionally, alerts may be cleared by reception of a J2.0 message with the EMG IND and/or FT IND set to value 0.

A JU shall initiate/terminate an alert on a PU/RU being forwarded onto Link 16 by setting/clearing the alert indicator with a J7.0 (ACT = 3 or 4) message. Upon receipt, the FJU shall accept and report the condition in the J2.0 message. Other receiving JUs shall initiate/terminate the alert in their databases upon receipt of the J7.0 (ACT = 3 or 4) message. Optionally, alerts may be cleared by reception of a J2.0 message with the EMG IND and/or FT IND set to value 0.

4.7.1.4.2 ALERT INDICATORS FOR JTIDS/MIDS UNITS

Each JU shall initiate an emergency alert on itself by setting the EMG IND in its J2 messages. All receiving C^2 JUs shall accept the alert in their databases.

Each JU shall terminate an emergency alert on itself by setting the EMG IND to value 0 in its subsequent J2 messages. All receiving JUs shall clear the alert in their databases, if set, upon receipt of a J2 message with the EMG IND set to value 0.

A JU shall not initiate or terminate an emergency alert on another Active JU.

A C^2 JU shall have the capability to initiate/terminate a force tell alert on another JU by setting/clearing the FT IND in a J7.0 (ACT = 4) message. Upon receipt, the JU whose force tell status is being changed shall accept and report the change in its J2 message. The other JUs shall set/clear the alert indicator in their databases upon receipt of the J7.0 (ACT = 4) message. Optionally, other JUs may clear the alert indicator upon reception of a J2 message with FT IND set to value 0.

4.7.1.4.3 ALERT INDICATORS FOR REFERENCE POINTS, LINES, AND AREAS

A JU with R^2 shall initiate a force tell alert on a reference point, line, or area by setting the FT IND in the J3.0 Reference Point message. All receiving JUs shall accept the alert.

The JU with R^2 shall terminate a force tell alert by transmitting a J7.0 (ACT = 4) message terminating the alert and setting the FT IND in subsequent J3.0 messages to value 0. All receiving JUs shall terminate the alert upon receipt of the J7.0 (ACT = 4) message. Optionally, alerts may be cleared by reception of a J3.0 message with FT IND set to value 0.

When another JU assumes R^2 for the point, line, or area, it shall transmit the appropriate FT IND value as previously received in the J3.0 message.

A JU without R^2 shall initiate/terminate a force tell alert by setting/ clearing the FT IND in a J7.0 (ACT = 4) message. Upon receipt, the JU with R^2 shall set/clear the FT IND in the J3.0 message. Other receiving JUs without R^2 shall set/clear the FT IND upon receipt of the J7.0 (ACT = 4) message. Optionally, alerts may be cleared by reception of a J3.0 message with the FT IND set to value 0.

The JU with R^2 shall initiate a force tell alert on a segmented line or multisided area by transmitting the FT IND set to value 1 in all J3.0 messages used to report the line or area. The JU with R^2 shall terminate a force tell alert by transmitting a J7.0 (ACT = 4) message terminating the alert for each Reference TN which has been used to report the line or area and setting the FT IND to value 0 in subsequent J3.0 messages.

A JU without R^2 shall initiate/terminate a force tell alert on a segmented line or multisided area by setting/clearing the FT IND in a J7.0 (ACT = 4) message for each Reference TN which has been used to report the line or area. Upon receipt, the JU with R^2 shall set/clear the FT IND in all J3.0 messages used to report the line or area.

All receiving JUs shall set the FT IND to value 1 in their database for all TNs in a segmented line or multisided area if a J3.0 message with the FT IND field set to value 1 or a J7.0 (ACT = 4) message with the Alert Status Change field set to value 1 is received for any TN in the line or area. All receiving JUs shall terminate the force tell alert on all TNs in a segmented line or multisided area on receipt of a J7.0 (ACT = 4) message clearing the force tell on any TN in the line or area.

A JU initiating a force tell alert on a slaved reference point or area shall also initiate an alert on the Related TN, as specified above, if Related TN does not already have the FT IND set. When the alert is terminated for the reference point or area, the JU terminating the alert shall also terminate the alert for Related TN, unless Related TN had the FT IND set prior to the slaved point or area alert being initiated. A JU terminating a force tell alert on a track shall also terminate the force tell alert on any reference point or area that is slaved to the track.

Emergency alerts are not used on reference points, lines, or areas.

4.7.1.4.4 ALERT INDICATORS FOR EMERGENCY POINTS

Alerts are not used for the J3.1 Emergency Point message since these points cannot be filtered.

4.7.1.4.5 ALERT INDICATORS FOR TRACKS

A JU with R^2 shall initiate an emergency or force tell alert on tracks by setting the appropriate EMG IND or FT IND in the J3.2 Air Track, J3.3 Surface (Maritime) Track, J3.4 Subsurface (Maritime) Track, or J3.5 Land (Ground) Point/Track message. All receiving JUs shall accept the alert in their databases.

The JU with R^2 shall terminate an emergency or force tell alert by transmitting a J7.0 (ACT = 3 or 4) message terminating the alert and setting the appropriate EMG IND field or FT IND field in subsequent J3.2, J3.3, J3.4, or J3.5 messages to 0. All receiving JUs shall terminate the alert in their databases upon receipt of the J7.0 (ACT = 3 or 4) message. Optionally, alerts may be cleared by reception of a J3.X message with the EMG IND and/or FT IND set to value 0.

When another JU assumes R^2 for a track, it shall transmit the appropriate EMG IND or FT IND which was received in previous J3.2, J3.3, J3.4, or J3.5 messages.

A JU without R^2 shall initiate/terminate an emergency or force tell alert by setting/clearing the appropriate EMG IND or FT IND in a J7.0 (ACT = 3 or 4) message. Upon receipt, the JU with R^2 shall set/clear the appropriate EMG IND or FT IND in the J3.2, J3.3, J3.4, or J3.5 message. Other receiving JUs without R^2 shall set/clear the appropriate EMG IND or FT IND in their databases upon receipt of the J7.0 (ACT = 3 or 4) message. Optionally, alerts may be cleared by reception of a J3.X message with the EMG IND or FT IND set to value 0.

4.7.1.4.6 ALERT INDICATORS FOR LAND (GROUND) POINTS OR SUBSURFACE CONTACTS

A JU with R^2 shall initiate an emergency or force tell alert on a land (ground) point or subsurface contact by setting the EMG IND or FT IND in the J3.5 (PTI = 0) Land (Ground) Point message or J5.4 Acoustic Bearing/Range message. All receiving JUs shall accept the alert.

The JU with R^2 shall terminate an emergency or force tell alert by transmitting a J7.0 (ACT = 3 or 4) message terminating the alert and setting the EMG IND or FT IND in subsequent J3.5 or J5.4 messages to value 0. All receiving JUs shall terminate the alert upon receipt of the J7.0 (ACT = 3 or 4) message. Optionally, alerts may be cleared by reception of a J3.5 or J5.4 message with the EMG IND and/or FT IND set to 0.

(Note: The remainder of this paragraph does not apply to subsurface contacts.)

When another JU assumes R^2 for the point, it shall transmit the appropriate EMG IND or FT IND value as previously received in the J3.5 message.

A JU without R^2 shall initiate/terminate an emergency or force tell alert by setting/clearing the EMG IND or FT IND in a J7.0 (ACT = 3 or 4) message. Upon receipt, the JU with R^2 shall set/clear the EMG IND or FT IND in the J3.5 message. Other receiving JUs without R^2 shall set/clear the EMG IND or FT IND upon receipt of the J7.0 (ACT = 3 or 4) message. Optionally, alerts may be cleared by reception of a J3.5 message with the EMG IND and/or FT IND set to value 0.

4.7.1.4.7 ALERT INDICATORS FOR ELECTRONIC WARFARE PRODUCT INFORMATION

A JU with R^2 shall initiate an emergency or force tell alert on EW Product information by setting the appropriate EMG IND or FT IND in the J3.7 message. All receiving JUs shall accept the alert in their databases.

The JU with R^2 shall terminate an emergency or force tell alert by transmitting a J7.0 (ACT = 3 or 4) message terminating the alert and setting the appropriate EMG IND or FT IND in subsequent J3.7 messages to 0. All receiving JUs shall terminate the alert in their databases upon receipt of the J7.0 (ACT = 3 or 4) message. Optionally, alerts may be cleared by reception of a J3.7 message with the EMG and/or FT IND set to value 0.

A JU without R^2 shall initiate/terminate an emergency or force tell alert by setting/clearing the appropriate EMG IND or FT IND in a J7.0 (ACT = 3 or 4) message. Upon receipt, the JU with R^2 shall set/clear the appropriate EMG IND or FT IND in the J3.7 message. Other receiving JUs without R^2 shall set/clear the appropriate EMG IND or FT IND in their databases upon receipt of the J7.0 (ACT = 3 or 4) message. Optionally, alerts may be cleared by reception of a J3.7 message with the EMG IND and/or FT IND set to value 0.

4.7.1.5 STRENGTH CHANGE

The J7.0 (ACT = 5) Strength Change message is used to change the Strength field as reported in the J3 messages or to make a Vehicle Strength change by changing the Strength, Total Number of Vehicles and/or Strength, Percent of Tracked Vehicles field(s) in the J3.5C3 word. The J7.0 (ACT = 5) message is initiated as a result of operator action by a JU without R^2 to indicate a known Strength or Vehicle Strength change. All JUs that implement the J3.5C3 word shall accept Vehicle Strength changes when received or indicate to the operator that a Vehicle Strength change has been received. All JUs shall accept Strength changes when received or indicate to the operator that a Strength change has been received.

When the J7.0 (ACT = 5) message is implemented for reception, and the Strength field in the J7.0I word and the J3.5C3 word are implemented, both the Strength, Total Number of Vehicles and the Strength, Percent of Tracked Vehicles fields in the J7.0E0 must be processed.

4.7.1.6 EXERCISE STATUS ORDER

a. The J7.0 (ACT = 6) Exercise Status Order message is used to rapidly clear the Exercise Indicator and all artificial data from exercise tracks.

b. Upon receipt of a J7.0 (ACT = 6) message, all JUs shall take the following actions on all tracks in their database which have the Exercise Indicator set to value 1:

(1) Automatically set the Identity Amplifying Descriptor to Exercise Friend.

(2) Automatically set all data fields that may contain artificial information (as specified for each message in the appropriate paragraphs of this Volume) to the No Statement, default value, or actual values if held in database, and set the Exercise Indicator to value 0.

(3) Break any locally originated engagement involving the TN by transmitting a J10.2 (WES = 8) message to report the engagement broken.

(4) Terminate any locally originated Command message with Command values 2, 3, 5, or 7 involving the TN, by transmitting a J9.0 message with the Command field set to value 4, Cease Engage, or value 5, Hold Fire, if the Engagement Status field is set to value 4, Firing.

c. All data fields set No Statement or default values, as specified in paragraph 4.7.1.6b(2) above, shall remain so set until an operator action is taken to change them or a remote report with the Exercise Indicator set to value 0 is received which changes them.

d. After receipt of a J7.0 (ACT = 6) message, all subsequent messages received with the Exercise Indicator set to value 1 shall be discarded, and no messages with the Exercise Indicator set to value 1 shall be originated until local operator action is taken to reenable the JU to accept and originate exercise tracks.

4.7.1.7 EXERCISE INDICATOR

The Exercise Indicator and the Identity Amplifying Descriptor field in the J7.0 message always refer to the Reference TN.

4.7.2 DATA UPDATE REQUEST

The J7.1 message consists of the J7.1I Data Update Request initial word and J7.1C1 Data Update Request Additional Addresses continuation word and is used to request:

a. Data on a specific TN by setting the Action, Data Update Request field to value 1,

b. Data by specific request indicator values by setting the Action, Data Update Request field to value 0, or

c. Space track state vector or covariance data by setting the Action, Data Update Request field to value 2.

4.7.2.1 DATA UPDATE REQUEST BY TRACK NUMBER

The J7.1 (ACT = 1) Data Update Request by TN or (ACT = 2) Ballistic Missile Update Request message has the capability to request update information on a specific TN. When used for this purpose, the requesting JU initiates the J7.1 (ACT = 1 or 2) message with the specific TN in the Reference TN field and addressed to a specific Addressee TN(s) or to the collective address of 00177 octal. The responding JU(s), whether a specific address or collective addressee, shall then reply as described below.

4.7.2.1.1 SURVEILLANCE DATA FROM A JU WITH REPORTING RESPONSIBILITY IN RESPONSE TO A DATA UPDATE REQUEST

The JU with R^2 shall respond with surveillance information upon receipt of a J7.1 (ACT = 1) message on a specific TN. This JU shall transmit all data held in the appropriate J3 message, except that covariance data will not be included on ballistic missile tracks. A JU with R^2 for a line or area shall transmit the entire line or area upon receipt of a J7.1 (ACT = 1) for any TN used to define the line or area.

4.7.2.1.2 SURVEILLANCE AMPLIFICATION DATA FROM A JU IN RESPONSE TO DATA UPDATE REQUESTS

Upon receipt of a J7.1 (ACT = 1) message on a specific TN, the JU(s) that have originated surveillance amplification data on the track shall respond with the J6.0 Amplification message containing all available data.

4.7.2.1.3 CONTROLLING UNIT RESPONSE TO DATA UPDATE REQUESTS

Upon receipt of a J7.1 (ACT = 1) message on a specific TN, the JU controlling the TN shall transmit the appropriate J10 Weapons Coordination and Management messages and J13 Platform and System Status messages to include the J10.5 Controlling Unit Report message, the J10.2 Engagement Status message, and the appropriate J13 Platform and System Status messages.

4.7.2.1.4 C^2 JU RESPONSE TO DATA UPDATE REQUESTS FOR OWN TN

All C^2 JUs receiving a J7.1 (ACT = 1) message containing their own TN shall transmit J10.2 Engagement Status messages to report the status of all engagements they are conducting and a J13 Platform and System Status message to report their own status.

4.7.2.1.5 ELECTRONIC WARFARE DATA IN RESPONSE TO DATA UPDATE REQUESTS

If the Reference TN is being reported in a J3.7 message, the reporting JU shall transmit all data held in a J3.7 message. Also, if the request is collectively addressed, any JU which has initiated an EW evaluation or association on the Reference TN in a J14.2 message shall transmit a J14.2 message with EW Action Value field set to values 7, 8, or 9 addressed to the requesting unit with the R/C field set to value 1. If the request is specifically addressed, the addressee shall transmit all locally held EW evaluations and associations in the J14.2 message with EW Action Value field set to values 7, 8, or 9 addressed to the requesting unit with R/C field set to value 1.

4.7.2.1.6 BALLISTIC MISSILE DATA IN RESPONSE TO DATA UPDATE REQUESTS

The C^2 JU with R^2 for the Reference TN shall respond with a J3.6 Space Track message upon receipt of a J7.1 message with the Data Update Request Action field set to value 2, Ballistic Missile Update Request, on a specific TN. The JU shall transmit the data held in the appropriate J3.6 word sequence. NonR^2 JUs shall not respond to a J7.1 (ACT = 2) Ballistic Missile Update Request. If an R^2 shift occurs during execution of a DUR response, where the Number/Frequency of Updates field is set to value 2 or 3, the JU assuming R^2 shall not respond to any prior Data Update Request.

4.7.2.2 DATA UPDATE REQUEST BY REQUEST INDICATOR VALUES

The J7.1 (ACT = 0) Data Update Request by Request Indicator message has the capability to request information by request indicator values. The message is addressed to a specific Addressee TN(s) or to the collective address of 00177 octal. The desired request indicator values are selectable by the requesting JU setting the appropriate request indicator value. Table 4.7-4 lists the various request indicator information categories available and the response messages required by the C^2 JU which originated the data, or by a C^2 JU which has R^2 for a J3.0 multi-point area or multi-segmented line (defined by more than one J3.0 message) if the Reference Point Data Request Indicator is set to value 1.

4.7.2.3 RESPONSE INDICATORS

When a JU responds with a J3.0, J3.7 and/or a J6.0 Amplification message, the Response Indicator field in these messages shall be set to value 1. This field shall provide each JU with the option to process reference point and/or electronic warfare/amplification messages that are in response to a J7.1 (ACT = 0) message. This reduces the processing required by each JU to clear the displays on previously purged points.

The specific words containing the Response Indicator field are as follows:

a. J3.0I Reference Point initial word.

b. J3.7I EW Product Information initial word.

c. J6.0I Amplification initial word.

TABLE 4.7-4. Response Messages to Request Indicator Values

REQUEST INDICATOR INFORMATION CATEGORY	RESPONSE MESSAGE(S)
REFERENCE POINT	J3.0 (Note 1)
EA DATA	J3.7, J14.2 (Note 2)
ES DATA	J3.7, J14.2 (Note 2)
EW FIXES	J3.7, J14.2 (Note 2)
WEAPON STATUS	J10.2, J13.3, J13.5
WEATHER DATA	TBD
AMPLIFICATION	J6.0
FILTER	J7.6 (Note 3)

NOTES

1 RESPOND ONLY WITH J3.0 LINES AND AREAS DEFINED BY MORE THAN ONE J3.0 MESSAGE.

2 ONLY EXISTING EW ACTION VALUE = 7, 8, OR 9 EVALUATIONS AND ASSOCIATIONS CONCERNING THE APPLICABLE REQUESTED DATA TYPE (EA, ES, EW FIX), WHICH OWN JU HAS INITIATED IF THE REQUEST IS COLLECTIVELY ADDRESSED, OR LOCALLY HELD IF THE REQUEST IS SPECIFICALLY ADDRESSED. THESE J14.2 MESSAGES SHALL BE ADDRESSED TO THE REQUESTING UNIT, WITH R/C = 1.

3 TRANSMITTED TO A SPECIFIC ADDRESS ONLY.

4.7.3 RESOLUTION OF AIR AND SURFACE TRACK DUAL DESIGNATIONS

a. The recognition and resolution of dual designations require all IUs to periodically compare remote tracks to local tracks (and, optionally, to common local tracks) to determine if a dual designation has occurred. The frequency of such comparisons the criteria for determining that two tracks represent the same object, and the correlation rules shall be in accordance with section 4.4.4.3.1, Air and Surface Track Correlation. The rules for land (ground) and space track dual designation resolution are TBD.

b. When a C^2 JU recognizes that two tracks which are being reported to the interface are eligible for correlation, that JU shall initiate action, either automatically or manually, to resolve the dual designation. The recognizing JU shall transmit the J7.2 Correlation message requesting all other C^2 IUs to perform a correlation of the two tracks. The message identifies the TN to be retained and the TN to be dropped. The receiving IUs shall accept the requested correlation unless certain prespecified conditions exist which require or allow the receiving IU to reject the requested correlation or respond with a reverse correlation request. The originating JU indicates in the J7.2 message if it has any constraint which would prohibit accepting a reverse correlation. The Response Value (RV) field is provided for this purpose. When the RV field is set to value 0 it indicates a reverse correlation would be acceptable, and when the RV field is set to value 1 it indicates a reverse correlation request would be rejected. Receiving IUs desiring to reverse the requested correlation use the RV field to determine if a reverse correlation request should be originated or if the original correlation request should be rejected. Whenever a correlation request is rejected the J7.2 message with the RV field set to value 2 shall be transmitted to report the rejection. When the RV field is set to value 3, it indicates the correlation was manually initiated and shall be accepted unless certain conditions apply which require rejection (see paragraph 4.7.3.2.c). The rules for the resolution of dual designations are provided in the following paragraphs.

c. All C^2 JUs capable of reporting air or surface tracks shall have the capability to transmit and receive all the response values of the J7.2 message for real-time air and/or surface tracks, which are held locally by their system.

4.7.3.1 RULES FOR A C^2 JU ORIGINATING A J7.2 CORRELATION MESSAGE

a. Whenever a TN pair is determined, to be a dual designation, the recognizing JU shall initiate transmission of the J7.2 message with the Retained TN/Dropped TN selection in accordance with paragraph 4.4.4.3.1j. If a selection conflict occurs due to OCCs on both the Retained TN and the Dropped TN the correlation shall be abandoned until the next correlation check. The RV field shall be set to:

value	if
0	there is no OCC on the Retained TN.
1	the Retained TN has an OCC.
3	the correlation was manually initiated.

b. Transmission of a J7.2 message with the RV field set to value 0 or 1 shall be discontinued upon receipt of a J7.2 message containing one or both of the same TNs.

c. If the originating C^2 JU holds R^2 for the Dropped TN, it shall drop the Dropped TN and transmit the J7.0 (ACT = 0) message. The J7.0 (ACT = 0) message shall be transmitted after the J7.2 message.

d. C^2 JUs capable of transmitting the J7.2 message shall have an operator selectable capability to deactivate automatic transmission of the message.

4.7.3.2 RULES FOR C^2 JUs RECEIVING A CORRELATION MESSAGE

The rules to be followed by C^2 JUs receiving a J7.2 correlation request are as follows:

a. C^2 JUs receiving a J7.2 message with the RV field set to value 0 or 1 shall not accept the requested correlation when local or remote data held indicates one or more of the following conditions exist:

(1) There is a correlation restriction as listed in paragraph 4.4.4.3.1g. In this case the correlation shall be rejected.

(2) The Retained TN and the Dropped TN will decorrelate, i.e., when subjected to the decorrelation criteria once, the tracks would decorrelate. In this case the correlation shall be rejected.

(3) There is an OCC on the Dropped TN as listed in paragraph 4.4.4.3.1g(7) and the received RV field is set to value 0. The reverse correlation shall be transmitted if the new Dropped TN has no correlation constraint. If both the Retained TN and Dropped TN have an OCC, the correlation shall be rejected.

(4) There is an OCC on the Dropped TN as listed in paragraph 4.4.4.3.1g(7) and the received RV field is set to value 1. In this case, the correlation shall be rejected.

b. C^2 JUs receiving or generating a J7.2 message with the RV field set to value 2, Correlation Rejection, shall not automatically originate a request with the same Retained TN and Dropped TN for a period of 2(1-10,1) minutes. When a correlation request is rejected for a manual correlation, the JU originating the request shall provide an operator alert as a cue to conduct voice coordination. An operator alert in the event of the rejection of an automatic correlation shall be a system option.

c. C^2 JUs receiving a J7.2 message with the RV field set to value 3 shall automatically accept the requested correlation unless one of the following restrictions applies, in which case the correlation shall be rejected:

(1) The two tracks are of a different E/C, or either track has an existing E/C conflict.

(2) One track is simulated and the other is live.

(3) Both tracks are locally derived real-time tracks.

Note: After acceptance of a manual correlation the resulting track shall not be the subject of automatic decorrelation processing for a period of 5 minutes.

d. C^2 JUs rejecting the requested correlation shall initiate transmission of a J7.2 message with the Retained TN/Dropped TN set as received and RV field set to value 2.

e. C^2 JUs responding with a reverse correlation shall transmit the J7.2 message with the originally received Retained TN and Dropped TN reversed and the RV field set to value 1.

f. C^2 JUs not holding the Dropped TN shall not take any further action.

g. If the Retained TN is not held but the Dropped TN is held, the correlation request shall be processed as follows:

(1) If the Dropped TN has an OCC, the following action shall be taken:

(a) If RV is set to 0, transmit a reverse correlation with RV set to 1.

(b) If RV is set to 1, transmit a correlation rejection with RV set to 2.

(c) If RV is set to 3, execute the correlation using Dropped TN data and Retained TN track number.

(2) If the Dropped TN does not have an OCC, execute the correlation using Dropped TN data and Retained TN track number.

h. C^2 JUs rejecting a J7.2 message and holding the Dropped TN as a local or common local track shall not interpret the J7.2 message as a Drop Track message for the purpose of determining R^2.

i. If the received J7.2 message contains one or both of the same TNs, as contained in the transmission of the own unit J7.2 message sequence in progress, the following actions shall be taken:

(1) If the own unit RV field is set to value 0, 1, or 3, discontinue transmission of the own unit J7.2 message and process the received message in accordance with rules 4.7.3.2 a through h.

(2) If the own unit RV field is set to value 2, complete the transmission of the message sequence in progress.

4.7.4 POINTERS

A J7.3 message provides the capability for C^2 JUs to designate a geographic position and up to twenty characters of text on one or more C^2 JU's displays. In the absence of textual clarification the J7.3 message is used in conjunction with voice communications. The J7.3 message can be addressed to one, multiple, or all IUs. When it is addressed to one JU, the J7.3I Pointer initial word contains the specific address. When it is addressed to multiple JUs, the J7.3I word contains one address and the J7.3C1 Pointer Additional Addresses continuation word can contain up to four additional addresses. Multiple J7.3C1 words can be sent to accommodate more than five addresses. The J7.3C2 and J7.3C3 words are used to provide amplifying textual information of up to twenty characters. When a J7.3 message is addressed to all JUs, the J7.3I word contains the collective address. The J7.3 message can be used to specify one or more operator positions by function within a JU through the use of the pointer action data element. There is no TN assigned to the pointer; therefore, it must be displayed and dropped by local procedure.

4.7.5 TRACK IDENTIFIER MANAGEMENT

The J7.4 message is used to provide the North Atlantic Treaty Organization (NATO) Link 1 TN, the Army Tactical Data Link-1 (ATDL-1) TN, the Link 11/11B TN, or the IJMS System Reference Number (SRN) associated with a TN that is being reported on Link 16. The J7.4 message can be used to report (Report/Request TN field set to value 0) or request (Report/Request TN field set to value 1) these TNs individually, collectively, or in any combination.

A J7.4 message which reports one or more TNs, uses the Track Number Applicability indicators to indicate which TN(s) is/are being reported and which TN field(s) of the message is/are to be interpreted. A J7.4 message which requests TNs, uses the Track Number Applicability indicator to indicate which TN(s) is/are being requested.

The J7.4 report message is transmitted initially by any JU which assigns Link 11/11B, NATO Link 1, ATDL-1 TNs, or IJMS SRNs and by those JUs which forward tracks from Link 11/11B, NATO Link 1, ATDL-1 or IJMS to Link 16. The J7.4 report message may also be transmitted by any JU in response to a J7.4 request message or as the result of operator action. The J7.4 request message may be originated by any JU as a result of operator action. After any JU responds to the request, other JUs need not respond unless additional TNs for different links have been requested and are held for the track. There is no other management of track identifier data. The latest Link 11/11B, NATO Link 1 TN, ATDL-1 TN, or IJMS SRN received on a track shall supersede previously received data.

4.7.6 IFF/SIF DATA MANAGEMENT AND SPECIAL CODE REPORTING

Management of IFF/SIF data is required to insure commonality of data between the IUs. The J7.5 message with the following action values is used to perform this function:

a. J7.5 (ACT = 0) Clear IFF/SIF message.

b. J7.5 (ACT = 1) IFF/SIF Difference Report message.

c. J7.5 (ACT = 2) IFF/SIF Update Request message.

d. J7.5 (ACT = 3) Special Code message.

The reporting of IFF/SIF data in conjunction with periodic surveillance data is the responsibility of the JU with R^2, while all other JUs without R^2 are responsible for monitoring such data and only reporting different data with the J7.5 message. In this way the JU with R^2 can be assumed to be reporting the most current data available on the interface.

A code of all zeroes (00 or 0000) is illegal for use as an assigned operational IFF/SIF Mode I, II, or III code. Any IFF/SIF Mode I, II, or III Code field set to all zeroes indicates that the reporting unit has no data for that mode for transmission. This condition is referred to as the No Data status.

4.7.6.1 UNIQUE MODE II CODE PROTECTION

The Mode II code requires special consideration because it is a unique identifier which can deter erroneous track correlations and alert systems/operators to erroneous entries. Therefore, the maintenance of a clear tactical picture is dependent, to a certain extent, upon the protection and utilization of the Mode II code uniqueness. The following rules apply for this purpose:

a. Software shall inhibit any change to a valid Mode II code for the specific local track. However, the initiation or receipt of the J7.5 (ACT = 0) Clear IFF/SIF message, designating all modes or Mode II code of the specified track to be cleared, shall cause the Mode II code status to be returned to a No Data status. Automatic tracking systems may maintain the Mode II code data, for tracking purposes, until the next Mode II code interrogation. When local sensors detect a Mode II code change, it shall be treated as a new track.

b. Operators may be alerted when two or more tracks have the same Mode II code.

c. All unique Mode II codes should be treated as unique tracks.

4.7.6.2 CLEARING IFF/SIF DATA

When erroneous codes are detected and there are no other valid codes available or changes are inhibited, as in Mode II code reporting, a capability to delete or clear the erroneous codes is necessary so that the interface can return to a No Data status for the specified track and its corresponding mode(s). Accordingly, any JU capable of originating a J3 message that includes a continuation word containing IFF/SIF data shall also have a capability to manually originate the J7.5 (ACT = 0) message. Additionally, any JU capable of maintaining IFF/SIF data in its database shall have a capability, upon initiation or receipt of a J7.5 (ACT = 0) message, to automatically set the designated mode(s) for the specified track to the No Data status (except for Mode IV as stated below). The following rules apply for this function:

a. Any JU may originate, by operator action only, the J7.5 (ACT = 0) message for the clearing of one or more modes on the specified track.

b. All JUs, upon receipt of the J7.5 (ACT = 0) message, shall automatically set the designated mode(s) for the specified track to the No Data status (except that acceptance or rejection of a received J7.5 (ACT=0) Mode IV Clear message may be automatic or by operator determination). The No Data status, if accepted, should be used for all subsequent interface functions and data link messages until updated by valid code responses from local or remote sources. The operator display shall indicate that a J7.5 (ACT = 0) message was received.

c. A JU with R^2, upon receiving or initiating a J7.5 (ACT = 0) message that results in no IFF/SIF data being held on the track, shall not continue transmitting the periodic J3 message that includes the continuation word containing IFF/SIF data.

d. Any JU may change a local mode to a No Data status without transmitting a J7.5 (ACT = 0) message.

4.7.6.3 IFF/SIF DIFFERENCE RESOLUTION

Each JU without R^2 shall compare locally held data with IFF/SIF data reported by the JU with R^2 and report any valid data that are different, in accordance with the rules below. The JU without R^2 shall report current valid changes.

a. Any JU receiving a J3 message that includes a continuation word with remote IFF/SIF data or J7.5 (ACT = 1) message differing from locally held data shall respond as indicated in Table 4.7-5.

TABLE 4.7-5. IFF/SIF Difference Resolution Matrix

OWN UNIT DATA / REMOTE DATA			R^2 UNIT			UNIT WITHOUT R^2			
				VALID DATA			VALID DATA		
			NO DATA	NON-CURRENT DATA	CURRENT DATA	NO DATA	LOCAL NON-CURRENT DATA	LOCAL CURRENT DATA	REMOTE
J7.5 (ACT=1)	MODE I OR III		AT	AT	NT	NA or A	NA or A	NA	NA or A
	MODE II		AT	C	C	NA or A	NA	NA	NA
	MODE IV		AT	AC1	AC1	NA or A	AC2	AC2	NA or A
J3.XC1	NO DATA (ZEROS) MODE I, II, III, OR IV		NA	NA	NA	NA	T1	T1	A
	VALID DATA	MODE I OR III	NA	NA	NA	A	A	TC or C	A
		MODE II	NA	NA	NA	A	C	C	A
		MODE IV	NA	NA	NA	A	AC3	AC3	A
J2.XC1	ALL DATA	MODE I, II, OR III	NA	NA	NA	A	A	AC	A

LEGEND
- A = ACCEPT.
- AC = ACCEPT DATA, ALERT OPERATOR.
- AC1 = IF THIS IS AN UPGRADE[1], ACCEPT THE DATA AND TRANSMIT J3.XC1 WORD. IF THIS IS A DOWNGRADE[2], REJECT THE DATA[3]
- AC2 = IF THIS IS AN UPGRADE[1], ACCEPT THE DATA. IF THIS IS A DOWNGRADE[2], TAKE NO ACTION[3].
- AC3 = IF THIS IS AN UPGRADE[1], ACCEPT THE DATA. IF THIS IS A DOWNGRADE[2], REJECT THE DATA[3] AND TRANSMIT LOCAL DATA IN A J7.5 (ACT = 1) MESSAGE.
- AT = ACCEPT DATA AND TRANSMIT RECEIVED DATA IN A J3.XC1 WORD AT THE NEXT TRANSMIT OPPORTUNITY.
- C = THIS IS A CONFLICT. DO NOT ACCEPT DATA AND ALERT OPERATOR.
- NA = NON APPLICABLE. NO ACTION ALLOWED EXCEPT AS STATED IN PARAGRAPH 4.7.6.3.C.
- NT = DO NOT ACCEPT DATA AND TRANSMIT LOCAL DATA IN A J3.XC1 WORD AT NEXT TRANSMIT OPPORTUNITY.
- T1 = TRANSMIT LOCAL DATA IN A J7.5 (ACT = 1) MESSAGE.
- TC = TRANSMIT LOCAL DATA IN A J7.5 (ACT = 1) MESSAGE. IF THE SAME REPORT IS TRANSMITTED TWICE WITHIN 30 SECONDS, AUTOMATIC TRANSMISSION OF THE J7.5 ACT = 1) MESSAGE IS INHIBITED AND THE OPERATOR IS ALERTED.

NOTES
1 UPGRADE - AN INCREASE IN THE NUMERICAL VALUE OF THE DATA ITEM CODE.
2 DOWNGRADE - A DECREASE IN THE NUMERICAL VALUE OF THE DATA ITEM CODE.
3 OPERATOR ALERT UPON A RECEIPT OF A DOWNGRADE IS SYSTEM DEPENDENT.

b. Any JU without R^2 entering a change of nonzero to nonzero or zero to nonzero value to its locally held Mode I, III or IV IFF/SIF data, or a change from zero to nonzero Mode II data, shall automatically report the new data in a J7.5 (ACT = 1) message.

c. Operator alerts, in addition to those specified in Table 4.7-5, may be implemented in individual JUs on an optional basis. An example would be a JU using manual IFF/SIF inputs that may desire to alert an operator whenever its data have been changed by accepting remote data.

d. When an operator receives an IFF/SIF data conflict alert as required in Table 4.7-5, he shall have the following manual actions at his disposal for attempting resolution of the difference:

(1) Update local data manually or verify automatic inputs.

(2) Initiate J7.5 (ACT = 0) Clear IFF/SIF message (any mode).

(3) Initiate J7.5 (ACT = 1) IFF/SIF Difference Report message (any mode).

(4) Change local data to agree with remote data except in the case of Mode II code.

(5) Decorrelate the local data from the remote data, causing the assignment of a new track number to local data.

(6) Clear operator alert (any mode).

4.7.6.3.1 <u>CURRENT/NONCURRENT DATA</u>

Current IFF/SIF data, as defined for use in Table 4.7-5, are those valid code responses that are no more than 40 seconds old since entry into the database by automatic or manual inputs. However, systems need not time-tag IFF/SIF data for purposes of determining currency. When remote IFF/SIF data is accepted in accordance with the difference resolution matrix, Table 4.7-5, such remote data will be entered as valid noncurrent data. Systems not maintaining currency indicators will assume local track/mode is current if the track/mode is currently being received automatically from own sensors. All other code data shall be assumed to be noncurrent. Processing of Mode IV codes is exempt from all current/noncurrent indications.

4.7.6.4 IFF/SIF UPDATE REQUESTS

Data updating can occur spontaneously as a result of the R^2 unit reporting a No Data status (value 0) for one or more modes in a required IFF/SIF Surveillance data report, J3.XC1. Receiving units which hold valid nonzero data will respond as required by the IFF/SIF Difference Resolution Matrix, Table 4.7-5. Data updating can also occur as a result of an operator action wherein the update request is transmitted in a J7.5 (ACT = 2) IFF/SIF Update Request message. Units receiving the J7.5 (ACT = 2) message will respond by transmitting their local data codes. Rules for the IFF/SIF update function are as follows:

a. The J7.5 (ACT = 2) message shall be manually initiated by R^2 and nonR^2 units with the applicable mode indicators set when requesting update of IFF/SIF data.

b. R^2 units receiving the J7.5 (ACT = 2) message will respond by initiating a J3.XC1 message regardless of the No Data status.

c. NonR^2 units receiving the J7.5 (ACT = 2) message from the R^2 unit will respond by initiating a J7.5 (ACT = 1) message if valid local data (nonzero codes) are held for the requested mode(s). If the requested data has been transmitted by another JU, the remaining JUs need not respond with their local data.

d. NonR^2 units receiving the J7.5 (ACT = 2) message from other nonR^2 units will not respond to the request.

4.7.6.5 SPECIAL CODE REPORTING

The J7.5 (ACT = 3) message is used to exchange codes that have special meaning for implementing JUs. The following rules are applicable:

a. JUs implementing the special codes capability shall provide nonambiguous displays for both IFF/SIF code responses and the special code responses. Also, JUs implementing more than one of the special code fields shall provide nonambiguous displays which clearly distinguish each type of special code from all other types of special codes.

b. The rules for reporting and managing the J7.5 (ACT = 3) message shall be as stated in this paragraph and are not governed by the rules for IFF/SIF data.

c. Any JU may report special codes using the J7.5 (ACT = 3) message to initiate, change, or clear such codes.

d. Any JU clearing one or more of the special codes shall transmit the J7.5 (ACT = 3) message with the special code applicability indicator fields set and the associated special code fields set to value 0.

e. JUs implementing the special code capability shall accept all zero or nonzero special code values as received.

f. A JU shall transmit special code information only if data are held.

g. The JU originating or changing a special code shall assume J7.5 (ACT = 3) reporting responsibility for retransmission until such time as a special code message is received for that track from another unit, or the track is dropped, or a clear special code is received.

h. The JU having or assuming reporting responsibility for the track surveillance report shall also have reporting responsibility for nonzero special codes if that system implements the J7.5 (ACT = 3) message.

i. When a JU transmits a J7.5 (ACT = 3) Special Code message all nonzero special codes for that track will be reported.

4.7.7 FILTERS

Two types of filters are used by a JU, message label/sublabel filters and data filters, as described below.

a. Message label/sublabel filters may be used to inhibit overloading of the terminal-to-host interface, or to reduce demands for TDS processor time, on a JU. The message label/sublabel filter shall be considered a separate category of filter from data filters, and its use shall not be restricted by the data filter rules described in paragraph 4.7.7.8. However, use of these filters is restricted to receive only filtering for those messages which the JU does not implement due to the mission or particular capabilities/restrictions of that platform. The message label/ sublabel filter will select messages to be filtered by the Link 16 label and sublabel fields, and therefore will not be forwarded to the Host TDS. The J7.6 message shall not be used to request implementation/deletion or status of message label/sublabel filters, and this type of filter will not be reported in the J7.6 Filter Description Report. If implemented, the message label/ sublabel filter shall only be used for the purposes described above, i.e. it shall not be used as a data filter. All subsequent subparagraphs of 4.7.7 refer to data filters and not to the message label/sublabel filter. (A message label/sublabel filter shall not be used to avoid the data forwarding requirements as set forth in Appendix C, Data Forwarding.)

b. Data filters may be used to inhibit the flow of data on a data link. A data filter that inhibits data from being transmitted on a data link is a transmit filter. A data filter that deletes data received on a data link prior to entry into an IU database is a receive filter. Interfacing systems have certain defined filter capabilities in order to prevent data link overload conditions, overload of a system database, and/or undesired data from entering a system database. Data filter implementation is optional and system constraints may dictate the type of filters used.

4.7.7.1 <u>DATA FILTER TYPES</u>

There are five broad filter types as follows:

a. Environment/Category.

(1) Unknown.

(2) Space.

(3) Air.

(4) Surface (Maritime).

(5) Subsurface (Maritime).

(6) Land (Ground).

(7) Reference Point.

(8) Electronic Warfare.

b. Identity.

(1) Pending.

(2) Unknown.

(3) Assumed Friend.

(4) Friend.

(5) Neutral.

(6) Suspect.

(7) Hostile.

c. Special Processing.

d. Simulation.

e. Geographic Area.

(1) Circle/Ellipse.

(2) Annulus.

(3) Circular Sector.

(4) Sector of Annulus.

(5) Rectangle/Square.

(6) Nested Rectangle.

(7) Line.

(8) Other multisided figures.

4.7.7.2 ENVIRONMENT/CATEGORY FILTERS

An environment/category filter allows a JU to filter tracks and nonC^2 IUs from the space, air, surface (maritime), subsurface (maritime), and land (ground) environment/categories, as well as reference points and electronic warfare product information.

4.7.7.3 IDENTITY FILTERS

An ID filter allows a JU to filter tracks and nonC^2 IUs based on their IDs. Exercise Indicator settings have no influence on ID filters. Identity and Identity Amplifying Descriptor are filtered in the same manner e.g., a Friend filter would filter both Friend and Exercise Friend, a Hostile filter would filter both Hostile and Faker, etc.

4.7.7.4 GEOGRAPHIC FILTERS

A geographic filter allows a JU to filter tracks and nonC^2 IUs based on their geographic location. Maximum and minimum altitude values may also be defined for each filter that make it possible to describe volumes. Filters can be fixed geographically, slaved to the filtering JU or some other moving reference point, or move independently. (See Table 4.7-6.)

a. A circle filter is defined by a center point, a major and minor axis that are equal, and an axis orientation. When a second set of major and minor axes that are equal and a second axis orientation are used, an annulus filter is defined, e.g., a ring-shaped area.

b. A circular sector filter is defined by a center point, a major and minor axis that are equal, an axis orientation, a beginning bearing, and an ending bearing. When a second set of major and minor axes that are equal and a second axis orientation are used with the same beginning and ending bearing, a sector of an annulus filter is defined.

c. A line filter is defined by two or more points with an indication of the direction of filtering from the line. The direction is indicated as the true compass quadrant in which a normal to the line in the direction to be filtered lies. The entire area extending outward and from both ends of the line infinitely will be filtered. For a segmented line, the direction is indicated as it applies to the first segment, i.e., the segment described by the Latitude; Longitude; and Delta Latitude, 1; Delta Longitude, 1 fields of the J7.6 message that has the Line/Area Continuation Indicator, 1 set to value 0. Figure 4.7-1 illustrates the method of specifying line filters. The shaded area will be filtered. Note that a multisided figure that is not a square, rectangle, circle, or ellipse is just a special case of a multisegmented line with the first and last points being coincident.

d. A rectangular filter is defined by a center point, a major and minor axes, and an axis orientation. When a second set of major and minor axes and a second axis orientation are used, a nested rectangular filter is defined.

e. The area filters also require an indication of whether the filtering is being done inside or outside the defined area.

Table 4.7-6. Geographic Filter Description (Sheet 1 of 2)

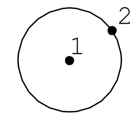
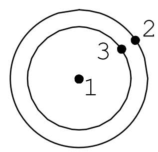
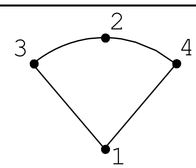
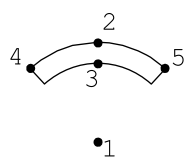
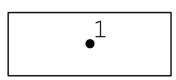
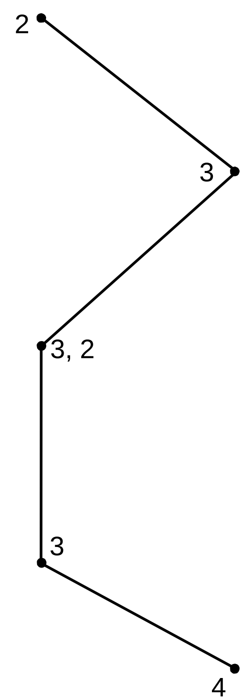
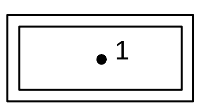
NAME	DIAGRAM	DESCRIPTION	CONTAINED IN WORD	WORD SEQUENCE
CIRCLE		1. LATITUDE/LONGITUDE – ORIGIN OF THE CIRCLE 2. AREA MAJOR AXIS, 1/AREA MINOR AXIS, 1/AXIS ORIENTATION, 1/SQUARE/CIRCLE SWITCH, 1.	J7.6E0 J7.6C1	J7.6I/ J7.6E0/ J7.6C1
ANNULUS		1. LATITUDE/LONGITUDE – ORIGIN OF THE ANNULUS. 2. AREA MAJOR AXIS, 1/AREA MINOR AXIS, 1/AXIS ORIENTATION, 1/SQUARE/CIRCLE SWITCH, 1. 3. AREA MAJOR AXIS, 2/AREA MINOR AXIS, 2/AXIS ORIENTATION, 2/SQUARE/CIRCLE SWITCH, 2.	J7.6E0 J7.6C1 J7.6C1	J7.6I/ J7.6E0/ J7.6C1
CIRCULAR SECTOR		1. LATITUDE/LONGITUDE – ORIGIN OF THE CIRCLE. 2. AREA MAJOR AXIS, 1/AREA MINOR AXIS, 1/AXIS ORIENTATION, 1/SQUARE/CIRCLE SWITCH, 1. 3. BEARING 1 – START BEARING 4. BEARING 2 – END BEARING (CLOCKWISE ROTATION).	J7.6E0 J7.6C1 J7.6C1 J7.6C1	J7.6I/ J7.6E0/ J7.6C1
SECTOR OF ANNULUS		1. LATITUDE/LONGITUDE – ORIGIN OF THE CIRCLE. 2. AREA MAJOR AXIS, 1/AREA MINOR AXIS, 1/AXIS ORIENTATION, 1/SQUARE/CIRCLE SWITCH, 1. 3. AREA MAJOR AXIS, 2/AREA MINOR AXIS, 2/AXIS ORIENTATION, 2/SQUARE/CIRCLE SWITCH, 2. 4. BEARING 1 – START BEARING 5. BEARING 2 – END BEARING (CLOCKWISE ROTATION).	J7.6E0 J7.6C1 J7.6C1 J7.6C1 J7.6C1	J7.6I/ J7.6E0/ J7.6C1
RECTANGLE		1. LATITUDE/LONGITUDE – ORIGIN OF THE RECTANGLE. 2. AREA MAJOR AXIS, 1/AREA MINOR AXIS, 1/AXIS ORIENTATION, 1/SQUARE/CIRCLE SWITCH, 1.	J7.6E0 J7.6C1	J7.6I/ J7.6E0/ J7.6C1

Table 4.7-6. Geographic Filter Description (Sheet 2 of 2)

NAME	DIAGRAM	DESCRIPTION	CONTAINED IN WORD	WORD SEQUENCE
LINE		1. LINE/AREA CONTINUATION – SET TO THE NO STATEMENT VALUE FOR THE FIRST WORD SEQUENCE DEFINING THE SEGMENTED LINE; SET TO THE LINE/AREA CONTINUATION VALUE FOR ALL WORD SEQUENCES FOLLOWING THE FIRST WORD SEQUENCE.	J7.6I	MULTIPLE J7.6I/ J7.6E0/ J7.6C2 SEQUENCES
		2. LATITUDE/LONGITUDE – DESCRIBE THE INITIAL POINT IN A SEGMENTED LINE. THE LATITUDE/LONGITUDE FIELDS ARE CONTAINED IN THE FIRST WORD SEQUENCE. IN ALL WORD SEQUENCES FOLLOWING THE FIRST, THE POSITION DESCRIBED BY THESE FIELDS IS COINCIDENT WITH THE LAST POINT DESCRIBED IN THE PREVIOUS WORD SEQUENCE.	J7.6E0	
		3. DELTA LATITUDE/DELTA LONGITUDE – DESCRIBE THE ADDITIONAL POINTS THAT SHOULD BE JOINED TO FORM A SEGMENTED LINE.	J7.6C2	
		4. END POINT – WHEN SET, IDENTIFIES THE ASSOCIATED POINT AS BEING THE END POINT OF A SEGMENTED LINE. THIS POINT SHOULD BE COINCIDENT WITH POINT 3 IF DESCRIBING A MULTISIDED FIGURE.	J7.6C2	
NESTED RECTANGLE		1. LATITUDE/LONGITUDE – ORIGIN OF BOTH RECTANGLES.	J7.6E0	J7.6I/ J7.6E0/ J7.6C1
		2. AREA MAJOR AXIS, 1/AREA MINOR AXIS, 1/AXIS ORIENTATION, 1/SQUARE/CIRCLE SWITCH, 1.	J7.6C1	
		3. AREA MAJOR AXIS, 2/AREA MINOR AXIS, 2/AXIS ORIENTATION, 2/SQUARE/CIRCLE SWITCH, 2.	J7.6C1	

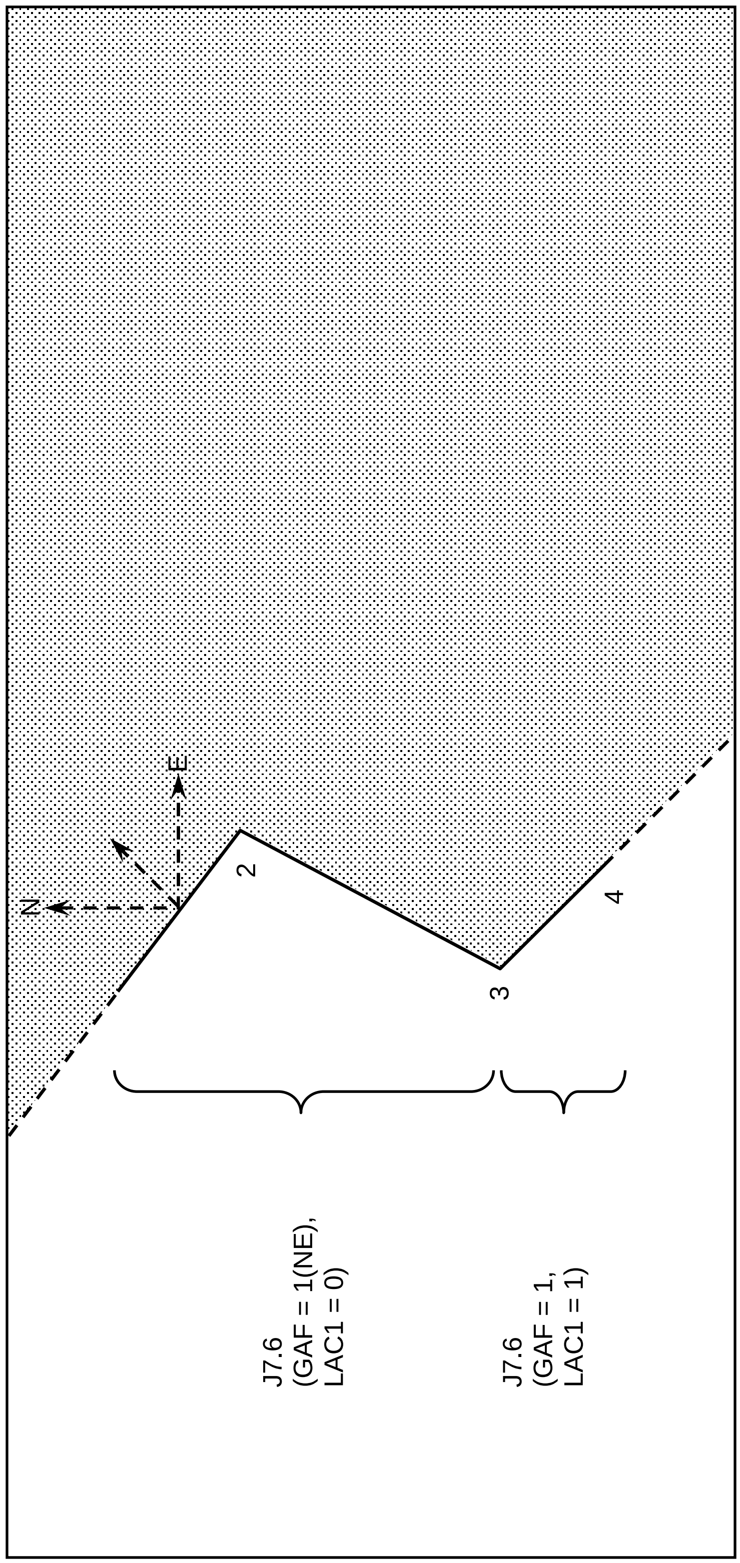


FIGURE 4.7-1. Multisegmented Line Filter

4.7.7.5 SPECIAL PROCESSING FILTERS

A special processing filter allows a JU to filter data based on the setting of the Special Processing Indicator field.

4.7.7.6 SIMULATION FILTERS

A simulation filter allows a JU to filter data and IUs based on the setting of the Simulation Indicator field.

4.7.7.7 DATA FILTER RULES

The data filtering rules at sub-paragraphs a. through i. below apply to C^2 JUs and those at sub-paragraphs a. through j. apply to nonC^2 JUs operating on Needline PGs:

a. The use of interface filters shall be coordinated with all IUs to minimize track management problems. Coordination of filtering requests may be done by voice or other communications media.

b. Any system which filters tracks/IUs on receipt must establish a transmit filter which duplicates the receive filter. In addition, when a receive filter is geographically defined, the transmit filter must, where possible, be defined to permit the area filtered for transmission to be slightly larger than the area filtered for reception so that tracks entering or leaving the filtered area may be displayed to the operator to prevent dual designations.

c. If the storage files of a JU are filled and all applicable filters have been used, acceptance of the new data shall not be required, regardless of its ID or priority. This procedure applies to both real-time and nonreal-time data.

d. Any track or nonC^2 IU with an EMG IND or FT IND set to the value of 1 shall not be filtered. A J3.1 message shall not be filtered.

e. Active nonsimulated C^2 IUs cannot be filtered. In other words, C^2 IUs with the Simulation Indicator field set in their J2 PPLI message may be filtered.

f. All filters are identified by filter number for coordination with other JUs.

g. Tracks are eligible for transmission on the interface only if they are not inhibited from transmission by any of the transmission filters currently set.

h. Filters shall apply to tracks initiated prior to filter activation as well as to tracks initiated while the filter is active. When a transmit filter is activated by a unit, the unit shall cease reporting any track for which it has R^2 and which meets the filter criteria, and shall comply with the rules for terminating transmission of the applicable track data of the applicable Environment/Category.

i. The J7.2 Correlation message shall not be inhibited by any filter.

j. Targets reported in J12.7 messages shall be processed as EW Product information for the purposes of environment/category filtering.

4.7.7.8 FILTER MESSAGE

Management and reporting of Link 16 transmit filters are accomplished using the following messages:

a. J7.6 (ACT = 0) Filter Implementation Request message.

b. J7.6 (ACT = 1) Filter Description Report message.

c. J7.6 (ACT = 2) Delete Filter Request/Report message.

d. J7.1 (ACT = 0) Data Update Request by Request Indicator message.

The J7.6 message only applies to transmit filters as defined in paragraph 4.7.7, i.e., it is only used to request or report the insertion or deletion of transmit filters including data forwarding filters. The Filter Unit Type field indicates whether the filter applies to individual JU transmissions or forwarding unit transmissions of forwarded data. The use of receive filters is neither requested nor reported via Link 16. Forwarding unit filters requested or reported are only those used for filtering transmissions originating on Link 16. Filters for forwarding data from any other link to Link 16 are neither requested nor reported via Link 16.

Voice coordination is required in addition to the filter message to ensure filter management on the interface.

4.7.7.8.1 FILTER IMPLEMENTATION REQUEST

The J7.6 (ACT = 0) message is used by a JU to request that a filter be implemented by another JU. The implementation request consists of specifying the filter types and the parameters for each type and whether to filter inside or outside the defined area, with Filter Number field set to value 0. If specific filters have been prearranged, then an implementation request may consist of specifying the filter number with all Filter Indicator fields of the J7.6 (ACT = 0) set to value 0.

4.7.7.8.2 FILTER DESCRIPTION REPORT

The J7.6 (ACT = 1) message is used by a JU to report a filter which the JU has inserted into its TDS or to respond to a J7.1 (ACT = 0) message. The filter number shall be set to a value between 1 and 14. When used in response to a J7.1 (ACT = 0) message, the filter message(s) shall be addressed to the JU requesting the filter information.

A new filter report on a previously received filter number from a JU shall supersede prior filter data for that number. In the case of a line or area filter requiring multiple messages all with the same filter number to describe the line or area, all of the messages must be treated as a single filter report.

4.7.7.8.3 INTERPRETATION OF FILTER REQUEST/REPORTS

The following rules specify the interpretation and interrelationships of the various Filter Indicators in the J7.6I word. The phrase "are filtered" used below means "shall be filtered" in J7.6 (ACT = 0) Request, or "is being filtered" in a J7.6 (ACT = 1) Report. All of the below listed rules are subject to the restrictions in paragraphs 4.7.7.8d and e.

a. Transmit filters requested or reported in the J7.6 message apply to four classes of data as follows:

(1) Tracks - Tracks reported in J3.2 through J3.5 messages and nonC^2 IUs reported in J2.0 and J2.2 through J2.6 messages if Friends are filtered. The term "tracks" used herein includes nonC^2 IUs unless otherwise indicated.

(2) Reference Points - Reference points, lines, and areas reported in J3.0 messages.

(3) Electronic Warfare Product Information - Reported in J3.7 messages.

(4) Targets - Targets reported in J12.6 and J12.7 messages on Needline PG.

b. Filters requested or reported in the J7.6 messages do not apply to any messages other than the J2, J3, and J12 (on Needline PG) series messages listed above, e.g., J2 series PPLI data for C^2 IUs, J6.0 Amplification data, J14.0 EW Parametric data, etc., except a simulation filter applies to C^2 IUs.

c. Track filters shall be requested/reported in separate J7.6 messages from reference point and EW product filters, with the following exception: if in a track filter message the Unknown E/C Filter Indicator is set to value 1, then EW product data with Unknown E/C shall be filtered in addition to any other valid filter combination contained within that message. Valid combinations of filter indicators for tracks, together with their meanings, are given in Table 4.7-7.

d. Since reference points have no E/C or ID, point filters shall be requested/reported in separate J7.6 messages from tracks and EW product information, i.e., if the Reference Point Filter Indicator is set, the only other Filter Indicators that may be set are the SPI and Simulation Filter Indicators and, if required, a Geographic Area Filter. Valid combinations of filter indicators for reference points, together with their meanings, are given in Table 4.7-8.

e. EW product information filters shall be requested/reported in separate J7.6 messages from tracks and points except that if the Unknown E/C filter is set, then Unknown EW product information are filtered regardless of the setting of the EW Filter Indicator. When the EW Filter Indicator is set, then all other Filter Indicators set in the same message apply only to EW product information data. Valid combinations of filter indicators for EW products, together with their meanings, are given in Table 4.7-9.

f. If a Geographic Area Filter is set and the EW Filter Indicator is set, then all EW Fixes within/out the area and all EW AOPs having their center within/out the area and all EW LOBs with origin within/out the area are filtered.

g. If a Geographic Area Filter is set and the Reference Point Filter Indicator is set, then all points within/out the area, all lines with all points within/out the area, and all areas completely within/out the area are filtered.

4.7.7.8.4 MOVING FILTERS

Moving filters are specified using the J7.6I Slaved Indicator and the J7.6C3 continuation word. The Slaved Indicator must be set to value 1 if the J7.6C3 word is included. If the filter is slaved to an existing TN, the TN shall be reported as TN, Related with Course and Speed set to No Statement. If Latitude and Longitude in the J7.6EO are set to No Statement, then the position of TN, Related shall be used instead of the J7.6E0 Latitude and Longitude. If the filter is to move independently of any other TN, then TN, Related shall be set to No Statement with Course and Speed specified. Movement of the filter shall begin at the time of transmission of the J7.6 (ACT = 1) filter description report. If fixed geographic points are used in the initial filter description, they shall be updated in any subsequent reports of the same filter based on the movement of TN, Related or the filter's course and speed.

4.7.7.8.5 DELETE FILTER REQUEST/REPORT

The J7.6 (ACT = 2) message is used by a JU to request that a filter or all filters be deleted by an addressed JU. A JU may also report the deletion of one or all of its filters with this message. A TN address of 00177 octal shall be used when a JU deletes a filter. A filter number of 15 shall be used to indicate all of a JU's filters.

4.7.7.8.6 DATA UPDATE REQUEST

The J7.1 (ACT = 0) message shall be used by a JU requesting information on a filter. When used, the J7.1 (ACT = 0) message shall be addressed to a specific JU; i.e., the collective address of 00177 octal shall not be used. The JU receiving the request shall transmit either all locally inserted filters in response to Filter Number equal to 15 or parameters on a specific filter as specified by the Filter Number field in the J7.1 (ACT = 0) message. The J7.1 (ACT = 0) Filter Number field shall not be set to value 0 when the Filter Data Request Indicator is set to value 1.

4.7.7.8.7 TERMINATION OF FILTERS

When a JU deletes a filter which it had reported, it should transmit a J7.6 (ACT = 2) message. Remote filters shall be dropped when a J7.6 (ACT = 2) message is received.

4.7.7.8.8 PURGING OF FILTER REQUESTS

Filter messages are nonredundant messages, and each JU should have the capability to drop remote filter reports from its own system.

4.7.8 DATA ASSOCIATION

The J7.7 message provides the capability to indicate that two TNs or the information defining two TNs is associated with the same contact. For example, the association of an air track with an ES report could indicate that the designated air track is the source of the ES data. The association of a ballistic missile track with a missile launcher is another example of data association. The J7.7 message shall not be used to correlate two TNs or to pair a TN to any other TN. The J7.7 message is totally independent of the J6.0, J10.6, J7.2, and J10.2 messages and may be transmitted concurrently with those messages.

4.7.8.1 TERMINATING ASSOCIATION

An association shall be terminated by the JU which had originated the association when it is determined that the association no longer exists.

4.7.8.2 PURGING ASSOCIATION DATA

The J7.7 message is transmitted periodically and JUs should purge received data if data have not been updated after a specified time. This time interval is optional.

4.7.9 UNIT DESIGNATOR MANAGEMENT

The J8.0 message provides the capability to relate a unit designator with an IU TN. In an NCS community where changes in Needline PGs can occur after initialization, an NCS must manage, drop, or add unit designators to be associated with JU or RU TNs.

4.7.10 MISSION CORRELATOR MANAGEMENT

The J8.1 message provides the controlling unit the capability to add, delete, or change the mission correlator (MC) of TNs under its control. (See paragraph 4.10.1.1, Mission Correlator, for information concerning the tactical application of mission correlator.)

4.7.10.1 MISSION CORRELATOR CHANGE FIELD

The Mission Correlator Change field allows for:

a. The assignment of one MC.

b. The deletion of the assigned MC.

c. The change of the assigned MC to another MC.

4.7.10.2 USE OF THE J8.1 MISSION CORRELATOR FIELDS

When initially assigning or deleting a mission correlator, the Mission Correlator field in the J8.1 message contains the MC number to be assigned or deleted, and the Mission Correlator, New field is set to No Statement. When changing a previously assigned mission correlator, the Mission Correlator field contains the previously assigned MC number, and the Mission Correlator, New field contains the new MC number.

Table 4.7-7. Transmission Filter Interpretation For Tracks
(Sheet 1 of 3)

ENV[1]	ID	GEO	SP	SIM	INHIBIT FROM TRANSMISSION
0[2]	0	0	0	0	No tracks being filtered.
1	0	0	0	0	Any track of defined Environment categories.
0	1	0	0	0	Any track of defined Identity categories.
1	1	0	0	0	Any track of defined Environment and Identity categories.
0	0	1	0	0	Any track within/out defined geographic area.
1	0	1	0	0	Any track of defined Environment categories within/out defined geographic area.
0	1	1	0	0	Any track of defined Identity categories within/out defined geographic area.
1	1	1	0	0	Any track of defined Environment and Identity categories within/out defined geographic area.
0	0	0	1	0	Any track with Special Processing status.
1	0	0	1	0	Any track of defined Environment categories with Special Processing status.
0	1	0	1	0	Any track of defined Identity categories with Special Processing status.
1	1	0	1	0	Any track of defined Environment and Identity categories with Special Processing status.
0	0	1	1	0	Any track within/out defined geographic area with Special Processing status.
1	0	1	1	0	Any track of defined Environment categories within/out defined geographic area with Special Processing status.
0	1	1	1	0	Any track of defined Identity categories within/out defined geographic area with Special Processing status.
1	1	1	1	0	Any track of defined Environment and Identity categories within/out defined geographic area with Special Processing status.

Table 4.7-7. Transmission Filter Interpretation For Tracks
(Sheet 2 of 3)

ENV[1]	ID	GEO	SP	SIM	INHIBIT FROM TRANSMISSION
0	0	0	0	1	Any track with Simulation status.
1	0	0	0	1	Any track of defined Environment categories with Simulation status.
0	1	0	0	1	Any track of defined Identity categories with Simulation status.
1	1	0	0	1	Any track of defined Environment and Identity categories with Simulation status.
0	0	1	0	1	Any track within/out defined geographic area with Simulation status.
1	0	1	0	1	Any track of defined Environment categories within/out the defined geographic area with Simulation status.
0	1	1	0	1	Any track of defined Identity categories within/out the defined geographic area with Simulation status.
1	1	1	0	1	Any track of defined Environment and Identity categories within/out the defined geographic area with Simulation status.
0	0	0	1	1	Any track with Simulation status or Special Processing status.
1	0	0	1	1	Any track of defined Environment categories with Simulation status or Special Processing status.
0	1	0	1	1	Any track of defined Identity categories with Simulation status or Special Processing status.
1	1	0	1	1	Any track of defined Environment and Identity categories with Simulation status or Special Processing status.
0	0	1	1	1	Any track within/out the defined geographic area with Simulation status or Special Processing status.

Table 4.7-7. Transmission Filter Interpretation For Tracks
(Sheet 3 of 3)

ENV[1]	ID	GEO	SP	SIM	INHIBIT FROM TRANSMISSION
1	0	1	1	1	Any track of defined Environment categories within/out the defined geographic area with Simulation status or Special Processing status.
0	1	1	1	1	Any track of defined Identity categories within/out the defined geographic area with Simulation status or Special Processing status.
1	1	1	1	1	Any track of defined Environment and Identity categories within/out the defined geographic area with Simulation status or Special Processing status.

Notes

1. Environment/Category of “Unknown” applies only to EW Product data, see paragraph 4.7.7.8.3c.

2. In this table "0" indicates that no filter indicator(s) are set from the corresponding filter type, and "1" indicates that one or more filter indicators are set from the filter type.

Legend

ENV - Environment/Category Filter
ID - Identity Filter
GEO - Geographic Area Filter
SP - Special Processing Filter
SIM - Simulation Filter

Table 4.7-8. Transmission Filter Interpretation For Reference Points

GEO	SP	SIM	INHIBIT FROM TRANSMISSION
0	0	0	Any Reference Point or when requesting establishment/modification of a prearranged filter.
1	0	0	Any Reference Point within/out defined geographic area.
0	1	0	Any Reference Point with Special Processing status.
1	1	0	Any Reference Point within/out the defined geographical area with Special Processing status.
0	0	1	Any Reference Point with Simulation status.
1	0	1	Any Reference Point within/out the defined geographic area with Simulation status.
0	1	1	Any Reference Point with Simulation status <u>or</u> Special Processing status.
1	1	1	Any Reference Point within/out the defined geographic area with Simulation status <u>or</u> Special Processing status.

<u>Note</u>

In this table "0" indicates that no filter indicator(s) are set from the corresponding filter indicator category, and "1" indicates that one or more filter indicators are set from the filter indicator category.

<u>Legend</u>

GEO - Geographic Area Filter
SP - Special Processing Filter
SIM - Simulation Filter

Table 4.7-9. Transmission Filter Interpretation For EW Products (Sheet 1 of 2)

ENV	ID	GEO	SP	SIM	INHIBIT FROM TRANSMISSION
0	0	0	0	0	Any EW Product or when requesting establishment/modification of a prearranged filter.
1	0	0	0	0	Any EW Product of defined Environment categories.
0	1	0	0	0	Any EW Product of defined Identity categories.
1	1	0	0	0	Any EW Product of defined Environment <u>and</u> Identity categories.
0	0	1	0	0	Any EW Product within/out defined geographic area.
1	0	1	0	0	Any EW Product of defined Environment categories within/out defined geographic area.
0	1	1	0	0	Any EW Product of defined Identity categories within/out defined geographic area.
1	1	1	0	0	Any EW Product of defined Environment <u>and</u> Identity categories within/out defined geographic area.
0	0	0	1	0	Any EW Product with Special Processing status.
1	0	0	1	0	Any EW Product of defined Environment categories with Special Processing status.
0	1	0	1	0	Any EW Product of defined Identity categories with Special Processing status.
1	1	0	1	0	Any EW Product of defined Environment <u>and</u> Identity categories with Special Processing status.
0	0	1	1	0	Any EW Product within/out defined geographic area with Special Processing status.
1	0	1	1	0	Any EW Product of defined Environment categories within/out defined geographic area with Special Processing status.
0	1	1	1	0	Any EW Product of defined Identity categories within/out defined geographic area with Special Processing status.
1	1	1	1	0	Any EW Product of defined Environment <u>and</u> Identity categories within/out defined geographic area with Special Processing status.

Table 4.7-9. Transmission Filter Interpretation For EW Products (Sheet 2 of 2)

ENV	ID	GEO	SP	SIM	INHIBIT FROM TRANSMISSION
0	0	0	0	1	Any EW Product with Simulation status.
1	0	0	0	1	Any EW Product of defined Environment categories with Simulation status.
0	1	0	0	1	Any EW Product of defined Identity categories with Simulation status.
1	1	0	0	1	Any EW Product of defined Environment and Identity categories with Simulation status.
0	0	1	0	1	Any EW Product within/out defined geographic area with Simulation status.
1	0	1	0	1	Any EW Product of defined Environment categories within/out the defined geographic area with Simulation status.
0	1	1	0	1	Any EW Product of defined Identity categories within/out the defined geographic area with Simulation status.
1	1	1	0	1	Any EW Product of defined Environment and Identity categories within/out the defined geographic area with Simulation status.
0	0	0	1	1	Any EW Product with Simulation status or Special Processing status.
1	0	0	1	1	Any EW Product of defined Environment categories with Simulation status or Special Processing status.
0	1	0	1	1	Any EW Product of defined Identity categories with Simulation status or Special Processing status.
1	1	0	1	1	Any EW Product of defined Environment and Identity categories with Simulation status or Special Processing status.
0	0	1	1	1	Any EW Product within/out the defined geographic area with Simulation status or Special Processing status.
1	0	1	1	1	Any EW Product of defined Environment categories within/out the defined geographic area with Simulation or Special Processing status.
0	1	1	1	1	Any EW Product of defined Identity categories within/out the defined geographic area with Simulation status or Special Processing status.
1	1	1	1	1	Any EW Product of defined Environment and Identity categories within/out the defined geographic area with Simulation status or Special Processing status.

Note

In this table "0" indicates that no filter indicator(s) are set from the corresponding filter indicator category, and "1" indicates that one or more filter indicators are set from the filter indicator category.

Legend

ENV	-	Environment/Category Filter
ID	-	Identity Filter
GEO	-	Geographic Area Filter
SP	-	Special Processing Filter
SIM	-	Simulation Filter

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4.8 ANTISUBMARINE WARFARE

This section describes the relationship of Antisubmarine Warfare (ASW) to command, control, and surveillance. Those portions of the Link 16 interface design that support ASW are contained in appropriate portions of paragraphs 4.4, Surveillance; 4.10, Mission Management; 4.11, Weapons Coordination and Management; and 4.12, Control. Link 16 provides the vehicle by which parametric data may be exchanged between collectors (ASW assets) and analysis centers (ASW nodes) as well as the exchange of product data between ASW nodes and other JUs. The following describes the Link 16 interface design ASW capabilities. The Link 16 interface design provides for:

a. Capabilities to meet the requirements for conducting ASW operations.

b. Capabilities to provide ASW support to other warfare areas. These capabilities include but are not limited to:

(1) Coordination and control of ASW operations.

(2) Exchange of acoustic and other parametric data to support the development of:

(a) Tactical plot information.

(b) Threat identification.

(c) Threat assessment.

ASW can be conducted as an independent operation or as part of coordinated operations in close support of a task force. The interface has been designed to provide maximum flexibility in the rules for reporting information related to ASW in order to allow for differences in the ASW mission.

4.8.1 DEFINITIONS

4.8.1.1 ANTISUBMARINE WARFARE (ASW)

Antisubmarine warfare involves the use of military assets to search for, detect, locate, track, classify, and attack/destroy a submarine threat to friendly forces.

4.8.1.2 SUBSURFACE SURVEILLANCE

Subsurface surveillance is the reporting of subsurface information to support the compilation of the general surveillance picture and the conduct of ASW.

4.8.1.3 NONANTISUBMARINE WARFARE COMMAND AND CONTROL JTIDS/MIDS UNITS

NonASW C^2 JUs are C^2 units that have no organic ASW capability other than to: (1) request ASW product data, (2) use ASW product data in their own surveillance systems, (3) coordinate activities of weapon systems with other C^2 JUs, and (4) control nonC^2 weapon platforms.

4.8.1.4 COMMAND AND CONTROL JTIDS/MIDS UNITS (ANTISUBMARINE WARFARE NODE)

C^2 JUs (ASW node), in addition to the usual C^2 functions, possess organic ASW processing capability. An ASW node has the capacity to collect, coordinate, and analyze parametric data and derive product data.

4.8.1.5 NONCOMMAND AND CONTROL JTIDS/MIDS UNIT (ANTISUBMARINE WARFARE ASSET)

NonC^2 JUs (ASW asset) may be either an ASW collecting/reporting unit or an ASW weapons platform. ASW assets may communicate with ASW nodes and/or with one another.

4.8.2 ANTISUBMARINE WARFARE MESSAGE DESCRIPTIONS

ASW related messages are listed in Table 4.8-1. The number and name of each message is listed in the left column of the table. In the two columns immediately to the right of the message number and name are the purpose and reference paragraph numbers for related information about that particular message. These messages will be supplemented, when necessary, by other messages from various functional areas such as PPLI, Surveillance, and Control in order to provide all the necessary information to perform ASW missions.

TABLE 4.8-1. Summary of Messages Supporting Antisubmarine Warfare

MESSAGE NUMBER AND NAME	ASW MESSAGE PURPOSE	REFERENCE PARAGRAPH
J2.4 SUBSURFACE (MARITIME) PPLI MESSAGE	REPORTS SUBSURFACE JU'S NETWORK PG STATUS, IDENTIFICATION, AND POSITION.	4.3
J3.0 REFERENCE POINT MESSAGE	THE REFERENCE POINT MESSAGE REPORTS ASW POINTS, LINES, AREAS, AND SONOBUOYS.	4.4.3.1 4.8.4
J3.4 SUBSURFACE (MARITIME) TRACK MESSAGE	EXCHANGES SUBSURFACE SURVEILLANCE TRACK INFORMATION.	4.4.5
J5.4 ACOUSTIC BEARING/ RANGE MESSAGE	REPORTS ACOUSTIC BEARING AND/OR RANGE OF CONTACTS.	4.8.4.2
J9.0 COMMAND MESSAGE	COORDINATION OF ASW COMMAND ACTIVITIES BETWEEN C^2 JUs.	4.11.2.1
J10.2 ENGAGEMENT STATUS MESSAGE	REPORTS STATUS OF ASW WEAPON ENGAGEMENTS.	4.11.2.3
J13.4 SUBSURFACE (MARITIME) PLATFORM AND SYSTEMS' STATUS MESSAGE	PROVIDES THE CURRENT STATUS OF A SUBSURFACE (MARITIME) PLATFORM TO INCLUDE OPERATIONAL STATUS AND ON BOARD SYSTEMS' STATUS.	4.12.1.2.11

4.8.3 ANTISUBMARINE WARFARE APPLICATIONS

Future C^2 systems will contain greater flexibility and ability to exploit the use of ASW assets and provide increased analytical capacity. This, coupled with JTIDS communications, will permit a wide range of cooperative nonC^2 and C^2 activities to interact more effectively with the changing tactical situation. At higher levels, this means that C^2 IUs may reassign ASW assets in real-time to new missions in support of other C^2 IUs, not only in performing limited ASW functions but even to the extent of overall assignment changes. Such flexibility implies the capability to dynamically update both parametric and product databases and to disseminate information among subscribers.

Accordingly, ASW data exchange on Link 16 is characterized in several ways. Data flow design permits dynamic, real-time reaction to situations. Data dissemination design permits integration of nonC^2 ASW assets, C^2 IUs and other IU assets, as well as the exchange of ASW data between C^2 IUs. There are provisions for requests and commands concerning ASW data and for ASW action among C^2 IUs, nonC^2 ASW assets, and nonC^2 weapons platforms. ASW participants will be able to perform their missions in close coordination with other combat units participating in the tactical warfare.

Systems implementing Subsurface Surveillance may also use ASW data to support threat determination. The information exchange within the Subsurface (Maritime) Track and Acoustic Bearing/Range messages satisfies the needs of command, control, coordination, and surveillance systems.

There are requirements for the exchange of parametric ASW data for association purposes and to support weapon employment decisions. Those parametric data may be obtained from real-time, on-scene measurement or from library held values of ASW nodes. When available and requested, whether preplanned or ad-hoc, parametric data may be associated with any track. While multiple acoustic frequencies generated by one target platform may be concurrently associated with one track, ASW nodes with that information would tailor or limit the data to the minimum needed by the requesting unit to accomplish its mission. ASW nodes may be tasked to provide timely bearings to support targeting.

ASW acoustic bearings and/or ranges are reported routinely for correlation, coordination, or other purposes. When they are the only means of locating the threat/target/object, single ASW bearings and/or ranges may be reported on the Surveillance Network PG. The data passed over the Surveillance Network PG will normally be limited to product information.

ASW acoustic bearings and/or ranges, either singularly or in conjunction with other types of lines or bearings, may be used to establish fixes from which vehicular tracks may be developed. ASW nodes will report fixes over the Surveillance Network PG. ASW tracks derived from sequential fixes will be reported on the Surveillance Network PG in the J3.4 message.

Tactically significant ASW information including parametrics may be passed on the Surveillance Network PG.

4.8.4 ASW MISSION DATA

Described within this section are those messages used to provide data in support of the ASW mission. The messages described in this section are:

a. J3.0 Reference Point message for transmission of ASW points, lines, areas, and sonobuoys.

b. J5.4 Acoustic Bearing/Range message.

4.8.4.1 ASW POINTS, LINES, AND AREAS

A C^2 JU shall also be capable of reporting ASW Points on the Surveillance net as appropriate or when sufficient data to report a subsurface track may not be available. The ASW Reference Point types are contained in the Point Type/Point Amplification table used in the J3.0 message.

This information can be associated with other data for the purpose of developing a subsurface track reported on the Surveillance net.

The J3.0 message is also used to report the location and amplification data of deployed sonobuoys. This information is used for mission planning and coordination of ASW assets. A C^2 JU shall also be capable of reporting a sonobuoy pattern reference position and type of sonobuoy pattern barrier on the Surveillance net.

4.8.4.2 ACOUSTIC BEARING/RANGE MESSAGE

The J5.4 Acoustic Bearing/Range message provides the capability of reporting lines-of-bearing and/or ranges to a detected submarine or surface vessel. The use of this message is intended to furnish the bearings/ranges from ASW sensors on board surface vessels or ASW sensors aboard aircraft. The setting of the Bearing Report Type and Sensor fields is critical to the analysis of the bearings produced by either of the above platforms, leading to decisions for reporting of a track in a J3.4 Subsurface (Maritime) Track message. Associated acoustic parametric information may be provided to correlate with other data for the purpose of developing a subsurface track reported on the Surveillance Network PG. Additionally, the J5.4 message may be used to report acoustic bearings/ranges on the Surveillance Network PG when deemed tactically significant.

4.8.5 EXERCISE INDICATOR

The Exercise Indicator and the Identity Amplifying Descriptor fields in the J5.4 message always refer to the Reference TN.

4.9 THREAT WARNING

Threat warning information is exchanged on the interface using the J15.0 Threat Warning message.

4.9.1 THREAT WARNING PROCEDURES

a. Threat warning information is exchanged on the interface to provide immediate notification of impending hostile threats. The Threat Warning message is originated by any JU having knowledge of a threat to either a JU or another friendly track/point, and is independent of track reporting and R^2. NonC^2 JUs shall only initiate a J15.0 message if the Threat TN is already being reported on the interface. Threat warning information shall be exchanged on the Surveillance NPG. The J15.0 shall be used to initiate a track when immediate notification is necessary and the threat track is not currently being reported on the Surveillance NPG. If a J15.0 is used to initiate a track, the initiating unit shall also report the threat in a J3 series message if the threat still exists. The Threat TN shall be used in the J3 series message to allow for TN continuity. The Threat TN shall be the same as the surveillance track when the surveillance track already exists on the interface.

b. When the J15.0 is used to initiate a track, Threat Posture set to value 5, Cancel, shall be used as a "drop track" if a surveillance track has not been initiated. If a surveillance track has been initiated, Threat Posture = 5 applies to the J15.0 only and has no relation to the J3 series message being transmitted.

c. Upon receipt of a J15.0, JUs shall break all local filters on the Threat TN.

4.9.2 THREAT WARNING ADDRESSING

a. When possible, the message should be addressed to the unit responsible for protection of the targeted unit. When the target is the addressed unit, the Targeted TN shall be the Addressee TN.

b. The J15.0 shall be addressed to the collective address when:

(1) The message originator is in doubt as to the unit assigned to protect the targeted unit.

(2) When the Targeted TN is not a JU and it is tactically advantageous for multiple platforms to be alerted to a threat against an individual platform, e.g., High Value Asset.

(3) The threat is general in nature and applies to many or all JUs and friendly tracks/points. (In this case, Targeted TN shall be set to No Statement).

c. It should be noted that although the message may be addressed to an individual platform, it may be advantageous to be addressed to the collective address since it is often tactically desirable for multiple platforms to be aware of a threat against an individual platform, e.g. High Value Assets.

4.9.3 THREAT WARNING MESSAGE CONTENTS

a. The J15.0 Threat Warning message contains information to warn a unit or group of units of an impending hostile threat and shall include sufficient information to establish a track file. This allows the operator to decide what tactics might be employed to counter the threat. The message includes but is not limited to the following information:

(1) Addressee TN (collective or as reported in PPLI).

(2) Threat TN (either originated or as reported in Surveillance).

(3) Targeted TN (as reported in PPLI or Surveillance).

(4) Threat Posture, e.g., Search/Surveillance, Ready to Launch/Fire, Directed to Engage, Cancel.

(5) Threat Type, e.g., Aircraft, Ship.

(6) Threat Weapon, e.g., Heat Air-to-Air Missile, HARM.

(7) Location of Threat.

(8) Course, Speed, Altitude, Threat Fuel state.

(9) Threat Strength (Raid Size).

(10) Specific Type of Threat, e.g., Mig 21, SA-6.

b. The Exercise Indicator field is used in conjunction with the Threat TN field and will always be set the same as in the surveillance message reporting that track.

4.9.4 TIMELINESS

a. It is imperative that the warning of the threat be received on a timely basis. This implies several characteristics in the processing of the message:

(1) It must not be filtered.

(2) Priority of the data should assure transmission ahead of any other type of data. Response time shall be the minimum time allowed.

(3) The J15.0 message shall be transmitted on the Surveillance Network PG.

4.9.5 RELATING THREAT WARNING INFORMATION

a. Threat warning of affected targets or tracks consists of coupling the Targeted TN with the Threat TN. As such, the Targeted TN must be an active surveillance track, point, or PPLI except when the Threat is general in nature (addressed to the collective address) when the Targeted TN may be No Statement, see paragraph 4.9.2b(3).

b. Since the capability exists in the J15.0 message to report hostile to friendly couplings between two TNs regardless of environment/category, the J15.0 shall not be used to report pairings or engagements that are specified for reporting in the J10.6 Pairing message or the J10.2 Engagement message.

Systems shall not allow the J15.0 message that couples two TNs to replace pairings or engagements established by the J10.6 or J10.2 messages. When display of both types of couplings or pairings/engagements is implemented, i.e., J10.6/J10.2 and J15.0, they must be unique so as to avoid operator misinterpretation. J15.0 couplings may overlay J6.0 pairings and engagements.

4.10 MISSION MANAGEMENT

Commanders must manage resources to effectively employ weapon systems to meet operational objectives in a dynamic tactical environment. The Mission Management function on Link 16 provides for the exchange of information between C^2 JUs necessary for monitoring tactical situations and requesting and responding to requests for immediate support requirements. This includes, but is not limited to, those reports and statuses required by the tactical commander to effect mission requests; air, surface (maritime), subsurface (maritime), land (ground) tasking orders; sortie allotments; mission employment and allocation; and in-flight and mission reports. Normally, the command level that implements this functional area does not directly control weapon systems but is responsible for the timely allocation of resources between subordinate C^2 JUs. This function shall be supported principally by voice, teletype or character-oriented data links; however, certain requests, reports and other information may be required in real-time or near real-time.

4.10.1 MISSION MANAGEMENT INFORMATION EXCHANGE REQUIREMENTS

Table 4.10-1 lists the elements of information exchanged within the Mission Management function. Information requirements may translate into one or more data elements and may require more than one word or message to exchange all of the elements.

4.10.1.1 MISSION CORRELATOR

A mission correlator is a unique number assigned to all JUs participating in a specific overall mission. This number allows the identification and isolation of the associated JUs. The mission correlator is not synonymous with the mission number assigned to a specific aircraft or flight of aircraft. The mission correlator may be the same for numerous mission numbers. For example, one mission correlator would be assigned to a strike mission and the supporting, i.e., pre- and post-strike tankers, CAP aircraft, EW support aircraft, an aircraft for that strike and the forward air controller (FAC) aircraft. Through display filtering by mission correlator, all the mission participants can be identified.

4.10.2 MISSION MANAGEMENT MESSAGE DESCRIPTIONS

The Link 16 messages used in mission management are described below.

TABLE 4.10-1. Mission Management Information Exchange Requirements (Preliminary)[1]

ELEMENTS	NOTES
IMMEDIATE TASKING/IMMEDIATE REQUESTS	
STATUS OF FRIENDLY FORCES	INCLUDES STATUS OF JUs AND NON-JTIDS UNITS.
FORCE COMPOSITION	INCLUDES THE COMPOSITION OF TASK FORCE ELEMENTS, FLIGHTS, GROUND UNITS, ETC.
MISSION DEGRADE	INDICATES CHANGES IN A WEAPON SYSTEM'S SUPPORTING PLATFORM'S ABILITY TO ACCOMPLISH AN ASSIGNED MISSION.
MISSION RESULTS	INCLUDES BATTLE DAMAGE ASSESSMENT AND STATEMENT OF MISSION SUCCESS.
FORWARD LINE OF OWN TROOPS (FLOT)/ FORWARD EDGE OF THE BATTLE AREA (FEBA)/ FIRE SUPPORT COORDINATION LINE (FSCL)	
NAVIGATIONAL AIDS AND SUPPORT FACILITIES STATUS	SUPPORT FACILITIES INCLUDE AIRFIELDS, AIRCRAFT CARRIERS, AND GROUND STAGING AREAS.
WEATHER	

NOTE

1 THIS LIST IS NOT ALL INCLUSIVE, NOR ARE THE ELEMENTS LISTED IN ORDER OF IMPORTANCE. INFORMATION REQUIREMENTS MAY TRANSLATE INTO ONE OR MORE DATA ELEMENTS AND MAY REQUIRE MORE THAN ONE WORD OR MESSAGE TO EXCHANGE ALL THE ELEMENTS.

4.10.2.1 IMMEDIATE TASKING MESSAGE

The Immediate Tasking message (TBD) is used by C^2 JUs to direct subordinate JUs to perform specific tasks in support of the overall mission or specific missions. This message provides flag commanders the capability to reallocate resources in real-time in response to changes in the tactical situation.

4.10.2.2 MISSION RESULTS MESSAGE

The Mission Results message (TBD) is used to report results of missions in near-real-time to C^2 JUs responsible for monitoring the tactical situation and for immediate tasking/reallocation of resources in a dynamic tactical environment.

4.10.2.3 AIRFIELD STATUS MESSAGE

The J13.0 Airfield Status message is used to report significant changes in the capability of an airbase with its supporting facilities or an aircraft carrier, to support joint operations and to conduct planned or anticipated operations.

4.10.2.4 FIRE SUPPORT COORDINATION MEASURES MESSAGE

The Fire Support Coordination Measures message (TBD) is used to inform C^2 JUs, in near-real-time, of current significant fire support coordination measures, such as FLOT, FEBA, FSCL, airspace coordination areas, and no fire areas.

4.10.2.5 IMMEDIATE REQUEST FOR SUPPORT MESSAGE

The Immediate Request for Support message (TBD) is used to forward such immediate mission requests as close air support (CAS), artillery fire, reconnaissance, search and rescue, and tactical airlift.

4.10.2.6 WEATHER OBSERVATION/FORECAST MESSAGE

The Weather Observation/Forecast message (TBD) is used to inform C^2 JUs of current weather observations or forecasts within the tactical operational area.

4.10.2.7 SEVERE WEATHER REPORT MESSAGE

The Severe Weather Report message (TBD) is used to inform C^2 JUs of severe weather conditions that may impact tactical operations.

4.10.2.8 ATMOSPHERIC WEATHER REPORT MESSAGE

The Atmospheric Weather Report message (TBD) is used to inform C^2 JUs of weather conditions of specified atmospheric levels.

4.10.3 MISSION MANAGEMENT PROCEDURES AND PROTOCOLS

Procedures and protocols for this area remain to be determined.

4.11 WEAPONS COORDINATION AND MANAGEMENT

The Weapons Coordination and Management function includes those activities required to accomplish weapons employment and to prevent mutual interference during tactical operations. Operational commanders (OPNL CDRs) must have the capability to direct the activities of controlling units and the employment of weapons. Controlling units must have the capability to coordinate their control actions and to transfer control of weapons systems to other controlling units in real-time. The Weapons Coordination and Management function on Link 16 provides information exchange between C^2 JUs that manage or directly control both weapons systems (e.g., fighter aircraft, surface-to-air missiles (SAMs), etc.) and support platforms (e.g., reconnaissance, cargo, etc.). The Weapons Coordination and Management function is monitored by nonC^2 JUs as necessary to compile the tactical picture. However, nonC^2 JUs do not originate Weapons Coordination and Management data. The Weapons Coordination and Management function is interactive with the Control function and the Mission Management function. It is supported by the PPLI function, the Surveillance function, and the EW/Intelligence function.

4.11.1 WEAPONS COORDINATION AND MANAGEMENT INFORMATION EXCHANGE REQUIREMENTS

Table 4.11-1 lists the elements of information exchanged within the Weapons Coordination and Management function. The purpose of the table is to provide general comprehension of the types of information exchange requirements within the Weapons Coordination and Management function and to relate these requirements to messages, protocols, and procedures. Information requirements may translate into one or more data elements and may require more than one word or message to exchange all of the elements.

4.11.2 WEAPONS COORDINATION AND MANAGEMENT MESSAGE DESCRIPTIONS

The Weapons Coordination and Management messages are described below. These messages shall be supplemented, when necessary, by messages from other functional areas such as PPLI, Surveillance, EW/Intelligence, and Control in order to provide all the necessary information to perform Weapons Coordination and Management.

TABLE 4.11-1. Weapons Coordination and Management Information Exchange Requirements[1]

ELEMENTS	PARAGRAPH
COMMANDS	4.11.3.1
MISSION CHANGE	4.11.3.1
CONTROLLING UNIT REPORTS	4.11.3.2
HANDOVER INFORMATION	4.11.3.2
CONTROLLING UNIT CHANGE/CHANNEL/VOICE CALL SIGN	4.11.3.2.2
WEAPON SYSTEM/PLATFORM ENGAGEMENT STATUS	4.11.3.3.1
WEAPON SYSTEM/PLATFORM STATUS[2]	4.11.3.3.2
PAIRING INFORMATION	4.11.3.3.3

NOTES

1 THIS LIST IS NOT ALL INCLUSIVE, NOR ARE THE ELEMENTS LISTED IN PRIORITY OF IMPORTANCE. IT SHOULD BE NOTED THAT INFORMATION REQUIREMENTS MAY TRANSLATE INTO ONE OR MORE DATA ELEMENTS AND MAY REQUIRE MORE THAN ONE WORD OR MESSAGE TO EXCHANGE ALL THE ELEMENTS.

2 ADDRESSED HERE AS A PROCEDURAL REQUIREMENT BUT CONTAINED IN THE APPROPRIATE FUNCTION OF CONTROL.

4.11.2.1 COMMAND MESSAGE

The J9.0 Command message is used by controlling units to direct other controlling units in weapons control activities and to transmit general alert conditions and weapons condition orders. Weapons control activities include directions to launch aircraft, return aircraft to base, transfer control of aircraft to another controlling unit, direct weapons systems engagement/disengagement for air defense, direct Air Support Operations (ASO) activities and direct antisubmarine warfare (ASW) operations.

4.11.2.2 ENGAGEMENT COORDINATION MESSAGE

The J9.1 Engagement Coordination message provides the means for two or more elements to coordinate engagements in order to conduct more efficient engagements and to reduce the probability of wasted resources.

Engagement Coordination includes those activities between two or more weapon systems with common or shared defense responsibilities within an area of operations or theater. Weapon systems must have a means of exchanging options, strategies and expectations of support in order to ensure adequate defense of defined assets and effective use of limited resources.

A primary example of engagement coordination is the upper tier/lower tier defense strategy for theater ballistic missile defense. Coordination is facilitated through the use of the J9.1 Engagement Coordination message. The J9.1 Engagement Coordination message is used to advise a lower tier/adjacent system that support on a particular engagement is desired; and to advise the requesting system that support to that engagement can or cannot be provided.

4.11.2.3 ENGAGEMENT STATUS MESSAGE

The J10.2 Engagement Status message provides the status of an engagement between the Reference TN and the Target TN. This message also provides an indication of the effectiveness of an engagement as well as a Heads Up warning to denote that the Source TN is unable to assure complete destruction of the target and that a threat remains. The Engagement Status message also provides a means of reporting a time of predicted intercept of the Target TN by a Friendly Weapon TN (intercept missile) from which the predicted intercept location may be determined. The Engagement Status message also provides a means of reporting the actual time of intercept for the Target TN from which the actual intercept location may be determined.

4.11.2.4 HANDOVER MESSAGE

The J10.3 Handover message provides the data necessary to perform a digital handover of controlled aircraft between controlling units. The data includes the Link 4A Address and Voice Call Sign of the controlled aircraft, and if the aircraft is engaged or paired, the Objective TN of the entity the aircraft is engaging or is paired to. The J10.3C1 Handover continuation word 1 is used to provide data concerning the new Control Channel, Voice Frequency/Channel, Link 4A Frequency, IFF data, and radio information. The J10.3C2 Handover continuation word 2 is used to provide the controlled aircraft's Mission Correlator.

4.11.2.5 CONTROLLING UNIT REPORT MESSAGE

The J10.5 Controlling Unit Report message is used by C^2 JUs with air control missions to indicate the aircraft they have under their control.

4.11.2.6 PAIRING MESSAGE

The J10.6 Pairing message is used to indicate the type of pairing between a friendly TN and the TN of another track or point. The J10.6 message is not used for the same purpose as the J7.2 Correlation message or the J7.7 Association message.

4.11.2.7 INTERRELATIONSHIPS BETWEEN J9.0, J10.2, J10.6, J12.0, AND J12.6 MESSAGES

As stated in paragraph 4.11, the Weapons Coordination and Management function and the Control function are interactive. As such, the transmission/reception of a specific message, word, or data element within a function will cause the transmission of a specific message, word, or data element within the other function. Specifically the J9.0, J10.2, J10.6, J12.0 and J12.6 messages are dependent in such a manner as to necessitate the same interpretation of their interrelationship among all interfacing JUs. When a system that has control capability elects to implement a specific J9.0 Command, Tables 4.11-2, 4.11-3, 4.11-4, and 4.11-5 require that the system also implement for transmission the corresponding J12.0 Mission Assignment Discrete (MAD) and J10.2 Weapon Engagement Status (WES) or J10.6 Pairing Action and for reception the corresponding J12.6 Status Information Discrete (SID). Likewise, when a system chooses to implement a specific J12.0 MAD, even though it is not obligated to implement all the corresponding J9.0 Commands, it shall implement the corresponding J10.2 WES or J10.6 Pairing Action, i.e., if a system chooses to implement the J9.0 Command value 15, Cease Proceeding to Point, it shall also implement the J12.0 MAD value 3, Recall, and the J10.6 Pairing Action value 15, Terminate Pairing. As the system is required to implement the J12.0 MAD value 3, Recall, it is not obligated by the tables to also implement the J9.0 Command value 17, Cease Conducting Procedures Indicated, or 19, Cease Duties Indicated. The tables establish requirements only when read from left to right. These tables do not imply any data forwarding requirements. The following tables specify this interrelationship.

Table 4.11-2 depicts the message flow between units and can be used to supplement Tables 4.11-3, 4.11-4, and 4.11-5.

Tables 4.11-3, 4.11-4, and 4.11-5 represent the relationship between J9.0 Commands, J10.2 WESs, J12.0 MADs, and J12.6 SIDs.

Table 4.11-3 assumes a J9.0 message is sent between C^2 JUs and the receiving C^2 JU transmits either manually or automatically a corresponding J12.0 message to the nonC^2 JU. If a nonC^2 JU transmits a J12.0 WILCO message, the J10.2 column indicates the J10.2 WES value, or J10.6 message, if appropriate, to be automatically transmitted by the C^2 JU, as a result of that WILCO. This table is also used for J12.0 MADs that were originated without reception of a J9.0 message.

Table 4.11-4 is used for the remaining MADs that do not have a correlation with the J9.0 message, i.e., J12.0 messages that were originated by a C^2 JU but were not induced by reception of a J9.0 message. In this table, WES value 2, Weapon Assigned, is used most frequently because it is the most generic of the WES values. All other WES values have meanings that do not equate to any MAD value.

TABLE 4.11-2. Flow Diagram of Message Sequences for Tables 4.11-3, 4, and 5[1]

C^2 UNIT #1 (OPNL CDR)	C^2 UNIT #2	NONC^2 UNIT

```
C2 UNIT #1 TRANSMITS COMMAND TO C2 UNIT #2

J9.0------------------->
<-------------------J9.0 WILCO

C2 UNIT #2 TRANSMITS MISSION ASSIGNMENT TO NON C2 UNIT

J12.0-------------------->
<------------------------J12.0 WILCO

<---------------J10.2 or J10.6--------------->
(The J10.2 or J10.6 message is
broadcast to all JUs on the
Mission Management/Weapons
Coordination & Management NPG)

C2 UNIT #2 TRANSMITS J12.0 WITHOUT DIRECTION FROM C2 UNIT #1

J12.0-------------------->
<--------------------J12.0 WILCO

<---------------J10.2 or J10.6---------------->
(All Net participants)

C2 UNIT #2 RECEIVES A J12.6 FROM A NONC2 UNIT
(TRANSMITTED BY THE NONC2 UNIT INDEPENDENT
OF RECEPTION OF A J12.0)

<------------------------J12.6

<----------------J10.2 or J10.6---------------->
(All Net participants)
```

NOTE:
[1] The J10.6 Pairing values in the following tables do not mandate a Pairing being transmitted. However, if a Pairing is transmitted, the values specified in the tables shall be used.

TABLE 4.11-3. J9.0, J12.0, J10.2, J10.6, and J12.6 Action Value Relationships (Sheet 1 of 2)

J9.0 Command/WILCO	J12.0 MAD/WILCO[1]	J10.2 WES, J12.6 WES or J10.6 Pairing (If Pairing Transmitted)
0 - Weapons Free	25 - Weapons Free	N/A
1 - Weapons Tight	26 - Weapons Tight	N/A
2 - Engage	5 - Engage	4 - Firing/Missile In Flight/Engaging To Destroy
3 - Assign	8 - Investigate/ Interrogate	11 - Investigating/ Interrogating[2]
4 - Cease Engage	7 - Break Engagement	8 - Engagement Broken
5 - Hold Fire	7 - Break Engagement[2] 47 – Hold Fire[3]	8 - Engagement Broken
6 - Cease Fire	7 - Break Engagement 46 – Cease Fire[3]	8 - Engagement Broken
7 - Cover	31 - Cover	14 - Covering
8 - Salvo/Clear Aircraft	27 - Salvo/Clear Aircraft	N/A
9 - Assume Control	---Handover Sequence---	---Handover Sequence---
10 - Attack	41 - Attack	4 - Firing/Missile In Flight/Engaging To Destroy
11 - Cease Attack	42 - Cease Attack	8 - Engagement Broken
14 - Proceed To Point	12 - Divert	J10.6 (1 - General Pairing)
15 - Cease Proceeding To Point	3 - Recall	J10.6 (15 - Terminate Pairing)

NOTE:

1 If the received J9.0 Threat Warning Condition field is set to value 1, White, 2, Yellow, or 3, Red, a J12.0 MAD set to value 28, Alert Condition White, 29, Alert Condition Yellow, or 30, Alert Condition Red, respectively, will be broadcast in addition to the indicated messages.

2 For aircraft.

3 For SAM sites.

TABLE 4.11-3. J9.0, J12.0, J10.2, J10.6, and J12.6 Action Value Relationships
(Sheet 2 of 2)

J9.0 Command/WILCO	J12.0 MAD/WILCO[1]	J10.2 WES, J12.6 WES or J10.6 Pairing (If Pairing Transmitted)
16 - Conduct Procedures Indicated (Command Mission:		
Search & Rescue	15 - Search and Rescue	J10.6 (1-General Pairing)
Close Air Support	20 - Close Air Support	J10.6 (5-Close Air Support Pairing)
Armed Reconnaissance	40 - Armed Reconnaissance	2 - Weapon Assigned
Aerial Reconnaissance	22 - Aerial Reconnaissance	N/A
Suppression of Enemy Air Defenses	39 - Suppression of Enemy Air Defenses	2 - Weapon Assigned
17 - Cease Conducting Procedures Indicated	3 - Recall	J10.6 (15 - Terminate Pairing)
18 - Assume Duties Indicated (Duty Assignment:		
Search & Rescue	15 - Search & Rescue	J10.6 (1 - General Pairing)
Combat Air Patrol)	16 - Combat Air Patrol	J10.6 (4 - Combat Air Patrol Pairing)
19 - Cease Duties Indicated	3 - Recall	J10.6 (15 - Terminate Pairing)
20 - Transfer Control	---Handover Sequence---	---Handover Sequence---
21 - Return To Base	4 - Return To Base	J10.6 (6 - Return To Base Pairing)
22 - Launch Alert Aircraft	N/A	N/A
23 - Investigate/ Interrogate	8 - Investigate/ Interrogate	11 - Investigating/ Interrogating
24 - Intervene	11 - Intervene	13 - Intervening
25 - Shadow	24 - Shadow	12 - Shadowing
28 - Priority Kill	6 - Priority Kill	4 - Firing/Missile In Flight/Engaging To Destroy

NOTE:

[1] If the received J9.0 Threat Warning Condition field is set to value 1, White, 2, Yellow, or 3, Red, a J12.0 MAD set to value 28, Alert Condition White, 29, Alert Condition Yellow, or 30, Alert Condition Red, respectively, will be broadcast in addition to the indicated messages.

[2] For Aircraft.

[3] For SAM sites.

TABLE 4.11-4. Mission Assignment Discretes not Corresponding to J9.0 Messages

J12.0 MAD/WILCO	J10.2 WES, J12.6 WES or J10.6 Pairing (If Pairing Transmitted)
1 - Refuel	J10.6 Pairing Transmitted[1]
2 - Orbit	J10.6 (1 - General Pairing)
9 - Clear To Drop	J10.6 (1 - General Pairing)
10 - Cease/Do Not Drop	J10.6 (15 - Terminate Pairing)
13 - Air-to-Surface	N/A
14 - Air-to-Air	N/A
17 - Precision Bombing	2 - Weapon Assigned
18 - Laser Designation	2 - Weapon Assigned
19 - Beacon Bombing	2 - Weapon Assigned
21 - Interdiction	J10.6 (2 - Interdiction Pairing)
23 - Escort	J10.6 (3 - Rendezvous Pairing)
28 - Alert Condition White	N/A
29 - Alert Condition Yellow	N/A
30 - Alert Condition Red	N/A
32 - Visual Identification	11 - Investigating/Interrogating
34 - Go to Voice	N/A
35 - High Interest Track Designation	N/A
36 - Cancel High Interest Track Designation	N/A
37 - Sensor Target Reports On	N/A
38 - Sensor Target Reports Off	N/A
43 - Related Mission Data	N/A
44 - Counter Air Attack	2 - Weapon Assigned
45 - Fighter Sweep	N/A
63 - Cease Mission	N/A

NOTE:

[1] If refuel is to a tanker, J10.6 (7 - Tanker Pairing), otherwise J10.6 (1 - General Pairing).

Table 4.11-5 depicts the J10.2 WES values that are transmitted as a result of receiving a J12.6 message from a nonC^2 JU. This table specifies the relationship between J10.2 WES values and J12.6 SID values.

J9.0 Command, J12.0 MAD, and J12.6 SID values of No Statement, Undefined, and those only transmitted between nonC^2 JUs are not included in the tables because reception of these values would not cause another message to be sent by a C^2 JU.

TABLE 4.11-5. J10.2 WES Resulting from Reception of a J12.6 Message

J12.6 SID	J10.2 WES
1 – Engaging or Attacking	4 - Firing/Missile In Flight/Engaging To Destroy
2 - Investigating[1]	11 - Investigating/Interrogating
3 - Missile In Flight/Weapon Released	4 - Firing/Missile In Flight/ Engaging To Destroy
4 - New Sensor Target Report	N/A
5 - Cancel Sensor Target Report	N/A
6 - Track/Target Destroyed	5 - Effective/Target Destroyed/ Grand Slam
7 - Disengaging	8 - Engagement Broken
8 - Target Partially Destroyed	6 - Partially Effective
9 - Heads Up/Mark Point/Point of Interest	N/A
10 - Lock On/Primary Designated Target or Designated Surface Target or Designated Ground Target	N/A
11 – Not effective	7 – Not effective
11 - Battle Damage Assessment Unknown	15 - Battle Damage Assessment Unknown
12 - Covering	14 - Covering
12 - Recommend Reattack	1 - Recommend Reattack

NOTE:

[1] If a previous J12.0 WILCO message for Intervene, Shadow, or Cover was received resulting in a J10.2 WES of Intervening, Shadowing, or Covering, respectively, being transmitted as depicted in Table 4.11-3, the C^2 JU may continue to repeat the previous J10.2 WES in lieu of Investigating/Interrogating.

4.11.3 WEAPONS COORDINATION AND MANAGEMENT PROCEDURES AND PROTOCOLS

The messages described above are used in conjunction with other messages to coordinate and manage weapons traffic. General procedures for use of those messages within the various activities are discussed below. Specific transmit/receive rules for individual messages are included with the message descriptions in Section 5, Parts 1, 2, and 3.

4.11.3.1 COMMAND PROCEDURES

Command procedures provide for the direction of C^2 activities and the promulgation of weapon condition orders and general alert conditions. These procedures are executed as follows:

a. Commands that are transmitted between C^2 JUs to direct C^2 JU activities using the J9.0I/J9.0E0 word sequence include Engage, Assign, Cease Engage, Salvo/Clear Aircraft, Assume Control, Engage Objective TN With Weapon System Specified, Break Engagement With Objective TN With Weapon System Specified, Proceed to Point, Cease Proceeding To Point, Conduct Procedures Indicated, Cease Conducting Procedures Indicated, Assume Duties Indicated, Cease Duties Indicated, Transfer Control, Return to Base, Launch Alert Aircraft, Investigate/Interrogate, Intervene, and Shadow. The J9.OC1 Command continuation word may only be added in two cases: firstly, with the commands of 21, Return to Base, and 22, Launch Alert Aircraft to provide communication data that may be transmitted to Friendly Weapon TN, when applicable, about the base to which to return or the controlling agency to receive the alert aircraft; secondly, with the commands 2, Engage, and 3, Assign, to communicate the Method of Fire. R/C is required for all command values that direct controlling unit activities, except as indicated below in paragraph 4.11.3.1.3.

b. Commands transmitted between C^2 JUs to promulgate weapon condition orders using the J9.0I word include Weapons Free, Weapons Tight, Hold Fire, Cease Fire, etc. R/C is required for all weapon condition orders, except as indicated below in paragraph 4.11.3.1.3.

c. General alert conditions are transmitted between C^2 JUs via the J9.0I word.

There is no provision in existing C^2 systems for automatic response to J9.0 message commands, other than machine receipts. Systems do, however, provide an automatic alert to operators who shall respond by taking actions that may include voice communication with an airbase, ground TACS, ship, or aircraft; or by taking console actions that result in automatic transmission of data in accordance with paragraphs 4.11, 4.12 and associated subparagraphs.

4.11.3.1.1 COMMAND AUTHORITY

The command structure may require that one or more JUs be delegated the authority to transmit the J9.0 message. In this case, the JU(s) so designated will be identified by a Source TN which is promulgated to all IUs. If the command authority is transferred between JUs, all participating JUs will be informed through voice communication or other communications media. Nevertheless, any unit within the interface may be designated authority to transmit J9.0 messages without having been previously identified as a unit with Command Authority. Operator validation, based on the Source TN of received J9.0 messages, is required to verify that such orders were originated by an IU with the appropriate designated authority. Original J9.0 messages shall not be automatically rejected by receiving systems on the basis of Source TN, to preclude automatic rejection of legal orders.

4.11.3.1.2 REQUIRED COMMAND VALUES

The JOC may direct command structures that require the passing of messages containing command, weapons status, and engagement status information between IUs of different Services/Agencies. Therefore, those messages must be capable of being exchanged between Services/Agencies in support of and in accordance with operational doctrine. The Command field values of the J9.0 message which shall be implemented by all interfacing C^2 JUs and must be capable of inter-Service/Agency exchange are identified in Appendix A, Minimum Implementation.

4.11.3.1.3 ADDRESSING OF COMMAND MESSAGES

Original J9.0 messages (R/C field set to value 0 or 1) with the Command field values of Salvo/Clear Aircraft, Hold Fire, Cease Fire, Weapons Tight, Weapons Free, Conduct Procedures, and Cease Conducting Procedures may be addressed to individual JUs by using the Addressee TN field with the applicable TN set (R/C field set to value 0) or to all JUs by setting the Addressee TN field to the collective address of 00177 octal (R/C field set to value 1). Machine receipt J9.0 messages (R/C field set to value 2) are not transmitted in response to commands addressed to the collective address of 00177 octal.

4.11.3.1.4 COMPLIANCE WITH HOLD FIRE COMMAND DEFINITION

Receipt of the J9.0 message with the Command field set to value 5, Hold Fire, shall prevent launch of the missile and, upon compliance, shall cause transmission of a J10.2 message with the WES field set to value 8, Engagement Broken, if any engagement status has been reported. Because of the nature of certain missiles, strict compliance with the processing required by the definition of the J9.0 message with the Command field set to value 5, Hold Fire, is not possible, i.e., unable to destroy missile in flight. When the specific requirements of the Hold Fire cannot be met after the missile launch due to the nature of the weapon system, J10.2 engagement status reports shall continue until one of the following occurs:

a. A manual J10.2 message with the WES field set to value 5, Effective/Target Destroyed/Grand Slam, report is generated.

b. The missile is no longer capable of destroying the target, at which time a J10.2 message with the WES field set to value 8, Engagement Broken, shall be generated.

4.11.3.1.5 USE OF COMMAND MESSAGE FOR ASO MISSIONS

Commands may be provided to C^2 JUs controlling ASO aircraft by use of the J9.0 message. The J9.0I/J9.0EO word sequence will be used to provide C^2 JUs with information necessary to order missions and assign targets to nonC^2 units under the control of the receiving C^2 JUs as described in the following paragraphs.

a. The J9.0I word Command field values 10, Attack, and 11, Cease Attack, shall be utilized to direct ASO assets against specific targets. The Objective TN is the target to be destroyed. The Friendly Weapon TN may be set to the TN of the aircraft assigned the mission. The Weapon Type field in the J9.0I word shall be set to Aircraft. If the Friendly Weapon TN is set to No Statement, then the Addressee TN will assign a specific nonC^2 unit to accomplish the mission.

b. Commands to C^2 JUs to conduct other ASO missions are accomplished by utilizing J9.0I word Command values 16, Conduct Procedures Indicated, and 17, Cease Conducting Procedures Indicated. The Objective TN is the target for the mission. The Command Mission field in the J9.0E0 shall be set to value 27, Close Air Support, 28, Armed Reconnaissance, 29, Aerial Reconnaissance, or 30, Suppression of Enemy Air Defenses. Fragmentary orders may provide additional information and may be referenced by utilizing the J9.0E0 Fragmentary Order Number field. To direct an Addressee TN, i.e., a controlling C^2 JU, to use a specific nonC^2 unit to perform a mission, the Friendly Weapon TN is set to the TN of the nonC^2 unit. If the Friendly Weapon TN is set to No Statement, then the Addressee TN will assign a specific nonC^2 unit to accomplish the mission.

c. Control of nonC^2 JUs on ASO missions is accomplished in the Control NPG utilizing J12 series messages. Detailed protocols and procedures are found in Section 4.12.

4.11.3.2 PROCEDURES FOR CONTROL OF NONC^2 UNITS

To coordinate and manage the control of nonC^2 units, systems with nonC^2 unit control missions shall have the capability to indicate which nonC^2 units they have under their control and to effect transfer of nonC^2 unit control between controlling units. Controlling units are those C^2 JUs capable of performing nonC^2 unit control functions, such as positive control, flight following, radar advisory, etc. Procedures for assumption of control, termination of control, and handover of control are discussed below.

4.11.3.2.1 ASSUMPTION OF CONTROL

When a controlling unit has completed voice or digital communications as described in paragraph 4.12.1.3.7, assuring that both the nonC^2 unit and the controlling unit understand that the nonC^2 unit is under its control, the controlling unit initiates transmission of a series of J10.5 messages. A controlling unit shall transmit a J10.5 message for each unit under its control. Reporting of controlling unit status on the same nonC^2 unit by more than one C^2 JU shall cause operator alerts at the conflicting units. R^2 for surveillance data on a controlled nonC^2 unit is determined as for any other track.

4.11.3.2.2 HANDOVER OF CONTROL

The Link 16 digital handover of controlled nonC^2 units is performed as described in this paragraph. Procedures for the handover of a remotely piloted vehicle (RPV)/missile are TBD. The following procedures address Request For Assume Control, Request for Transfer Control, and Handover Resulting from a Command Message. Controlling C^2 JU A is the original controlling C^2 JU and controlling C^2 JU B is the new controlling C^2 JU.

a. Request for Assume Control. C^2 JU A requests C^2 JU B to assume control of a nonC^2 unit by transmitting an original J10.3I/J10.3E0 word sequence with the R/C field set to value 0. The J10.3E0 word provides the following nonC^2 unit information as appropriate: Voice Call Sign, the Objective TN to which it is assigned/engaged, and its Link 4A Address. The Request for Assume Control field in the J10.3 message shall be set to value 0 or 1. The Request for Assume Control field set to value 1 shall be used only when transferring control of a nonC^2 unit that is engaging, i.e., C^2 JU A is transmitting J10.2 messages with the WES field set to values 2-7 or 11-14 on the nonC^2 unit that is the subject of the handover. The nonC^2 unit may be engaged to one or more targets although only one target can be reported in the J10.3E0 word Objective TN field. Therefore, C^2 JU B should alert the operator to all J10.2 engagements currently held for the nonC^2 unit when the original J10.3 message is received. The Request for Assume Control field shall be set to value 0 when used to handover nonC^2 units that are not engaging. A J10.3C2 word may be added to transmit the Mission Correlator assigned to the nonC^2 unit. C^2 JU B transmits a machine receipt J10.3 message with the R/C field set to value 2. Upon receipt of the handover request, the operator in C^2 JU B will be alerted. The operator then performs console action(s) that cause transmission of a WILCO or a CANTCO J10.3 message with the R/C field set to value 3 or 6. The J10.3 message with the R/C field set to value 3, WILCO, shall be a J10.3I/J10.3E0/J10.3C1 word sequence with the information that C^2 JU A must provide to the nonC^2 JU in a J12.4 Controlling Unit Change message to assist in performing the handover.

C^2 JU A transmits a machine receipt J10.3 message with the R/C field set to value 2 to C^2 JU B in response to the C^2 JU B J10.3 message with the R/C field set to value 3, WILCO. If the nonC^2 unit is an active JU, the change of control is executed using J12.4 messages as described in paragraph 4.12.1.3.7b. Upon receipt of a J12.4 message with the R/C field set to value 3, WILCO, from the nonC^2 JU, C^2 JU A shall transmit a J10.5 Controlling Unit Report with the Controlling Unit Status and the Handover Indicator fields set to value 1 and shall cease reporting any J10.2 Engagement Status or J10.6 Pairing messages for the nonC^2 JU. After completion of the change of control in accordance with paragraph 4.12.1.3.7b, C^2 JU B shall indicate the completion of the handover by transmitting the J10.5 message and may begin transmission of the J12.X messages to the nonC^2 JU. C^2 JU A shall cease transmitting the J10.5 Controlling Unit Report message upon receipt of a J10.5 message from C^2 JU B. C^2 JU B shall transmit any J10.2 or J10.6 messages if C^2 JU A was reporting any engagements or pairings for the nonC^2 JU.

If for any reason the nonC^2 JU is unable to complete the handover with C^2 JU B in accordance with paragraph 4.12.1.3.7b, the nonC^2 JU may request control by C^2 JU A. If C^2 JU A assumes control again, it shall send a Cancel Handover Request to C^2 JU B and set the Handover Indicator field to value 0 in the J10.5 messages.

When the Request for Assume Control field is set to value 0 or 1, the J10.3C1 word shall be originated by C^2 JU B in its J10.3 message with the R/C field set to value 3, WILCO, response. The data in this J10.3C1 word shall provide information specified by C^2 JU B for control. As a minimum, it shall provide the Control Channel or Link 4A Frequency on which C^2 JU B desires to exercise control, unless control is to be performed by voice only. It may also provide the UHF Frequency or Channel Group A or B to be used for voice coordination (or control if both Control Channel and Link 4A Frequency fields are set to No Statement), secure radio information (Radio Type (UHF-AM or UHF-FM) and Secure Radio Indicator) about the UHF Frequency, the Mode III Code C^2 JU B desires the nonC^2 JU to use, or a request for the nonC^2 JU to Squawk Flash.

b. Request for Transfer Control. C^2 JU B may request control by transmitting the J10.3I/J10.3E0/J10.3C1 word sequence to C^2 JU A. The Request for Assume Control field in the J10.3 message shall be set to value 2. All of the communications information in the J10.3E0 and J10.3C1 words apply to C^2 JU B. If available, the C^2 JU B Voice Call Sign shall be provided. The Link 4A Address shall be provided if Link 4A control is desired. As a minimum, the J10.3C1 word shall contain the Control Channel or Link 4A Frequency on which C^2 JU B desires to exercise control, unless control is to be performed by voice only. It may also provide the UHF Frequency or Channel Group A or B to be used for voice coordination (or control if both Control Channel and Link 4A Frequency fields are set to No Statement), secure radio information (Radio Type (UHF-AM or UHF-FM) and Secure Radio Indicator) about the UHF Frequency, the Mode III Code C^2 JU B desires the nonC^2 unit to use, or a request for the nonC^2 unit to Squawk Flash.

The J10.3C1 word is included in the original J10.3 message with the Request for Assume Control field set to value 2 and the R/C field set to value 0, and C^2 JU A is not allowed to alter any of the data in its WILCO reply. If C^2 JU A does not agree with any of the J10.3C1 data, its only options are voice communications prior to transmitting a WILCO, or transmitting a J10.3 message with the R/C field set to value 6, CANTCO. When the J10.3 message with the R/C field set to value 6 is transmitted, C^2 JU A maintains control.

c. Handover Resulting from a Command Message. Handovers may occur as a result of orders received in the J9.0 message. After receipt of an order, the receiving unit shall initiate the appropriate Request for Assume Control sequence as described in paragraphs a and b.

d. Specific protocols for implementing the J10.3 messages to accomplish the handover functions are contained in the following paragraphs:

(1) Platform and System Status Information. C^2 JU B may or may not have platform and system status information on the Reference TN. If not, C^2 JU B may request this information by transmitting the J7.1 Data Update Request message to C^2 JU A prior to transmitting a J10.3 message with the R/C field set to value 3, WILCO.

(2) Cancellation of a Handover. A C^2 JU may cancel a handover by transmitting a J10.3 message with the Cancellation Indicator field set to

value 1 anytime prior to reception of a Controlling Unit Report from the other C^2 JU in accordance with the following:

(a) Cancel Handover Request. C^2 JU A initiation of a J10.3 message to cancel a Handover Request shall inhibit transmission of the J12.4 message if it has not already occurred, and the handover is terminated. If C^2 JU A desires to regain control after receiving a Controlling Unit Report from C^2 JU B, it shall initiate a Request for Transfer of Control as described in paragraph b above.

(b) Cancel Request for Transfer of Control. C^2 JU B initiation of a J10.3 message to cancel a Request for Transfer of Control shall inhibit transmission of the J12.4 message from C^2 JU A if it has not occurred already and the handover is terminated. If the J12.4 message has been transmitted, C^2 JU A shall transmit a J10.3 CANTPRO message and C^2 JU B shall complete the transfer of control. If after transmitting the Controlling Unit Report C^2 JU B desires C^2 JU A to take control, C^2 JU B shall initiate a Handover Request to C^2 JU A.

In either of the cases above, if the nonC^2 JU is unable to contact C^2 JU B and returns to C^2 JU A, C^2 JU A shall transmit a J10.3 message with the Cancellation Indicator field set to value 1.

A J10.3 message transmitted to cancel a handover or transfer of control shall be a copy of the original request except that the Cancellation Indicator field shall be set to value 1 and the Addressee TN shall be set appropriately.

(3) Failure to Acknowledge. When a J10.3 original message has not been acknowledged in accordance with the transmit/receive rules, the host system shall alert the operator. The receipt of a WILCO, CANTCO, or CANTPRO response to an original message shall inhibit setting the alert for no acknowledgement. If a CANTCO or CANTPRO response message is received, the handover process via data link terminates and voice coordination may be required.

(4) Assumption of Control. C^2 JU B shall transmit the J10.5 message in accordance with paragraph 4.11.3.2.1. If the nonC^2 unit is

engaged/paired, C^2 JU B must initially transmit the locally held engagement status/pairing values on the engagements/pairings previously reported. Acceptance of an engaged/paired handover constitutes the acceptance of the engagements/pairings. (See paragraphs 4.11.3.3.1 and 4.11.3.3.3.)

(5) Duplicate Reporting of Control. Units receiving a J10.5 message from a Source TN different from that previously received shall accept the latest Source TN as the controlling C^2 JU.

4.11.3.2.3 TERMINATION OF CONTROL

When a controlling C^2 JU terminates control of a track or is going to drop a track from its local database which it has previously been reporting as a controlled track, a J10.5 message indicating termination of control shall be transmitted. If the controlled track is a JU, the controlling C^2 JU shall send a J12.4 message to the nonC^2 JU indicating termination of control. A J10.2 Engagement Broken message or a J10.6 Terminate Pairing message shall be sent only when an engagement is broken or the pairing is terminated. These messages are not transmitted solely as the result of terminating control of a track. Transmission of the J10.5 message and the J12.4 message, when appropriate, with the Controlling Unit Status field set to the terminating control value, completes the terminate control procedure. The J10.5 Terminate Control message is not to be used during a handover among C^2 JUs. For handover procedures between C^2 JUs, refer to paragraph 4.11.3.2.2. When performing a handover from a C^2 JU to a nonIU, the J10.5 Terminate Control message shall be transmitted by the C^2 JU.

4.11.3.3 REPORTING OF STATUS

All JUs shall report their own platform and system status. Controlling units shall report the platform and system status of units under their control that are not reporting their own status. If conflicting data are received at approximately the same time, data received from the platform shall take precedence. C^2 JUs shall have the capability to report the status of engagements conducted by own JU, by units under their control, and by nonIUs not under control. C^2 JUs also report pairings. Engagement status, platform and system status, and pairing status reporting procedures are described in the following subparagraphs.

4.11.3.3.1 REPORTING OF ENGAGEMENT STATUS

The reporting of engagement status for controlled units and other than controlled units is as follows:

a. Engagement Status for Controlled Units. The reporting of engagement status for controlled units is as follows:

(1) Only the controlling C^2 JU shall report the engagement status of a controlled unit in the J10.2 message. To report engagement status, a controlling C^2 JU must have the Reference TN under control. Engagement status shall be reported by the controlling C^2 JU in the following situations:

(a) Upon initiating or changing the engagement status of the Reference TN, but only after confirmation is received from the Reference TN. Confirmation is receipt of a J12.0 WILCO message, a J12.6 message as described in (f) below, a voice acknowledgement, or an operator observation. In the case of one-way communication, transmission of the order is considered confirmation.

(b) Upon accepting the handover of an engaging platform.

(c) Periodically, in accordance with the transmit/receive rules.

(d) In response to a J7.1 message containing either the Reference TN or Target TN.

(e) In response to a J7.1 message with the Weapon Status Data Request Indicator field set to value 1.

(f) Upon receipt of an initial J12.6 message with the SID field set to value 1, 2, 3, 6, or 7 from an engaging nonC^2 JU or a J12.6 message changing a previously reported engagement status.

(2) Engagements shall be terminated by transmitting a J10.2 message with the WES field set to value 5, Target Destroyed, or 8, Engagement Broken. If value 5, Target Destroyed, is used, the message shall be

transmitted in accordance with Table J10.2 until sensor contact is cancelled/lost.

(3) The controlling C^2 JU shall transmit a J10.2 message with the WES field set to value 5, Target Destroyed, or 8, Engagement Broken, to break an engagement when the engagement which that C^2 JU has been reporting is terminated.

b. Engagement Status for other than Controlled Units. In addition to the controlling unit reporting engagement status of controlled units as specified in paragraph 4.11.3.3.1a, all C^2 JUs that have a weapon capability shall have the capability to report their own engagement status in the J10.2 message. Further, all C^2 JUs may report the status of engagements conducted by nonIUs in the J10.2 message. Rules for reporting engagement status of other than controlled units are as follows:

(1) The Reference TN is the unit actually conducting the engagement. The Reference TN shall be set identical to Source TN for reports of engagements conducted by own JU.

(2) Other than the setting of the Reference TN, there is no difference between the capability and procedures required for the reporting of engagements conducted by own JU and those conducted by nonIUs that are not controlled units. The JU initially transmitting nonIU engagement status shall retain Engagement Status report responsibility until the nonIU engagement is terminated.

(3) The C^2 JU initiating engagement status reporting on a Target TN shall retain the responsibility for reporting the status until the engagement is terminated. The reporting of all engagements must be terminated. Termination consists of transmitting a J10.2 message with the WES field set to value 5, Target Destroyed or 8, Engagement Broken.

4.11.3.3.2 REPORTING OF PLATFORM AND SYSTEM STATUS

Individual unit platform and system status must be available to all C^2 JUs in the interface. JUs will use the appropriate J13 Platform and System Status message to report current status including stores, fuel, operational status, host system's status, etc. The Voice Group A and B Channels reported in Platform and System Status messages shall be the channels on which the Reference TN is operating. C^2 JUs, weapons systems JUs, and support platform JUs shall report their own platform and system status and, under certain conditions described below, controlling C^2 JUs shall report the platform and system status of platforms under their control.

a. All JUs shall report their own platform and system status initially when entering the network, upon significant change of status, periodically in accordance with the transmit/receive rules, and for C^2 JUs in response to a J7.1 message. Platform and System Status messages shall be transmitted on the PPLI and Status Group B NPGs in accordance with paragraph 4.2.3.10.4.

b. The controlling C^2 JU shall report platform and system status on units under their control that do not report their own platform and system status. This will be done initially upon taking control, periodically in accordance with the transmit/receive rules, and in accordance with paragraph 4.2.3.10.4.

c. A C^2 JU that requires platform and system status on a controlled air track shall request the information from the C^2 JU controlling the platform, as indicated in the J10.5 message, by transmitting a J7.1 message with the Data Update Request Action field set to value 1, Data Update Request by TN. The controlling C^2 JU shall transmit the appropriate J13 message.

d. A C^2 JU that requires Platform and System Status on a C^2 JU shall request the information from the C^2 JU by transmitting a J7.1 Data Update Request by TN message containing the C^2 JU's TN as Reference TN.

e. C^2 JUs shall report platform and system status on units under their control when the controlled unit is in a Conditional Radio Silence mode. Also, when the controlling C^2 JU has not received a J13 message from the controlled unit for two update periods, the controlling C^2 JU shall begin transmitting periodic Platform and System Status messages on the controlled unit. When the controlled unit resumes transmission of Platform and System Status messages, the controlling C^2 JU shall cease its reporting.

f. Conflicting data may be received from different units reporting the status on a given platform. The acceptance priority is JU platforms' own status, then C^2 JUs exercising control over JU platforms.

g. The Voice Group A and B Channels reported in Platform and System Status messages shall be the channels on which the Reference TN is operating.

h. The J13.2C2 and J13.2C7 Type of Stores and Number of Stores fields shall be interpreted as follows:

(1) If the Type of Stores field is set to a value other than 0, No Statement, and the Number of Stores field is set to a value other than 63, No Statement, the aircraft's current specific onboard inventory (0 to 62 units) of that Type of Stores is reported.

(2) If Type of Stores is other than No Statement and Number of Stores is No Statement, that Type of Stores is currently carried by the aircraft but no data are being reported about the number of that Type of Stores.

(3) If Type of Stores is No Statement and Number of Stores is other than No Statement, the specific onboard inventory of an unspecified type of weapon is reported.

(4) If Type of Stores and Number of Stores are both No Statement, no data are reported.

4.11.3.3.3 C^2 JUS REPORTING OF PAIRING STATUS

C^2 JUs shall use the J10.6 message to indicate a pairing between a friendly track and another track or point. Pairing values shall not be used to pair a point or track for the purpose of indicating an engagement status. A pairing to a point must have been preceded by a J3 Surveillance message with the Point Amplification field set to a valid value. A JU that has been reporting a pairing on a track that is the subject of a completed handover shall cease transmitting the J10.6 message and shall not transmit a J10.6 message terminating the pairing on that track (see paragraph 4.11.3.2.2a). If the controlling C^2 JU reporting pairings becomes inactive, then all pairings previously reported by that controlling C^2 JU are purged. If one of the paired TNs is dropped, the pairing is purged.

4.11.3.4 ENGAGEMENT COORDINATION PROCEDURES

When operating in a theater with shared defense responsibilities, systems may find it operationally effective and efficient to coordinate their engagements against common threats. The J9.1 Engagement Coordination message provides a means for two or more JUs to coordinate engagements in near real-time via Link 16. Engagement coordination is a cooperative relationship that does not, in and of itself, empower any participant JU with command authority, as defined in paragraph 4.11.3.1.1.

When two or more JUs operate in a cooperative defense posture, they may share engagement intent, method of fire (MOF), probability of kill (PK), tracking status, and support expectations via the J9.1 Engagement Coordination message. If the coordinating systems have common defended assets, the assets, and the priority to be given to each asset, may be reported to each system via the J3.0 Reference Point message. Participating JUs are responsible for developing specific coordination procedures, but they shall adhere to the following general guidelines.

a. The normal message exchange sequence begins with a JU's detection, or receipt of a potentially threatening track. The JU shall evaluate the nature of the threat to determine if:

(1) the threat will be engaged,

(2) the threat is eligible for coordinated engagement, and

(3) support is needed.

Criteria for coordinated engagements shall be predetermined by the participating JUs. The JU will initiate the engagement coordination process by transmitting a J9.1 Engagement Coordination message with its engagement intent and/or support expectations.

b. Each threat shall be treated as a separate engagement coordination process.

c. The Engagement Coordination Action Value (ECAV) in the J9.1I word shall be used by a JU to indicate its engagement intentions, availability to provide support, or support expectations to other JUs participating in the engagement coordination activity.

(1) ECAV = 0, Intend to Engage, or ECAV = 1, Do Not Intend to Engage, is transmitted by a JU to announce its engagement intention against a target. No expectation of support is implied.

(2) ECAV = 2, Available for Support, or ECAV = 3, Not Available for Support, is transmitted by a JU as a response to the receipt of a J9.1 Engagement Coordination message with ECAV = 4, Support Expected. In addition, a JU may transmit a J9.1 Engagement Coordination message with ECAV = 2, Available for Support, or ECAV = 3, Not Available for Support, at any time to report its availability to support another JU.

(3) ECAV = 4, Support Expected, or ECAV = 5, Support Not Expected, is used when a JU intends to engage the threat. That is, JUs receiving these ECAVs may assume that the JU transmitting the message intends to engage the threat, and that the MOF is based on the expectation of support as indicated in the ECAV field.

d. A J9.1 Engagement Coordination message with ECAV = 0, Intend to Engage, ECAV = 4, Support Expected, or ECAV = 5, Support Not Expected, indicates an intention to engage and does not supplant the requirement to transmit the appropriate J10.2 Engagement Status message.

e. If a JU's availability changes after responding to a J9.1 Engagement Coordination message, the JU updates its availability status by transmitting another J9.1 Engagement Coordination message addressed to the JU that initiated the engagement coordination process.

f. A JU's MOF, as reported in the J9.1 Engagement Coordination message, reflects the JU's planned MOF against the referenced target.

g. The PK, as reported in the J9.1 Engagement Coordination message, is the predicted PK of the sending unit against the referenced target, based on the selected MOF. It does not reflect the combined PK of the participating JUs.

h. The Tracking Status field of the J9.1 Engagement Coordination message is used to indicate the reporting JU's tracking status even when that JU does not hold R^2 for the referenced track. It is not dependent on the engagement intent of the reporting JU and is not transmitted in lieu of a J10.2 Engagement Status message.

4.11.3.5 THEATER BALLISTIC MISSILE DEFENSE PROCEDURES

Theater Missile Defense (TMD) is defined as all measures taken to defeat, destroy, or neutralize enemy theater missiles employed against friendly forces and assets. The term theater missile (TM) applies to ballistic missiles, cruise missiles (CM), and tactical air-to-surface missiles (TASM) whose targets are within a given theater of operation. A ballistic missile is any missile which does not rely upon aerodynamic surfaces to produce lift and consequently follows a ballistic trajectory when thrust is terminated (JCS Pub 1-02).

The active portion of the TMD provides protection against theater ballistic missiles (TBM), CMs and TASMs, by destroying them in flight. Theater Ballistic Missile Defense (TBMD) is concerned with the active defense against the TBM portion of the total TM threat.

TBMD capable systems may be comprised of lower tier and upper tier missile defenses which provide critical asset and area defense. The TBMD systems may operate independently or as an integrated, multi-tiered system, or in geographically distributed enclaves. Lower tier systems will provide TBMD for designated critical assets, e.g., airfields, theater C^2 nodes, or seats of government as well as protecting theater targets, naval and maneuver forces, supply points, or critical weapon delivery systems. When integrated with area defense elements, lower tier systems will have the capability to operate collectively or independently primarily against short-range ballistic missiles as well as other tactical missiles (CMs and TASMs). Upper tier TBMD systems provide broad coverage, area defense against TBMs. Area defense systems engage ballistic missiles at high altitude as early in their course as possible helping to negate the primary and secondary effects of mass destruction weapons, and provide for an overall larger defended area. When integrated with lower tier systems, area defense systems are capable of independent or cooperative operation to increase the overall defense effectiveness. The primary focus of upper tier systems is the medium-range ballistic missile.

4.11.3.6 ELECTRONIC WARFARE COORDINATION PROCEDURES

EW actions are divided into three types of EW, i.e., ES, EA, and EP. The ES and EA control and coordination procedures are limited to those JUs that perform ES and EA. This does not preclude a unit not possessing organic ES/EA capabilities from controlling and coordinating these actions. The specific protocols and procedures are contained in paragraph 4.5 of this document. Further, the EP activities of these EW participants are also contained in paragraph 4.5.

The EW C^2 JUs participating on the Surveillance Net PG will follow all of the protocols specified in paragraphs 4.4 and 4.7 of this document.

4.11.3.6.1 ELECTRONIC PROTECTION COORDINATION PROCEDURES WITH NONC^2 JUS

The EP activities of nonC^2 JUs are generally preplanned when they are in support of C^2 JUs. Therefore, coordination of these activities is not required here.

Cases also exist where nonC^2 JUs must initiate EP activities in a self defensive role. These cases will not require any coordination procedures on the Link 16 interface.

Cases which may require Link 16 support in the conduct of nonC^2 JU EP activities are TBD, but will likely be disseminated by communications media other than JTIDS/MIDS.

4.12 CONTROL

Control is the near real-time direction of weapons systems and supporting platforms for the accomplishment of assigned missions. The Control function provides the exchange of information between C^2 JUs and weapon systems/platforms to accomplish Aircraft Control, Surface (Maritime) Control (TBD), Subsurface (Maritime) Control (TBD), Land (Ground) Control (TBD), and EW Control.

From a controlling C^2 JU's point of view, missile systems are utilized in the same manner as aircraft weapons delivery systems. Obviously, missile systems have limitations that preclude the use of some of the J12 control series messages. However, in the areas of mission assignment, target track correlation, and target sorting, these missile systems are to be viewed exactly as fighter aircraft. Therefore, whenever a nonC^2 JU appears in the discussion of these areas, it shall be construed to mean both aircraft and missile systems of this type.

4.12.1 AIRCRAFT CONTROL

Aircraft Control is the direction of air units by controlling units. Aircraft Control using Link 16 messages provides the information necessary to direct actions such as air intercepts, vectoring support aircraft, search and rescue (SAR) operations, air traffic control (ATC), controlling remotely piloted vehicles (RPVs), controlling missiles, instrument landings, precision bombing, the aviation portion of ASW, EW support, and final control of CAS missions. Aircraft Control interacts with the Mission Management function and Weapons Coordination and Management function and is supported by the Surveillance function, EW/Intelligence function, Information Management function and PPLI function.

Controlling C^2 JUs will participate in continuous two-way Link 16 data communications with assigned nonC^2 JUs. Sensor target information derived locally by nonC^2 JUs will be made available to the Link 16 network by the controlling C^2 JU, given the constraints of the tactical situation and sensor target reporting is on. The default for sensor target reporting by nonC^2 JUs to C^2 JUs on the Control NPG is on. For nonC^2 JUs not implementing MADs 37 and 38 default is off. Canceling sensor target reporting by nonC^2 JUs to C^2

JUs on the Control NPG is initiated by the J12.0 (MAD = 38, Sensor Target Reports Off) Mission Assignment message. Situational awareness is provided primarily through J3 Surveillance series, J7 Information Management series, and J10.2 Engagement Status messages. Minimum implementation of messages for Air Control information exchange is provided in Appendix A.

4.12.1.1 AIRCRAFT CONTROL INFORMATION EXCHANGE REQUIREMENTS

The information exchange requirements for support of mission phases of Aircraft Control are contained within the J12 Control series and J13 Platform and System Status series messages.

4.12.1.2 NONCOMMAND AND CONTROL JTIDS/MIDS UNIT CONTROL MESSAGE DESCRIPTIONS

NonC^2 JU Control messages are described below.

4.12.1.2.1 MISSION ASSIGNMENT MESSAGE

The J12.0 Mission Assignment message is transmitted to assign missions, designate targets, and provide other information. The J12.0I Mission Assignment initial word provides the Mission Assignment discrete and threat warning environment information. The J12.0C1 Target Position continuation word provides position, Index Number, and Strength of the target. The J12.0C2 Target Data continuation word provides additional target information such as Course, Speed, Altitude, and Specific Type. See paragraph 4.12.1.3.17 for the use of the Exercise Indicator in the J12.0C2 continuation word. The J12.0C3 Point Location continuation word provides the point's position, type, number and elevation. The J12.0C4 Surface Attack continuation word provides Target Types, Target Defenses, Run-in/Egress Headings, and stores delivery information. The J12.0C5 Bombing continuation word provides the information necessary to perform beacon bombing. The J12.0C6 Targeting continuation word provides the information necessary for laser targeting or the Related 3 TN or Related IN. The J12.0C7 Third Party continuation word provides information for third party mission assignments and elevation angle of the target.

4.12.1.2.2 VECTOR MESSAGE

The J12.1 Vector message is used by controlling C^2 JUs to transmit course, speed, and altitude information for aircraft control activities such as ATC, air intercept control (AIC), and navigational assistance. The J12.1E0 Vector extension word provides Time-to-Intercept and R/C information.

4.12.1.2.3 PRECISION AIRCRAFT DIRECTION MESSAGE

The J12.2 Precision Aircraft Direction (PAD) message is used by controlling C^2 JUs for operations requiring precise control positioning of mission aircraft, e.g., ground-directed release of ordnance, automatic carrier landing operations, ground-directed air cargo delivery, and RPV operations. The J12.2I initial word provides the Addressee TN with vertical and lateral flight path corrections, a Drop Discrete for stores delivery, and an Autopilot Control Bit.

4.12.1.2.4 FLIGHT PATH MESSAGE

The J12.3 Flight Path message is used by controlling C^2 JUs to provide air units with multiple-leg flight path information. The J12.3I Flight Path initial word provides the Addressee TN with the Sequence Numbers of the waypoints and the time associated with the waypoint. The J12.3E0 Flight Path extension word provides the three-axis geographic position of each transmitted point.

4.12.1.2.5 CONTROLLING UNIT CHANGE MESSAGE

The J12.4 Controlling Unit Change message is used to provide information necessary to initiate control, handover control, or terminate control of a nonC^2 JU by a C^2 JU. Control may be initiated by either a C^2 JU or a nonC^2 JU. Procedures for all uses of the J12.4 message are provided in paragraph 4.12.1.3.7.

4.12.1.2.6 TARGET/TRACK CORRELATION MESSAGE

The J12.5 Target/Track Correlation message is used by controlling C^2 JUs to report the correlation/ decorrelation of an index number(s) of a target report(s) to a specified TN of a surveillance track. Multiple correlations and decorrelations may be reported by use of the J12.5E0/J12.5E1 Target/Track Correlation extension words. The J12.5I Target/Track Correlation initial word provides the Objective TN, Index Originator TN, Index Number assigned by originator, Correlation Indicator, Evaluated Strength, Evaluated Identity, and ID/Strength Indicator. The J12.5E0/J12.5E1 word(s) indicate additional correlations and decorrelations to the same surveillance track by providing six additional sets of Index Originator TNs, Index Numbers, and Correlation Indicators uniquely identified by the letters B through G to allow multiple correlations/decorrelations between Index Numbers and Index Originator TNs to the Objective TN in the J12.5I word. The J12.5 message shall be used by C^2 JUs to report the correlation/decorrelation of air, land (ground), and surface (maritime) targets. In the event that multiple targets (specified by IN/Index Originator TN combination) are correlated to the same track (Objective TN), it shall not be implied that a given target is correlated to the other targets listed.

4.12.1.2.7 <u>TARGET SORTING MESSAGE</u>

JUs shall use the J12.6 Target Sorting message to accomplish the following tasks:

a. Enable nonC^2 JUs to exchange targets and targeting information among themselves.

b. Pass sensor data to C^2 JUs and among nonC^2 JUs.

c. Pass nonC^2 JU engagement status information between nonC^2 JUs and from nonC^2 JUs to controlling C^2 JUs.

d. Control among nonC^2 JUs.

NonC^2 JUs originating J12.6 messages will report locally derived data or data derived from data fusion from offboard sources. If any of the fields, except Objective TN, contain data derived from offboard sources, this fact shall be reported in the Fusion Type field. If the Objective TN has been provided in a J12.5 or J12.0 message, the Correlation Indicator field shall be set to value 0. If the Objective TN is established from nonC^2 onboard correlation processing, the Correlation Indicator field shall be set to value 1 . The Identity field in the J12.6E0 word shall be changed by operator action only and the default value is 0, Pending.

The J12.6I and J12.6E0 Target Sorting initial and extension words contain basic information on the target and the Status Information Discrete (SID). The J12.6C1 Engagement Status continuation word contains information necessary for addressing and amplification of target data, as well as the capability to set a pointer. The J12.6C2 Fusion Type continuation word is used to provide Sensor and Fusion Type information about the Objective TN or Third Party Index Number and time tag information for the target data. The Time Indicator field in the J12.6C2 word describes how to interpret the Minute, Second, and Hundredths fields. If the Time Indicator field is set to Time of Observation, the Minute, Second, and Hundredths fields represent the time at which the target data was measured. If the Time Indicator field is set to Track Age, the Minute, Second, and Hundredths fields represent the time since the target data was last extrapolated. If the Time Indicator field is set to Time of Extrapolation, the Minute, Second, and Hundredths fields represent the time to which the host platform has extrapolated the target data. Time of Extrapolation does not imply that the platform has lost contact with the target and is "coasting" the target data. The J12.6C3 Kinematic Quality continuation word provides uncertainty information for radar targets, targets that are being derived from sensors other than radar, or in the case of aircraft with Multiple Source Integration (MSI) capabilities, target data derived from multiple onboard sensors. The J12.6C4 Identity/Specific Type Ambiguity continuation word is used to support ID exchange for aircraft with automatic ID correlation techniques. The J12.6C5 Future Event and the J12.6C6 Sensor Management continuation words are used to provide for rapid update of onboard system parameters among sophisticated nonC^2 JU weapon platforms. Target transmit sequences for nonC^2 JUs who implement various J12.6 words are provided in the J12.6 T/R rules.

C^2 JUs may also use the J12.6 Target Sorting message to report updated positional or engagement status data to nonC^2 JUs. In this case, the message is addressed collectively.

4.12.1.2.8 TARGET BEARING MESSAGE

The J12.7 Target Bearing message provides JUs the capability to pass sensor target information which has been derived from sensors that provide a line-of-sight to the target. Index Numbers are used to report targets in the same manner as in the J12.6 message, from a common pool. When reporting targets derived in this manner, e.g., IR, ES, TV, the reporting JU must establish the target using the J12.7I, J12.7E0, and J12.7E1 words. Origin of angles, angles to the target, and time associated with the target data shall be included as a minimum. If a range estimate for the target is available, then the J12.7C1 word may be transmitted. The J12.7C2 word is used when the identity of the target can be obtained by sensor sources. Angle rates may be transmitted in the J12.7E1 word. Range Rate may be transmitted in the J12.7C1 word. Angle rates and Range Rate contain both observer and target motion along the appropriate axis. Observer rates may be transmitted in the J12.7C1 and J12.7C3 words.

4.12.1.2.9 AIR PLATFORM AND SYSTEM STATUS MESSAGE

The J13.2 Air Platform and System Status message provides the current status of an air platform to include fuel, ordnance status, operational status and on-board systems' status.

4.12.1.2.10 SURFACE (MARITIME) PLATFORM AND SYSTEM STATUS MESSAGE

The J13.3 Surface (Maritime) Platform and System Status message provides the current status of a surface (maritime) platform to include ordnance load, operational status, and on-board systems' status.

4.12.1.2.11 THE SUBSURFACE (MARITIME) PLATFORM AND SYSTEM STATUS MESSAGE

The J13.4 Subsurface (Maritime) Platform and System Status message provides the current status of a subsurface (maritime) platform to include operational status and on-board systems' status.

4.12.1.2.12 LAND (GROUND) PLATFORM AND SYSTEM STATUS MESSAGE

The J13.5 Land (Ground) Platform and System Status message provides the current operational weapons and equipment status of a land (ground) platform.

4.12.1.3 AIRCRAFT CONTROL PROCEDURES AND PROTOCOLS

The procedures and protocols provided for within Aircraft Control are described below.

4.12.1.3.1 MISSION ASSIGNMENT PROCEDURES

Mission assignment procedures are described in the following paragraphs:

a. Mission Assignments. Definitions of specific words and mission assignment word sequences are specified in the J12 series transmit/receive rules found in section 5, part 2. The J12.0 Mission Assignment message shall include sufficient information to establish a track file.

Upon receipt of a J12.0 with the Objective TN set to other than No Statement, the nonC^2 JU will break all local filters on that Objective TN. The nonC^2 JU will not respond with a J12.0 message with the R/C field set to value 16, CANTPRO (Objective TN Not Held), until local filters have been broken for 30 seconds (60 seconds for LOB targets). Target report index numbers are correlated/decorrelated to the surveillance track TNs with the J12.5 Target/Track Correlation message as explained in paragraph 4.12.1.2.6.

b. Mission Assignments to Air Targets. Mission assignments that require position data by a C^2 JU against air targets require a J12.0I/J12.0C1/J12.0C2 word sequence. Mission Type changes may be ordered using the J12.0I word singularly.

c. Air Support Operations (ASO). This procedure spans all types of air-to-surface delivery. The term "surface" is inclusive of both ground and maritime surface environments. This procedure includes, but is not limited to, Air Interdiction (AI), Battlefield Air Interdiction (BAI), Tactical Air (TACAIR) Support for Maritime Operations (TASMO), Close Air Support (CAS), Precision Bombing, Laser Bombing, Suppression of Enemy Air Defenses (SEAD), Aerial and Armed Reconnaissance, TACAIR Transport and Counter Air Attack missions.

(1) Air Interdiction and Battlefield Air Interdiction. AI and BAI are related activities because targets for both are in the same general category. BAI targets have higher potential for near term effect on friendly forces. Real-time coordination of weapon systems conducting either mission may be accomplished via the interface by exchanging information between JUs to support, execute, and report results.

(2) Tactical Air Support for Maritime Operations. Air operations in support of maritime forces may consist of aerial minelaying, surveillance and reconnaissance, and interdiction of enemy naval surface forces, port facilities, and shipping. Surface situational awareness information is primarily available through the monitoring of J3.0, J3.3, J3.5, and J3.7 messages. J12.6 message information from nonC^2 JUs may also be utilized. This mission is made up of certain aspects of other ASO activities and is unique largely by the character of its objectives.

(3) Close Air Support. Tactical aircraft performing CAS, deliver ordnance against hostile forces that are in close proximity to friendly ground forces and requires coordination. ASO aircraft are given the location of a contact point from which to operate with an airborne or ground Forward Air Controller (FAC). The J12.4 message may be transmitted to provide the CAS aircraft the necessary information to contact the FAC. Final control to the target shall be provided by voice communication.

(4) Precision Bombing. Precision bombing is performed by aircraft flying a precise delivery course under the direction of a remote, precision guidance/sensor system. The remote system may transmit vector information via the J12.1 message. Precise vectors and drop information may be transmitted in the J12.2 message.

(5) Laser Bombing. Some tactical aircraft employ laser guided munitions. Targets for these munitions must be illuminated by a laser target designator. The J12.1 message may be used to vector the aircraft to the general location of the target/laser designator.

(6) Suppression of Enemy Air Defenses. The purpose of this mission is to neutralize enemy air defenses in a specific area by physical attack or electronic warfare. C^2 JUs that have the capability to transmit the J14.0 message on the Control NPG may provide near real-time parametric EW data necessary to a nonC^2 JU for accomplishment of the mission. NonC^2 JUs on SEAD missions may have capability to receive the J14.0 data to update weapon/EA equipment employment parameters.

(7) Aerial Reconnaissance. The purpose of this mission is to obtain intelligence information by airborne sensors or visual means. The J12.1 message may be used to provide course, speed, and altitude information to the aircrew, as required. The J12.3 message may be used to provide the platform with sequential multiple leg flight path information.

(8) Armed Reconnaissance. This mission differs from Aerial Reconnaissance by intentions to deliver ordnance when targets of opportunity are located.

(9) TACAIR Transport. The purpose of this mission is the carriage of passenger and cargo by means of airborne operations.

(10) Counter Air Attack. The purpose of this mission is to ensure freedom of action for friendly forces and operations by inflicting damage on, or destroying enemy assets on the ground.

d. Mission Assignment Discretes. The following specifies the use of Mission Assignment Discretes (MADs). Continuation words specified are requirements unless described as optional.

(1) No Statement. The J12.0 message with the MAD field set to value 0 is not used.

(2) Refuel. The J12.0 message with the MAD field set to value 1 is used to direct an aircraft to an airborne tanker or other refueling location. Its position is reported in either the J12.0C1 word, or in the J12.0C3 word with the Point Type, 1 field set to value 0, No Statement. The tanker or location shall be assigned a Track Number, reported by Objective TN. If the tanker is airborne or if Objective TN describes an airborne

refueling point, if available, an altitude, course, speed, and specific type information shall be provided in the J12.0C2 word.

(3) Orbit. The J12.0 message with the MAD field set to value 2 is used to direct an aircraft to orbit at a specified track or point that currently is being reported in a J2 or J3 series message. The Objective TN specifies the track or point. Its position is reported in either the J12.0C1 word, or in the J12.0C3 word with the Point Type, 1 field set to value 0, No Statement. If available, the Course and Speed of the Objective TN shall be included in the J12.0 message. If the Altitude is other than No Statement, the aircraft shall orbit at that altitude. If the Altitude is No Statement, the aircraft shall orbit at the nonzero altitude of the track or point, if any, or at pilot discretion.

(4) Recall. The J12.0 message with the MAD field set to value 3 is used to cancel any current mission, except Engage, Priority Kill, Attack, or Clear to Drop, and recall aircraft to a specified location to await further assignment. The recall location need not be assigned a Track Number, but if the location is a moving point, the Objective TN shall be the TN of the point, and it shall be assigned a Course and Speed. This MAD value is not used to direct aircraft to proceed to a specified location to land. The MAD field set to value 4, Return to Base, is used for that purpose.

(5) Return to Base (RTB). The J12.0 message with the MAD field set to value 4 is used to direct aircraft to proceed to a specified base, home base, or other prearranged base to land. The specified base is the Objective TN. Its position is reported in either the J12.0C1 word, or in the J12.0C3 word with the Point Type, 1 field set to value 0, No Statement. Other available amplifying information about the base is reported in the J12.0C2 word. If the Objective TN is No Statement, this MAD value is a general RTB order. In this case, aircraft are ordered to return to an unspecified base or other prearranged base, and only the J12.0I word is transmitted.

(6) Engage. The J12.0 message with the MAD field set to value 5 is used to order the destruction of an air target and provides target data. The J12.0C1 word provides position information and the J12.0C2 word provides other necessary data.

(7) Priority Kill. The J12.0 message with the MAD field set to value 6 is used to order a high priority on the destruction of a specific air target. Target data are also provided in the J12.0C1 and J12.0C2 words.

(8) Break Engagement. The J12.0 message with the MAD field set to value 7 is used to terminate a previous order to destroy an air target.

(9) Investigate/Interrogate. The J12.0 message with the MAD field set to value 8 is used to order an aircraft to investigate or interrogate an air target and provide additional target information. The J12.0C1 and J12.0C2 words provide necessary target data.

(10) Clear to Drop. The J12.0 message with the MAD field set to value 9 is used to provide clearance for aircraft on TACAIR Transport missions to drop stores at a specified location. Objective TN is the target. The J12.0C3 and, optionally, the J12.0C4 or J12.OC5 words provide necessary data. The J12.0C3 word with the Point Type, 1 field set to value 1, Target is used to designate precise drop area positional information. Additionally, the J12.2 message may be used by remote precision systems to accomplish air cargo delivery (see paragraph 4.12.1.2.3).

(11) Cease/Do Not Drop. The J12.0 message with the MAD field set to value 10 is used to order aircraft on TACAIR transport missions to stop dropping stores or not to drop stores at a specified location.

(12) Intervene. The J12.0 message with the MAD field set to value 11 is used to order an aircraft to take action to divert a designated target aircraft from its intended flight path. The target is the Objective TN, and amplifying information about the target is provided in the J12.0C1 and J12.0C2 words.

(13) Divert. The J12.0 message with the MAD field set to value 12 is used to direct an aircraft to cease its current mission and trajectory, except Engage, Priority Kill, Attack, or Clear to Drop, and proceed to a specified location. The location is specified by the Objective TN with amplifying information provided in the J12.0C1 or J12.0C3 words.

(14) Air-to-Surface and Air-to-Air. The J12.0 message with the MAD field set to value 13 or 14 is used to order an aircraft to change its mission to air-to-surface or air-to-air, respectively.

(15) Search and Rescue (SAR). The J12.0 message with the MAD field set to value 15 is used to assign an aircraft to SAR operations. The J12.0C1 word, or J12.0C3 word with Point Type, 1 field set to value 0, No Statement, is used to indicate the location of the search point.

(16) Combat Air Patrol (CAP). The J12.0 message with the MAD field set to value 16 is used to order an aircraft to a CAP mission and provides data on the CAP station. The assigned CAP station is the Objective TN. The position of the CAP station, including altitude, shall be provided in the J12.0C1 and J12.0C2 words. For moving CAP stations, Course and Speed shall also be provided.

(17) Precision Bombing. The J12.0 message with the MAD field set to value 17 is used to order an aircraft to a precision bombing mission and the target location and information is provided by the J12.0C3 and J12.0C4 words. The Point Type, 1 field shall be set to value 1, Target. If more precise location information is available than can be provided in the J12.0C3 word, the J12.0C5 word may be added. Either the Objective TN, or the Index Originator TN and Third Party IN in the J12.0C7 word identify the target. Third party targeting is not to be utilized if the precision bombing is part of a CAS mission.

(18) Laser Designation. The J12.0 message with the MAD field set to value 18 is used to order an aircraft to a laser designation mission and provides target and illuminator code data. The Objective TN, if available, is the TN of the target, not the laser designator. The J12.0C3 word is included to designate the location of the target with Point Type, 1 field set value 1, Target. The J12.0C4 word may be utilized for target information. The J12.0C6 word provides the Laser Illuminator Code information to the aircraft. Either the Objective TN, or Index Originator TN and Third Party IN in the J12.0C7 word identify the target. If the position of the laser designator is known, a subsequent J12.0 message with the MAD field set to value 43, Related Mission Data, the Point Type, 1 field set to

value 6, Laser Designator, and the Objective TN set to the TN of the laser designator may be transmitted.

(19) Beacon Bombing. The J12.0 message with the MAD field set to value 19 is used to order an aircraft to a beacon bombing mission and provide necessary targeting data. The J12.0C3 word with Point Type, 1 field set to value 4, Beacon, depicts the location of the Objective TN, which is the beacon, not the target. The location of the target is provided by the setting of the J12.0C5 Target Range and Target Bearing fields, which report data relative to the beacon location. Additional data is provided in the J12.0C4 and J12.0C5 words, including Delta Elevation and Beacon Code.

(20) Close Air Support (CAS). The J12.0 message with the MAD field set to value 20 is used to order an aircraft to a CAS mission and provides data needed for accomplishment of the mission. The Objective TN, if available, is the TN of the target. The J12.0C3 word is included to designate the location of the target. If the target is unknown, the Objective TN field and the J12.0C3 Latitude and Longitude fields shall be set to No Statement. The J12.0C4 word may be utilized for target information. A subsequent J12.0 message to specify the contact point and contact point location is transmitted in a J12.0I/J12.0C3/J12.0C6 word sequence with the MAD field set to value 43, Related Mission Data, the Point Type, 1 field set to value 5, Contact Point, and the Objective TN field set to the TN of the contact point.

(21) Interdiction. The J12.0 message with the MAD field set to value 21 is used to order an aircraft to an AI/BAI mission and provides target data. The J12.0C3 with the Point Type, 1 field set to value 1, Target, and the J12.0C4 word provide target location and information. If more precise location information is available than can be provided in the J12.0C3 word, the J12.0C5 word may be transmitted.

(22) Aerial Reconnaissance. The J12.0 message with the MAD field set to value 22 is used to order an aircraft to an Aerial Reconnaissance mission and provides data on the target. The Objective TN is the TN of the reconnaissance point. The J12.0C1 word, or J12.0C3 word with the Point Type, 1 field set to value 8, Point; value 9, Center Point; or

value 10, Initial Route Point, is included to designate the location of the reconnaissance point.

(23) Escort. The J12.0 message with the MAD field set to value 23 is used to order an aircraft to escort another aircraft or flight. The aircraft or flight to be escorted is the Objective TN. The current position of the Objective TN shall be reported in either the J12.0C1 word or J12.0C3 word with the Point Type, 1 field set to value 0, No Statement. Available amplifying data shall be transmitted in the J12.0C2 word.

(24) Shadow. The J12.0 message with the MAD field set to value 24 is used to order an aircraft to maintain surveillance on a designated airborne target. The target is the Objective TN. Amplifying information about the target is reported in the J12.0C1 and J12.0C2 words.

(25) Weapons Free and Weapons Tight. The J12.0 message with the MAD field set to value 25 or 26 is used to transmit a Weapons Free or Weapons Tight condition, respectively, to controlled nonC^2 JUs.

(26) Salvo/Clear Aircraft. The J12.0 message with the MAD field set to value 27 is used to order aircraft to depart from or avoid a specified location. The location is specified as either a track or point reported in the J12.0C3 word with Point Type, 1 field set to value 0, No Statement, or J12.0C1 word for other than ASO missions. The direction the aircraft is to proceed away from the track or point cannot be specified with this MAD value. If the direction is to be transmitted, a J12.1 Vector message with the Vector Discrete field set to value 12, Bug-out Heading, shall be transmitted.

(27) Alert Conditions White, Yellow, and Red. The J12.0 message with the MAD field set to value 28, 29, or 30 is used to broadcast these warning signals which represent progressive conditions of real or threatened danger to friendly forces. The definitions of these terms are contained in operational doctrine. These MAD values shall only be addressed to the collective address 00177 (octal). These messages are used to broadcast general warning conditions with the Objective TN set to No Statement.

(28) Cover. The J12.0 message with the MAD field set to value 31 is used to order an aircraft to maintain a position relative to a

designated air target, the Objective TN, from which a successful intercept can take effect if needed. The position and amplifying information reported in the J12.0C1 and J12.0C2 words relate to the target, not the relative position to be maintained. If specific relative position is to be maintained, then it is necessary to provide that information by other means, e.g., J12.1 Vector message or voice.

(29) Visual Identification. The J12.0 message with the MAD field set to value 32 is used to order a nonC^2 JU to visually identify the target designated as the Objective TN. The position of the target shall be transmitted in the J12.0C1 word or, if the Addressee TN is an ASO nonC^2 JU, in a J12.0C3 word with the Point Type, 1 field set to value 1, Target. Amplifying data shall be transmitted in the J12.0C2 word; if the Addressee TN is an ASO nonC^2 JU, the J12.0C5 and J12.0C7 words may be added if required.

(30) Go To Voice. The J12.0 message with the MAD field set to value 34 is used to order a nonC^2 JU to establish communications on the C^2 JU's JTIDS/MIDS Voice Channel as reported in PPLI messages or other prebriefed voice channel for C^2 JU control or additional information. Only the J12.0I word will be transmitted and the Objective TN will be set to No Statement. The Addressee TN may be set to a specific TN or the collective address, TN 00177 (octal).

(31) High Interest Track Designation. The J12.0 message with the MAD field set to value 35 is used to send initial track data and order nonC^2 JUs to establish and maintain track data on selected high interest tracks designated as the Objective TN. The Addressee TN may be set to a specific TN or the collective address, TN 00177 (octal). NonC^2 JUs shall monitor the Surveillance NPG for track updates.

The high interest track designation overrides the normal or currently selected host data and display filters designed into the nonC^2 JU. This capability shall be restricted to those special cases where the C^2 JU must be certain the nonC^2 JU accepts and displays the track data. Because the value is nonspecific as to the nature of the "High Interest", voice amplification is expected to follow the message. The C^2 JU shall transmit the J12.0 message with the MAD field set to value 36, Cancel High Interest Track Designation, as soon as the high interest nature of the track no longer exists. Reception of a J7.0 Drop Track message shall also cancel a high interest track.

(32) Cancel High Interest Track Designation. The J12.0 message with the MAD field set to value 36 is used to order nonC^2 JUs to cancel the high interest track designation of the Objective TN. This cancellation permits nonC^2 JUs to purge the Objective TN from their databases. The Addressee TN may be set to a specific TN or the collective address, TN 00177 (octal).

(33) Sensor Target Reports On. The J12.0 message with the MAD field set to value 37 is used to order a nonC^2 JU to report on the Control NPG all air targets that it derives locally. This MAD value is also used to restore Addressee TN sensor target reporting after it has been ordered by a J12.0 message with the MAD field set to value 38 to cease reporting.

(34) Sensor Target Reports Off. The J12.0 message with the MAD field set to value 38 is used to order a nonC^2 JU to cease Control NPG reporting of all air targets it derives locally. Receipt of this MAD value shall not inhibit nonC^2 JU engagement status reporting.

(35) Suppression of Enemy Air Defenses (SEAD). The J12.0 message with the MAD field set to value 39 is used to order an aircraft to a SEAD mission and provide initial target data. The J12.0C1, J12.0C3 with the Point Type, 1 field set to value 1, Target, or value 9, Center Point, J12.0C5 and J12.0C7 words provide specific target information, and the J12.0C3 word contains basic location information. A J12.0C5 word may be included if precision location information is available, and the J14.0 message may be sent to provide EW parametric data, if appropriate.

(36) Armed Reconnaissance. The J12.0 message with the MAD field set to value 40 is used to assign an ASO aircraft to an Armed Reconnaissance mission and provide target location information. The J12.0C3 with Point Type, 1 field set to value 8, Point, 9, Center Point, or 10, Initial Route Point, and optionally, the J12.0C5 and J12.0C7 words provide necessary data.

(37) Attack. The J12.0 message with the MAD field set to value 41 is used in two distinct ways:

(a) As a final execution authority for a previously assigned MAD, i.e., 17, Precision Bombing; 18, Laser Designation; 19, Beacon Bombing; 21, Interdiction; 39, Suppression of Enemy Air Defenses; 40, Armed Reconnaissance; and 44, Counter Air Attack; or, for a prebriefed mission for which a MAD has not been previously issued. This is used only if final execution authority is required by the Rules of Engagement. The absence of detailed target data in the J12.0 MAD value 41, Attack message for the same Objective TN as a previous MAD shall not cause the purging of that data associated with the previous MAD.

(b) For ASO missions other than CAS, to assign a new target, with immediate authority to complete the mission. In this use, the MAD is not preceded by another MAD value for the same Objective TN.

(38) Cease Attack. The J12.0 message with the MAD field set to value 42 is used to order an ASO aircraft to cease attacking the target specified by the Objective TN. This MAD value only cancels Attack MADs against specific targets, and not other mission assignments.

(39) Related Mission Data. The J12.0 message with the MAD field set to value 43 provides an ASO aircraft with data on a point or laser designator which is related to a target. After transmitting an initial J12.0 message with the MAD field set to value 9, 17, 18, 20, 21, 32, 39, 40, 41, or 44, additional J12.0I/J12.0C1/J12.0C3/J12.0C6 or J12.0I/J12.0C3/J12.0C6 word sequences with the MAD field set to value 43 may be transmitted. The Objective TN in the J12.0I word or the IN in the J12.0C1 word is the TN or IN of the related point or laser designator, the Latitude and Longitude in the J12.0C3 word is the position of the Objective TN or IN, and the Point Type, 1 field shall be set to a value other than 1, Target, or 15, Origin of Bearing. The Related 3 TN or Related IN field shall be set to the TN or IN of the target which was transmitted in the previous J12.0 message.

(40) Counter Air Attack. The J12.0 message with the MAD field set to value 44 is used to order an aircraft to a Counter Air Attack mission. The J12.0C3 with Point Type, 1 field set to value 1, Target, and the J12.0C4 word provide target location and information. The J12.0C5 word is optional.

(41) Fighter Sweep. The J12.0 message with the MAD field set to value 45 is used to order an aircraft on a Fighter Sweep mission. No target data is provided, as the mission is designed to seek out and destroy enemy targets of opportunity in the air.

(42) Cease Fire. The J12.0 message with the MAD field set to value 46 is used to order a nonC^2 JU SAM site not to fire against the target defined in the message. If firing has occurred, missiles in flight continue to intercept targets.

(43) Hold Fire. The J12.0 message with the MAD field set to value 47 is an emergency order used to order a nonC^2 JU SAM site not to fire against the target defined in the message. If firing has occurred, missiles in flight must be destroyed.

(44) Cease Mission. The J12.0 message with the MAD field set to value 63 is used to order a nonC^2 JU to clear any previous order against a specific target except for Engage, Priority Kill, Clear to Drop, or Attack, MAD value 5, 6, 9, or 41. These are to be cleared by setting the MAD field to value 7, Break Engagement (to cancel an Engage or Priority Kill assignment), 10, Cease/Do Not Drop (to cancel a Clear to Drop assignment), or 42, Cease Attack (to cancel an Attack assignment).

e. Index Numbers in Mission Assignment Messages. C^2 JUs transmitting J12.0 messages shall always set the Index Number field to No Statement. Units receiving a J12.0 with the Index Number set to No Statement shall not interpret the Origin of Index Number field.

NonC^2 JUs transmitting J12.0 assignments may set the Index Number and Origin of Index Number fields to other than their default values.

Assignments issued by nonC^2 JUs on nonC^2 JU sensor ASO targets are accomplished by transmitting the Index Number in the J12.0C1 word for engagements on targets reported by either the transmitting or receiving unit, or the Third Party IN in the J12.0C7 word for third party assignments. The following types of assignments may be issued:

(1) A first party assignment occurs when the nonC^2 JU receiving the order has derived the target via onboard local sensors and is reporting the target. The Origin of Index Number field is set to value 1 and the Index Number field is set to the receiver's target Index Number. Target data, e.g., Latitude, Longitude, Course, Speed, shall not be included.

(2) A second party assignment occurs when the nonC^2 JU transmitting the order has derived the target via onboard local sensors and is reporting the target. The Origin of Index Number field is set to value 0, and the Index Number field is set to the originator's target Index Number. All available target data shall be included.

(3) A third party assignment occurs when neither the nonC^2 JU transmitting the order, nor the addressed nonC^2 JU hold the target on local sensors. The target information is provided by a third party nonC^2 JU. In this case, the Origin of Index Number field is set to value 0, the Index Number field is set to No Statement, the J12.0C7 word Index Originator TN field is set to the third party nonC^2 JU, and the J12.0C7 word Third Party IN field is set to the third party's target Index Number. All available target data shall be included. Third party assignments will not be used for CAS.

f. Situational Awareness. All nonC^2 JUs performing the ASO mission are required to monitor the Surveillance NPG for situational awareness. Also, nonC^2 JUs may monitor the NonC^2 JU-to-NonC^2 JU NPG to aid surface/ground situational awareness. As a minimum, the J3.0 Reference Point, J3.2 Air Track, J3.3 Surface (Maritime) Track, and J3.5 Land (Ground) Point/Track messages must be received and processed to provide surface and enemy and friendly force information, target descriptions, and locations. The J3.7 EW Product Information message and the J14.0 Parametric Information message may be received by nonC^2 JUs with SEAD mission capability. NonC^2 JUs may also utilize J12.6 Target Sorting message reports specifying nonC^2 JU derived target data. NonC^2 JUs conducting ASO shall receive lines and areas for situational awareness and update information primarily from the Surveillance NPG. NonC^2 JUs shall monitor J7.0 Track Management and J10.2 Engagement Status messages for amplification of the surveillance data.

g. Ordering Mission Assignments. The initial J12.0 message is used by a controlling C^2 JU to order air-to-air, air-to-surface, and general mission assignments. Additionally, a nonC^2 JU conducting ASO missions may use J12.0 messages for inter- and intra-flight orders as described in paragraph 4.12.1.3.1.2n below. The R/C field on original orders shall be set as shown in table J12-2. The Objective TN field shall be set as follows:

(1) C^2 JUs originating J12.0 messages for MAD values 1, 2, 5, 6, 7, 8, 11, 12, 16, 17, 18, 19, 21, 22, 23, 24, 31, 32, 35, 36, 39, 40, 41, 42, 43, 44, and 63 shall set the Objective TN field to the TN of the target or entity which is the object of the assignment.

(2) C^2 JUs originating J12.0 messages for MAD values 3, 4, 9, 10, 15, 20, 25, 26, and 27 shall either set the Objective TN field to No Statement where the assignment does not relate to a target/entity or shall set the Objective TN field as in paragraph 4.12.1.3.1g(1) above.

(3) C^2 JUs originating J12.0 messages for MAD values 13, 14, 28, 29, 30, 34, 37, 38, and 45 shall set the Objective TN field to No Statement.

(4) To avoid TN accountability problems, the J12.0 message shall not be used to originate the Objective TN, i.e., the Objective TN shall have been reported on the Surveillance NPG.

(5) NonC^2 JUs originating J12.0 messages shall set the Objective TN field to the TN of the target/entity which is the subject of the mission assignment or, where no Objective TN is available, shall set either the IN or Third Party IN field to the IN of the target/entity. Where no TN or IN is currently being reported for the target/entity, the nonC^2 JU shall allocate its next available IN for the J12.0 message.

Mission assignments against targets defined by a line of bearing may be accomplished by transmitting a J12.0I/J12.0C1/J12.0C3/J12.0C5 word sequence. The J12.0C7 word may be added if elevation angle data is available. The J12.0C3 word Point Type, 1 field shall be set to value 15, Origin of Bearing.

h. Target Location. ASO missions are supported by location information broadcast in J3.0, J3.3, J3.5, and J3.7 Surveillance messages, J12.6 Target Sorting messages, and in a J12.0 Mission Assignment message. The J3 Surveillance information on a target is originated by any C^2 JU with R^2 for a point or track and is the primary source of situational awareness data for nonC[2] JUs. The J12.0C3 word with Point Type, 1 field set to value 1 and, optionally, the J12.0C1, J12.0C2, and J12.0C5 words include target data in a J12.0 message with the MAD field set to values 9, 17, 18, 19, 20, 21, 22, 39, 40, 41, or 44. The J12.0C5 word contains additional fields that may be used to expand the Latitude, Longitude, and Elevation fields to provide granularities of approximately 4 feet in all three dimensions. When the J12.0C5 word is included for purposes of increasing precision of location information, all other fields in that word will be set to No Statement. The J12.0C5 word shall not be transmitted if a J12.0C2 word indicates the target is moving, i.e., the Course and Speed fields are other than No Statement.

i. Target Description. The J12.0C4 word Target Type field provides the capability for JUs to pass general target categories to nonC[2] JUs on ASO missions. More specific target descriptions may be provided by use of the J12.0C1 and J12.0C2 word combination with the Env/Cat and Specific Type fields set appropriately. Additionally, the J12.0C2 word may be used to provide Course, Speed, and Exercise Indicator information if deemed appropriate.

j. Related Mission Information. Mission information related to the target is provided by setting the J12.0C3 word Point Type, 1 field to values other than 1 or 15 in a J12.0I/J12.0C3 word sequence. Multi-leg flight path information is provided in J12.3 messages. Up to 15 waypoints may be transmitted in separate J12.3 messages to update a preloaded route or as an original flight path assignment. A detailed explanation of J12.3 Flight Path message information is provided in the T/R rules. In some scenarios, J12.1 messages may be sent to provide vectors in lieu of J12.3 Flight Path message information. The J12.0C4 word provides specific targeting data to include Target Type, Run In, and Egress Headings, Number and Type of Stores, and Time information. The J12.0C4 word Time Discrete, Hour, and Minute fields are used to assign Time on Target and Initial Point Time to a nonC[2] JU. If a JU desires to change an assigned Time on Target, a J12.0I/J12.0C4 message sequence shall be sent once with Time Discrete set to value 4, Changed Time on Target. Receiving platforms should then update the Time on Target for the mission. Subsequent J12.0C4 words will reflect the updated time by setting the Time Discrete field to value 1, Time on Target, and the Hour and Minute fields appropriately.

k. Target Defenses. Target defense information is primarily available to nonC^2 JUs by monitoring the J3 series messages. Additionally, a controlling JU may provide information in a J12.0 message with the MAD field set to value 9, 17, 18, 19, 20, 21, 32, 39, 41, 43, or 44, by setting a value other than No Statement in the J12.0C4 Target Defenses field. Location of these defenses is provided by use of the Latitude and Longitude fields in a J12.0C3 word transmitted in a J12.0 message with the MAD field set to value 43 and the Point Type, 1 field set to value 11, Target Defenses.

l. Weather. Controlling C^2 JUs or nonC^2 JUs may broadcast weather in the target area using the J17.0 Weather Over Target message on the Control NPG in which the affected ASO aircraft is operating. The Objective TN is the target previously assigned in the J12.0 message. The Origin of Index Number and Index Number fields provide the capability for a nonC^2 JU to originate this message. Visibility, wind direction and strength, cloud cover and height, altimeter setting, and time of observation may be provided if data are available.

m. NonC^2 JU Status. JUs may monitor the status of nonC^2 JU ASO missions by receiving J2.2 Air PPLI and J13.2 Air Platform and System Status messages. The J2.2 message provides the interface with real-time status through the Airborne Indicator, Exercise Indicator, Mission Commander Indicator, Flight Leader Indicator, and Mission Correlator fields. Additionally, the Latitude and Longitude fields in the J2.2E0 word, and the Air Platform Activity and Mode III Code fields in the J2.2C1 word provide mission tracking information. The J13.2 message provides real-time data on ordnance load, fuel, operational status, and on board systems status. The J13.2I word Time Report Function, Minute, and Hour fields are used to provide real-time updates to the expected time on target. If the Mission Commander Indicator or the Flight Leader Indicator field in the J2.2I word is set to value 1, the Aircraft Operational Capability field in the J13.2I applies to the entire mission group or flight. Elements of a group or flight with a common mission may be identified by utilization of the J2.2 Mission Correlator field. Definition of specific values within the Mission Correlator field is determined by the operational commander (see paragraph 4.10.1.1).

n. NonC^2 JU to NonC^2 JU Communication. NonC^2 JUs on ASO missions shall have the capability to simultaneously operate on the Control and NonC^2 JU-to-NonC^2 JU NPGs. They may have the capability to assign missions to other aircraft by transmitting J12.0 messages with the MAD field set to value 3, 4, 9, 10, 13 through 22, 32, 34, 39 through 45, and 63 on the NonC^2 JU-to-NonC^2 JU NPG. Protocols for transmission of the J12.0 message by a nonC^2 JU are described in paragraphs 4.12.1.3.1c, d, and e above.

o. Reporting Mission Results. NonC^2 JUs shall have the capability to provide the controlling C^2 JU ASO mission results by utilizing the J12.6 message. NonC^2 JUs shall transmit the J12.6 message with the SID field set to value 6, Track/Target Destroyed, 7, Disengaging, 8, Target Partially Destroyed, 11, Battle Damage Assessment Unknown, or 12, Recommend Reattack. When the nonC^2 JU sets either the Mission Commander Indicator or Flight Leader Indicator field in the J2.2I word to value 1, the results may be reported for the entire mission group or flight. The C^2 JU will transmit the equivalent J10.2 WES message upon receipt of the J12.6 message ASO mission results from a nonC^2 JU.

p. Processing J12.0 Data Fields when Objective TN Already Held. All applicable J12.0 data held by the C^2 JU shall be transmitted in the J12.0 message as required, regardless of whether the Objective TN has been transmitted separately in a J3 Surveillance message.

q. Multiple Mission Assignments. On receipt of a Mission Assignment a nonC^2 JU shall interpret the order as an immediate order. Mission Assignments are divided into two distinct categories; those that initiate or cancel the release of weapons against a target (Attack missions: e.g. Priority Kill or Engage), and those that do not initiate the release of weapons (non-Attack missions). The Attack missions take precedence over the latter. NonC^2 JUs may undertake multiple Attack Mission Assignments, but shall undertake only one non-Attack Mission Assignment at a time (and not simultaneously with an Attack Mission Assignment). Non-Attack Mission Assignments may be 'stacked' by a C^2 JU for transmission to a nonC^2 JU; a nonC^2 JU accepting a non-Attack Mission Assignment shall cancel any previous non-Attack Mission Assignment which it was undertaking. Prior to assigning a non-Attack Mission Assignment, a C^2 JU shall first cancel any current Attack Mission Assignment.

r. Platform Activity Resulting From Mission Assignment. Selected Platform Activity values reported by a nonC^2 JU shall correspond to the mission functions and activities it performs. If a nonC^2 JU chooses to report a value other than the No Statement value in the Platform Activity field of the J2.2 PPLI message, it shall also implement value 127, Reset to No Statement. If a nonzero value, including the Reset to No Statement value, has been transmitted previously, either a new value other than zero or 127, Reset to No Statement, must be transmitted. A nonC^2 JU that implements nonzero Platform Activity field values shall set an applicable Platform Activity value in its PPLI message that corresponds to the J12.0 MAD when the controlled unit starts performing the assigned action.

Table 4.12-1 depicts the applicable J12.0 MAD to J2.2 Platform Activity relationships. The table requirements are applicable only when read from left to right and present required implementation only for those nonC^2 JUs implementing nonzero values of the J2.2 Platform Activity field. For example, if a nonC^2 JU elects to implement for reception the J12.0 MAD value 1, Refuel, it shall report in its J2.2 Platform Activity field value 29, Refueling/Tanking. If a nonC^2 JU elects to receive J12.0 MAD value 5, Engage, the reported Platform Activity can be any one of the listed values.

TABLE 4.12-1. J2.2 Platform Activity to be Transmitted after Transmitting a J12.0 WILCO (Sheet 1 of 4)

J12.0 MAD/WILCO	J2.2 Platform Activity[1] (NonC[2] JU)
1 - Refuel	29 - Refueling/Tanking
2 - Orbit	58 - Orbiting
3 - Recall	11 - Transiting 59 - Under Recall
4 - Return to Base	52 - Return to Base
5 - Engage	2 - Over the Horizon Targeting 12 - Special Weapons Attack 13 - Intruding 22 - Interception 25 - Conventional Attack 31 - Combat Air Patrol 49 - Antiair Warfare 51 - Counter-Air Warfare 60 - Engaging
6 - Priority Kill	2 - Over the Horizon Targeting 12 - Special Weapons Attack 13 - Intruding 22 - Interception 25 - Conventional Attack 31 - Combat Air Patrol 49 - Antiair Warfare 51 - Counter-Air Warfare 61 - Engaging (Priority Kill)
7 - Break Engagement	See Note 2.
8 - Investigate/Interrogate	22 - Interception 31 - Combat Air Patrol 62 - Investigating

TABLE 4.12-1. J2.2 Platform Activity to be Transmitted after Transmitting a J12.0 WILCO (Sheet 2 of 4)

J12.0 MAD/WILCO	J2.2 Platform Activity[1] (NonC[2] JU)
9 - Clear To Drop	4 - Logistics Support 17 - Airlift (Transport) 47 - Trooplift
10 - Cease/Do Not Drop	See Note 2.
11 - Intervene	19 - Shadowing/Intervening 31 - Combat Air Patrol 64 - Intervening
12 - Divert	11 - Transiting 65 - Diverting
13 - Air-to-Surface	5 - Antisurface Warfare 18 - Antisubmarine Warfare 21 - Air Assault 30 - Interdiction 35 - Close Air Support 37 - Ground Attack Tactics 43 - Strike Warfare 66 - Air-to-Ground
14 - Air-to-Air	22 - Interception 31 - Combat Air Patrol 49 - Antiair Warfare 51 - Counter-Air Warfare 67 - Air-to-Air
15 - Search and Rescue	8 - Search and Rescue
16 - Combat Air Patrol	31 - Combat Air Patrol 39 - Rescue Combat Air Patrol 40 - Surface Combat Air Patrol

TABLE 4.12-1. J2.2 Platform Activity to be Transmitted after Transmitting a J12.0 WILCO (Sheet 3 of 4)

J12.0 MAD/WILCO	J2.2 Platform Activity[1] (NonC[2] JU)
17 - Precision Bombing	25 - Conventional Attack 30 - Interdiction 35 - Close Air Support 37 - Ground Attack Tactics 43 - Strike Warfare 68 - Precision Bombing
18 - Laser Designation	25 - Conventional Attack 30 - Interdiction 35 - Close Air Support 37 - Ground Attack Tactics 43 - Strike Warfare 69 - Laser Designation
19 - Beacon Bombing	25 - Conventional Attack 30 - Interdiction 35 - Close Air Support 37 - Ground Attack Tactics 43 - Strike Warfare 70 - Beacon Bombing
20 - Close Air Support	35 - Close Air Support
21 - Interdiction	30 - Interdiction
22 - Aerial Reconnaissance	1 - Reconnaissance
23 - Escort	9 - Escorting
24 - Shadowing	19 - Shadowing/Intervening 31 - Combat Air Patrol 71 - Shadowing
25 - Weapons Free	N/A
26 - Weapons Tight	N/A
27 - Salvo/Clear Aircraft	N/A
28 - Alert Condition White	N/A
29 - Alert Condition Yellow	N/A
30 - Alert Condition Red	N/A

TABLE 4.12-1. J2.2 Platform Activity to be Transmitted after Transmitting a J12.0 WILCO (Sheet 4 of 4)

J12.0 MAD/WILCO	J2.2 Platform Activity[1] (NonC[2] JU)
31 - Cover	22 - Interception 31 - Combat Air Patrol 72 - Covering
32 - Visual Identification	22 - Interception 31 - Combat Air Patrol 73 - Visual Identification
34 - Go To Voice	N/A
35 - High Interest Track Designation	N/A
36 - Cancel High Interest Track Designation	N/A
37 - Sensor Target Report On	N/A
38 - Sensor Target Report Off	N/A
39 - Suppression of Enemy Air Defenses	5 - Antisurface Warfare 25 - Conventional Attack 37 - Ground Attack Tactics 43 - Strike Warfare 66 - Air-to-Ground
40 - Armed Reconnaissance	5 - Antisurface Warfare 18 - Antisubmarine Warfare 21 - Air Assault 25 - Conventional Attack 30 - Interdiction 35 - Close Air Support 37 - Ground Attack Tactics 43 - Strike Warfare 66 - Air-to-Ground
41 - Attack	5 - Antisurface Warfare 18 - Antisubmarine Warfare 21 - Air Assault 25 - Conventional Attack 30 - Interdiction 35 - Close Air Support 37 - Ground Attack Tactics 43 - Strike Warfare 66 - Air-to-Ground
42 - Cease Attack	See Note 2.
43 - Related Mission Data	N/A
44 - Counter Air Attack	30 - Interdiction 43 - Strike Warfare 51 - Counter-Air Warfare 66 - Air-to-Ground
45 - Fighter Sweep	22 - Interception 49 - Antiair Warfare 51 - Counter-Air Warfare 67 - Air-to-Air
63 - Cease Mission	N/A

Notes:

1. The value 0, No Statement, may be substituted for any value of Platform Activity. If a nonzero value had previously been transmitted, either a new value (other than 0) or 127, Reset to No Statement, must be transmitted.

2. Acceptance of Break Engagement, Cease/Do Not Drop, or Cease Attack does not necessarily constitute a change in Platform Activity.

s. Status Information Discretes Resulting from Mission Assignment. After transmitting a WILCO for a received J12.0 MAD, a nonC^2 JU shall report execution of the MAD by transmitting corresponding J12.6 SID values in addition to the requirements for transmitting J2.2 Platform Activity values.

t. Reception of Mission Assignment Messages by Subordinate NonC^2 JUs. In order to support operation of nonC^2 JUs as a flight of aircraft controlled as a single entity by the controlling C^2 JU or, for ASO missions, the nonC^2 Mission Commander, J12.0 messages addressed to the designated Flight Leader may be received and displayed by all flight members. In addition, responses to those messages may also be received and displayed. Only the addressed unit (Flight Leader) shall make the appropriate Receipt/Compliance responses.

4.12.1.3.2 TARGET/TRACK CORRELATION PROCEDURES

Controlling C^2 JUs shall perform correlation/decorrelation procedures on Index Numbers assigned to reported sensor targets and TNs assigned to Surveillance tracks. Correlated target/track data such as ID, etc., may be used to update databases and displays. C^2 JUs originating the J12.6 message must have previously assigned or associated a Surveillance TN with the target. Several nonC^2 JUs may hold sensor contact on the same target and already have assigned an Index Number to the target. All of these Index Numbers may be correlated to the target by the C^2 JU. The C^2 JU shall not concurrently correlate the same TN to more than one index number of a target from the same nonC^2 JU. All the above correlations shall be reported on the Control Network PG using the J12.5 message.

Multiple TNs shall not be correlated to a single IN/Index Originator TN combination by using multiple J12.5 messages. If a new correlation message is received that is in conflict with a previous correlation message, the receiving JU shall break the previous correlation and accept the new correlation defined in the new correlation message.

4.12.1.3.3 TARGET SORTING PROCEDURES

Target reports are transmitted by nonC^2 JUs to indicate a sensor contact or engagement status at a given position. Target sorting consists of five related areas that are discussed separately for clarity. These areas are, Index Number Usage; Acquiring, Updating, and Canceling Targets; Engagements; Pointers; and Mark Points/Points of Interest.

a. Index Number Usage. Index Numbers provide a means for nonC^2 JUs to distinguish individual sensor contacts. Index Numbers are an unmanaged block of 63 numbers, 1 through 77 octal, assigned by the originating nonC^2 JU. The Origin of Index Number field specifies whether the message originator or the message addressee assigned the Index Number. NonC^2 JUs are responsible for the management of their own Index Numbers and associated target data. New Index Numbers are established independent of the J12.6 SID field value. Index Numbers are canceled by use of the J12.6 message with the SID field set to value 5, Cancel Sensor Target Report. Index Numbers are assigned in sequential order and not repeated until all numbers have been used.

The J12.6 message may contain the Index Number, the Objective TN, neither, or both depending upon the data available.

b. Acquiring, Updating, and Canceling Targets. NonC^2 JUs report sensor target data on the NonC^2 JU-to-NonC^2 JU NPG using the appropriate SID field value and word sequences specified in section 5 part 2, Tables J12-4.1 through J12-4.6. NonC^2 JUs shall also have the capability to report selected sensor target data on the Control NPG. When nonC^2 JUs are transmitting their sensor target data on the Control NPG, the controlling C^2 JU shall monitor the nonC^2 JU originated sensor targets transmitted in J12.6 messages on the Control NPG to determine if an existing surveillance track correlates to a sensor target (see paragraph 4.12.1.3.2). If the sensor target meets the correlation criteria, a J12.5 message shall be transmitted on the same Control NPG as the J12.6 message was received. The Evaluated Identity and Evaluated Strength fields, if implemented, of the J12.5 message shall be set to the same values as locally held for the Identity and Strength of the surveillance track, and the ID/Strength Indicator field shall be set to value 2. If the sensor target fails to meet the correlation criteria and the presence of a new track is indicated, the C^{2}JU shall originate a J3 series message with a Track Quality as specified in Table 4.12-2, with the C^{2}JU as Source TN on the Surveillance NPG, and a J12.5 message on the Control NPG. The Evaluated Identity and Evaluated Strength fields, if implemented, of the J12.5 message shall be set to the same values as reported in the Identity and

Strength fields of the received J12.6 message, and the ID/Strength Indicator shall be set to value 1.

Table 4.12-2. TPQ to TQ Translation

TPQ	NOTES	TQ
0	No Statement	6
1	< or = 4.4 Square Data Miles	8
2	< or = 1.10 Square Data Miles	9
3	< or = 0.0281 Square Data Miles	10

When the J12.6 message is used to report the acquisition or updating of a radar target or when sensors other than radar or combined with radar determine there is a 95 percent probability that the target is within a 4.4 square data mile area, the Latitude and Longitude fields in the J12.6I word shall be used to report the location of the Objective TN, i.e., target. If radar accuracy is known to be worse than 4.4 square data miles, the Target Position Quality field shall be set to No Statement.

The J12.7 message is used to report a target derived exclusively by sources other than radar, i.e., alternate sensor(s), and there is not a 95 percent probability that the target is within a 4.4 square data mile area.

NonC^2 JUs shall update all sensor targets on a periodic basis by transmitting the J12.6 and/or J12.7 messages as specified in the T/R rules.

When a nonC^2 JU loses sensor contact it shall transmit a J12.6 message with the SID field set to value 5, Cancel Sensor Target Report. Since C^2 JUs use J12.6 sensor reports as an integrated sensor report, receipt of a Cancel Sensor Target Report shall be processed in the same manner as a lost radar report.

c. Engagements. Engagements of sensor targets/surveillance tracks may be ordered by controlling C^2 JUs, independently initiated by a nonC^2 JU, or directed by another nonC^2 JU.

(1) Engagements ordered by controlling C^2 JUs are explained in paragraph 4.12.1.3.1.

(2) NonC^2 JUs may have the capability to order or direct engagements among themselves. ENV/CAT = 2, Air SID values 13, Investigate, 14, Engage, or 15, Disengage, are used for this purpose. The J12.6 message shall contain either the Objective TN, an Index Number, or both if the data are available. If a correlation between Index Number and Track Number has been reported, the Objective TN must be included.

There are four types of engagements that may be prosecuted through the use of a J12.6 message with the ENV/CAT = 2, Air SID field set to value 13, 14, or 15. They are distinguished by whether nonC^2 JUs are sending the J12.6 message, receiving the J12.6 message, providing radar illumination of the target, or using a surveillance report.

(a) A first party engagement occurs when the nonC^2 JU receiving the order has derived the subject of the engagement via onboard local sensors and is reporting the target via the link. For a first party engagement, the Origin of Index Number field is set to value 1 and the Index Number field is set to the receiver's target index number. Target data, e.g., Latitude, Longitude, Course, Speed, etc., shall not be included.

(b) A second party engagement occurs when the nonC^2 JU that is sending the order has derived the subject of the engagement via onboard local sensors and is reporting the target via the link. For a second party engagement, the Origin of Index Number field is set to value 0, and the Index Number field is set to the sender's target index number. All available target data shall be included.

(c) A third party engagement occurs when neither the nonC^2 JU sending the order, nor the nonC^2 JU receiving the order holds the target on local sensors. The subject of the engagement is provided on the link by a third nonC^2 JU. For a third party engagement, the Origin of Index Number field is set to value 0, the Index Number field is set to No Statement, the Index Originator TN field is set to the TN of the illuminator; and the Third Party Index Number field is set to the illuminator's target index number. All available target data shall be included.

(d) A surveillance engagement occurs when no nonC^2 JU holds the surveillance track on local sensors. The subject of the engagement is provided by monitoring the Surveillance NPG. For a surveillance engagement all index number and index number related fields are set to No Statement. The surveillance TN and all other target data shall be included.

(3) NonC^2 JUs report engagements using the J12.6 message containing either the Objective TN, an Index Number, or both if the data are available. If a correlation between Index Number and TN has been reported the Objective TN must be included. The SID field values used to report the engagement are 1, Engaging or Attacking, 2, Investigating, 3, Missile In Flight/Weapon Released, 6, Track/Target Destroyed, or 7, Disengaging. J12.6 messages reporting engagements are transmitted on the Control NPG. As long as the engagement status remains unchanged, the same SID field value shall be used for updates at the rate specified in section 5, part 2, Tables J12-4.1 through J12-4.6. The SID field value shall change only when the actual engagement status changes.

(4) NonC^2 JUs operating on Needline PGs that have the capability to report engagements against air targets may use the J12.6C1 WES field, in addition to SID field. When implemented, the WES values must be in accordance with SID field values used to report the engagement as specified in the following table. The table does not apply to the Control or nonC^2 JU-to-nonC^2 JU NPGs.

Table 4.12-3. J12.6 Engagement Status Values Relationships

Status Information Discrete Value	Weapon Engagement Status
0 - No Statement	0 - No Statement
1 - Engaging	4 - Firing/Missile in Flight/Engaging to Destroy
2 - Investigating	2 - Weapon Assigned 3 - Tracking/Locked on/Ready to Fire 11 - Investigating/Interrogating
3 - Missile in Flight/Weapon Released	4 - Firing/Missile in Flight/Engaging to Destroy
6 - Track/Target Destroyed	5 - Effective/Target Destroyed/Grand Slam
7 - Disengaging	8 - Engagement Broken
8 - Target Partially Destroyed	6 - Partially Effective
11 – Not effective	7 – Not Effective
12 – Covering	14 – Covering

(5) When operating in a flight or group only one flight member, preferably the flight leader, shall report engagement status on the Control NPG. (A flight or group is a unit made up of aircraft that will execute orders as a single entity.) The member reporting shall do so for the entire flight, e.g., if one member of the flight is still engaging then the entire flight is engaging; also, if one member of the flight has broken the engagement but the others have not, a Disengaging shall not be sent until the entire flight has broken the engagement. This procedure applies to all SID field values.

(6) A "Heads Up" can be reported using the J12.6 message with the ENV/CAT = 2 Air SID field set to value 9, Heads Up. This message may be used between nonC^2 JUs or from a nonC^2 JU to a C^2 JU and must include either the Objective TN, an Index Number, or both, in accordance with paragraphs (2) and (3) above.

d. Pointers. The J12.6 message with the Pointer field set to value 1 provides the capability to designate a geographic position or track/target on a JU's display. When the Pointer field is set, voice communications usually specify why the pointer was transmitted. The method of removing pointers from the receiving system's display is a system option. This use of the J12.6 Pointer message has two applications.

(1) C^2 JU to NonC^2 JU. When a C^2 JU desires to designate a geographic position to a nonC^2 JU, a J12.6 message is used on the Control NPG. Also, if the C^2 JU desires to call the attention of a nonC^2 JU to a track, a J12.6 Pointer message is used. In this case, the track/target data shall reflect the actual data of the track/target but should not be processed if the nonC^2 JU already holds the track/target data to preclude conflicting data. Either the Objective TN or the Index Number must be provided. When used to designate a track/target, the SID field set to value 0 shall be used, but shall not override a previously received nonzero SID field value.

(2) NonC^2 JU to NonC^2 JU/C^2 JU. NonC^2 JUs shall use the J12.6 message to call the attention of another JU to a geographic position or track/target. When it is used to designate a track/target position, a nonC^2 JU shall use the J12.6 message as described in paragraph (1). When a nonC^2 JU wishes to call the attention of a JU to a geographic position, the J12.6

message is used with the SID field set to value 0 and the Index Number and Objective TN fields set to No Statement.

e. Mark Points/Points of Interest. Mark Points may be exchanged among nonC^2 JUs or sent to C^2 JUs on the Control NPG.

(1) Mark Points are used between nonC^2 JUs operating in an ASO environment to exchange tactically significant data points used to depict targets of opportunity or specific points for tactical coordination.

(2) When sent to a C^2 JU on the Control NPG, Mark Points normally depict a Target of Opportunity or specific attack location for a large target, e.g., the front of a column of tanks or specific location on an airfield. The Controlling C^2 JU shall decide on an individual manual basis if the Mark Point should be sent on surveillance as a J3.0 Reference Point, J3.3 Surface (Maritime) Track, J3.5 Land (Ground) Track/Point message, or not at all.

4.12.1.3.4 NONC^2 JU-TO-NONC^2 JU NPG PROCEDURES

As discussed in paragraph 4.2.3.10.13, the NonC^2 JU-to-NonC^2 JU NPG provides the capability for nonC^2 JUs to exchange data. The following subparagraphs describe the uses and capabilities of this NPG.

a. NonC^2 JUs shall have the capability to report and update targets, report engagement status and results, and may assign targets/order engagements to other nonC^2 JUs on the same NonC^2 JU-to-NonC^2 JU NPG. Message protocols and sequences are described in paragraphs 4.12.1.2.7 and 4.12.1.2.8.

b. J12.6 and J12.7 messages sent on a NonC^2 JU-to-NonC^2 JU NPG shall be updated at a higher data rate than that specified for the Control NPG (see section 5, part 2, Tables J12-4.1 through J12-4.6 and J12.7 T/R rules). This is necessary to provide the greater data accuracy possible with many nonC^2 JU onboard sensors.

c. Assigning of targets or ordering of engagements may be accomplished by any nonC^2 JU that has operational authority to do so. No protocols have been established to limit capabilities of any participating nonC^2 JU based on other Link 16 information provided on the interface.

d. NonC^2 JUs shall have the capability of operating concurrently on the Control and NonC^2 JU-to-NonC^2 JU NPGs. This enables a flight leader to report engagement status to the controlling C^2 JU while communicating with the flight during the conduct of the mission (see paragraph 4.12.1.3.3c(4)). It also allows all addressed nonC^2 JU flight members to receive controlling C^2 JU mission assignments, vectors, control change orders, and pointers. All participating nonC^2 JUs shall receive nonaddressed Control NPG communication, such as correlations and condition orders. The possibility of conflicting orders to any nonC^2 JU that this procedure establishes may be averted through application of operational doctrine.

e. C^2 JUs may receive but not transmit on a NonC^2 JU-to-NonC^2 JU NPG. A C^2 JU may monitor a NonC^2 JU-to-NonC^2 JU NPG in lieu of the Control NPG for the purpose of receiving target reports and engagement status to fulfill Controlling Unit reporting responsibilities delineated in paragraph 4.12.1.

4.12.1.3.5 VECTOR PROCEDURES

The J12.1 message may be used in virtually any phase of flight. Vector information is either advisory in nature or a command. When the R/C field is set to value 0, the J12.1 message is a command. When the R/C field is set to value 5, the J12.1 message is advisory, but a Machine Receipt is required. Absence of a J12.1E0 word indicates an advisory message and no R/C is required. Whenever the J12.1 message with the R/C field set to value 0 is used in conjunction with a J12.0 message, a J12.0 WILCO message must be received prior to transmitting the J12.1 message (see section 5, part 1, Table J12-3.).

4.12.1.3.6 RENDEZVOUS PROCEDURES

Tactical situations may require vectoring of nonC^2 JUs to a point in space used for rendezvousing to effect such actions as a join-up of nonC^2 JUs, placement of nonC^2 JUs on CAP stations, or assemblage of nonC^2 JUs for refueling. The J12.0I word is transmitted by the controlling C^2 JU to the nonC^2 JU to identify the rendezvous objective or mission and is followed by the J12.0C1 word and the J12.0C2 or J12.0C3 word that provide the rendezvous point and amplifying information. The J12.0I word contains R/C information. If the J12.1 message with the R/C field set to value 0 is required, it shall be transmitted after receipt of the J12.0 WILCO message. In the event that course, altitude, or speed are required in the execution of a rendezvous, the J12.1I word with the Vector Discrete field is set to value 9, 10, or 11 and the J12.1E0 word is added to require R/C. The J10.6 Pairing message is transmitted by the controlling C^2 JU to other controlling C^2 JUs to indicate the pairing between the nonC^2 JU under control and the rendezvous objective. Rendezvous pairings shall be terminated by controlling C^2 JUs in accordance with paragraph 4.11.3.3.3.

4.12.1.3.7 CONTROL INITIATION/CHANGE PROCEDURES

The J12.4 Controlling Unit Change message is used to initiate control of a nonC^2 JU not under control or whose controlling unit has become inactive, to effect the handover of control from a C^2 JU to another controlling unit, and to terminate control of a nonC^2 JU. The protocols for these three distinctly different uses are specified as follows:

a. Initiation of Control. Control may be initiated either by a C^2 JU or by a nonC^2 JU. These two cases are described separately.

(1) C^2 JU Initiation. The C^2 JU initiation of control is described in the following paragraphs.

(a) If a C^2 JU implements the option to initiate control of a nonC^2 JU not currently under control, the C^2 JU shall transmit a J12.4I/J12.4E0 word sequence with the Control Change Indicator (CCI) field set to value 0, Control Change Order, to the nonC^2 JU with the R/C field set to value 0. The New Control Agency TN field shall be set to the Source TN of the initiating C^2 JU. The Control Channel field shall be set to the JTIDS Control Channel Number of the Control NPG on which control is desired. The Voice Frequency/Channel and Voice Frequency/Channel Indicator fields may be set to specify the UHF Frequency or Channel Group A or B to be used for Primary or Alternate voice communications. The voice call sign of the initiating C^2 JU may also be provided in the New Control Agency Voice Call Sign field. The Mode III Code field may be set to a Mode III code that the nonC^2 JU is requested to use. The Squawk Flash Indicator may be set to request the nonC^2 JU to squawk flash. The Radio Type and Secure Radio Indicator fields may also be used to specify information about the UHF Frequency, if reported. The Link 4A Frequency field shall be set to No Statement.

(b) The nonC^2 JU addressed in the J12.4 message with the CCI field set to value 0 shall respond with a J12.4 message with the R/C field set to value 2, Machine Receipt. The nonC^2 JU shall also respond with a J12.4 message with an appropriate R/C field value. The C^2 JU shall respond with a J12.4 message with the R/C field set to value 2, Machine Receipt. If the nonC^2 JU response was WILCO, the nonC^2 JU shall transmit a J12.4I word with R/C set to value 0 and the CCI field set to value 1, Control Request, to the receiving C^2 JU on the Control Channel specified in the original J12.4 message with the CCI field set to value 0. The New Control Agency TN, Control Channel, Radio Type, and Secure Radio Indicator fields shall be set to No Statement.

(c) The C^2 JU addressed in the J12.4 message with the CCI field set to value 1 shall respond with a J12.4 message with the R/C field set to value 2, Machine Receipt, and then a J12.4 message with the R/C field set to value 4, HAVCO. The nonC^2 JU shall transmit a J12.4 message with the R/C field set to value 2, Machine Receipt. This completes the initiation of control.

(d) In the above sequence, if the C^2 JU implements the J0.3 message and has Control NPG time slots awaiting assignment to the nonC^2 JU, the J0.3 message shall be transmitted by the C^2 JU after the Machine Receipt for the original J12.4 message with the CCI field set to value 1 but before the HAVCO. The HAVCO shall not be transmitted until a Machine Receipt is received for the J0.3 message. If a CANTPRO is received for the J0.3 message, an operator in the C^2 JU shall be alerted in order to provide an opportunity to CANTCO the J12.4 message with the CCI field set to value 1.

(2) NonC^2 JU Initiation. Procedures for nonC^2 JU initiation of control differ depending on whether or not the nonC^2 JU knows the TN of the desired controlling C^2 JU, as described below.

(a) A nonC^2 JU that is not currently under control and knows the TN of the desired controlling C^2 JU on a control channel shall initiate a request to the C^2 JU for control by transmitting a J12.4 message with the R/C field set to value 0 and the CCI field set to value 1, Control Request. The Addressee TN shall be set to the TN of the C^2 JU. The New Control Agency TN, Control Channel, Radio Type, and Secure Radio Indicator fields shall be set to No Statement. The requested C^2 JU shall respond with a J12.4 message with the R/C field set to value 2, Machine Receipt. The requested C^2 JU shall assume control by transmitting a J12.4 message with the R/C field set to value 3, WILCO, or 4, HAVCO, or refuse control by transmitting a J12.4 message with the R/C field set to value 6, CANTCO, or 7, CANTPRO, to the requesting nonC^2 JU. The nonC^2 JU shall transmit a J12.4 message with the R/C field set to value 2, Machine Receipt. If the C^2 JU response was WILCO or HAVCO, this completes the initiation of control. If the C^2 JU has other J12.4 data to provide to the nonC^2 JU, it must reinitiate control after control has been initially assumed, i.e., after the WILCO or HAVCO message has been transmitted and receipted. The protocols for reinitiation in this case are identical to those for C^2 JU initiation.

(b) In the above sequence, if the C^2 JU implements the J0.3 message and has Control NPG time slots awaiting assignment to the nonC^2 JU, the J0.3 message shall be transmitted by the C^2 JU after the Machine Receipt for the original J12.4 message with the CCI field set to value 1 but before the WILCO or HAVCO. The WILCO or HAVCO shall not be transmitted until a Machine Receipt is received for the J0.3 message. If a CANTPRO is received for the J0.3 message, an operator in the C^2 JU shall be alerted in order to provide an opportunity to CANTCO the J12.4 message with the CCI field set to value 1.

(c) When a nonC^2 JU not currently under control does not know the TN of the controlling C^2 JU on a desired control channel, it shall initiate a request for control by transmitting a J12.4I word with the R/C field set to value 1 and the CCI field set to value 1. The Addressee TN shall be set to the collective addressee, 00177 (octal). The New Control Agency TN, Control Channel, Radio Type, and Secure Radio Indicator fields shall be set to No Statement. This J12.4 message shall be transmitted periodically at an RRN of 6 (12 seconds, 8-20 second interval) until transmission is terminated by operator action or a J12.4 message with the CCI field set to value 0, Control Change Order, is received. Any C^2 JU receiving this J12.4 message with the CCI field set to value 1, Control Request, shall display the request to an operator. If the operator accepts the request, the C^2 JU shall initiate control of the requesting nonC^2 JU as specified for C^2 JU initiation.

b. Handover of Control. The J12.4 message is also used to effect handover of nonC^2 JU control in conjunction with the following digital handover procedures under handover of control.

(1) A C^2 JU that has requested another IU to take control in the J10.3 message and has received a WILCO for the J10.3 message shall transmit a J12.4I/J12.4E0 word sequence with the R/C field set to value 0 and the CCI field set to value 0 to the nonC^2 JU which was the Reference TN in the J10.3 message. The New Control Agency TN field shall be set to the TN of the controlling unit receiving the handover. The New Control Agency Voice Call Sign shall be set to the voice call sign of the receiving unit, if held. The other J12.4 message fields shall be set to the same values as received in the J10.3C1 word of the WILCO message received in response to the original J10.3 message request.

(2) The nonC^2 JU addressed in the J12.4 message with the CCI field set to value 0 shall respond with a J12.4 message with the R/C field set to value 2, Machine Receipt. It shall also respond with a J12.4 message with an appropriate R/C. The C^2 JU shall respond with a J12.4 message with the R/C field set to value 2, Machine Receipt. If the response to the C^2 JU is WILCO, the nonC^2 JU shall transmit a J12.4I word three times at an RRN of 6 (12 seconds, 8-20 second interval) with the R/C field set to value 0 and the CCI field set to value 1 to the receiving C^2 JU on the Control Channel specified in the original J12.4 message with the CCI field set to value 0. Receipt of a response message shall cause the periodic transmission to cease. The New Control Agency TN, Control Channel, Radio Type, and Secure Radio Indicator fields shall be set to No Statement. If the nonC^2 JU response is CANTCO or CANTPRO, the C^2 JU shall retain control and transmit a J10.3 Cancel Handover message to the receiving C^2 JU.

(3) The C^2 JU addressed in the J12.4 with the CCI field set to value 1 shall respond with a J12.4 message with the R/C field set to value 2,

Machine Receipt, and a J12.4 message with the R/C field set to value 4, HAVCO. The nonC^2 JU shall transmit a J12.4 message with the R/C field set to value 2, Machine Receipt. This completes the handover of control. The former controlling C^2 JU shall not transmit a J12.4 message with the CCI field set to value 2, Terminate Control.

(4) In the above sequence, if the C^2 JU implements the J0.3 message and has Control NPG time slots awaiting assignment to the nonC^2 JU, the J0.3 message shall be transmitted by the C^2 JU after the Machine Receipt for the original J12.4 message with the CCI field set to value 1 but before the HAVCO. The HAVCO shall not be transmitted until a Machine Receipt is received for the J0.3 message. If a CANTPRO is received for the J0.3 message, an operator in the C^2 JU shall be alerted to provide an opportunity to CANTCO the J12.4 message with the CCI field set to value 1.

(5) A C^2 JU may direct a nonC^2 JU to change control to a unit that is not an IU by transmitting a J12.4I/J12.4E0 message with the CCI field set to value 0 and the R/C field set to value 0. Either the New Control Agency TN or New Control Agency Voice Call Sign must be set to other than No Statement. The Control Channel field shall be set to No Statement. Other J12.4E0 fields shall be set to other than No Statement, if data are available. The nonC^2 JU will respond with a J12.4 message with the R/C field set to value 2, Machine Receipt, followed by a J12.4 message with the appropriate R/C. If the controlling C^2 JU receives a J12.4 message with the R/C field set to value 3, WILCO, it shall report terminating control by transmitting a J10.5 message with the Controlling Unit Status field set to value 0. The nonC^2 JU will then contact the new controlling agency by voice as indicated in the original J12.4I/J12.4E0 message or as prebriefed. If the controlling C^2 JU receives a J12.4 message with the R/C field set to value 6, CANTCO, the controlling C^2 JU maintains control and cancels the handover. If the controlling C^2 JU receives a J12.4 message with the R/C field set to value 7, CANTPRO, the operator shall be alerted so that the operator may attempt the change of control by other means, e.g., voice.

If control of a paired or engaged nonC^2 JU is passed to a nonIU, the controlling C^2 JU shall send a J10.5 message indicating terminating control, and shall cease transmitting J10.6 pairings and J10.2 engagements.

c. Termination of Control. When a controlling C^2 JU terminates control of a controlled unit, then the C^2 JU shall comply with paragraph 4.11.3.2.3. The C^2 JU shall monitor for a response and if a CANTCO, CANTPRO, or No Machine Receipt is received, the operator shall be alerted.

4.12.1.3.8 REPORTING STATUS PROCEDURES

Air, surface (maritime), subsurface (maritime) and land (ground) platforms use Link 16 to pass their status. The reporting status structure is analogous to reporting PPLI and surveillance data; therefore, the messages are laid out according to environment/category. Procedures for reporting the status of platforms and systems are described in paragraph 4.11.3.3.2.

4.12.1.3.9 AIR TRAFFIC CONTROL

ATC is the control of aircraft for nontactical purposes. Services to aircraft include aid in arrival/departure and enroute traffic control. The J12.1 message is the basic tool used to provide ATC. When conducting ATC, the controlling C^2 JU uses the J12.1I word to provide the aircraft with course, altitude, and speed information; and the J12.1E0 word is used to provide R/C information. The J12.2I word is used to guide aircraft to approach and landing. The J12.3I and J12.3E0 words are used by air traffic controllers to provide aircraft with specific flight paths and altitudes. The J12.4I/J12.4E0 words provide the aircraft with the communications and IFF/SIF information necessary for local handovers.

4.12.1.3.10 AIR INTERCEPT CONTROL

AIC is the process of providing vector information to an aircraft to position it in the vicinity of another air track. The positioning data provided depends on the type of intercept to be accomplished and is indicated by the value set in the Vector Discrete field.

To initiate an intercept, the J12.0I word is transmitted to order the aircraft to engage or investigate the target. The J12.0I word is followed by the J12.0C1 and J12.0C2 words to provide amplifying target data.

4.12.1.3.11 ANTISUBMARINE WARFARE AIR CONTROL

ASW air control is the direction of aircraft capable of detecting and/or destroying submarines. Aircraft are provided with search areas, target locations, vectors for target localization and weapon release. Assignments are made using the J12.0I word, with the 12.0C3 word providing ASW related search areas and points as required. Target position may be determined by using the Objective TN and the J3 Surveillance messages. Vector information may be provided in the J12.1 message.

4.12.1.3.12 SEARCH AND RESCUE

The purpose of this mission is to assign aircraft to SAR operations. The J12.0C1 word or the J12.0C3 word, as appropriate for the aircraft, is used to indicate the location of the search point. Search patterns may be specified by using the J12.3 message, or search legs by using individual J12.1 messages.

4.12.1.3.13 REMOTELY PILOTED VEHICLE/MISSILE CONTROL

There are two distinct classes of control for these systems. One is RPV where the JU equipped RPV/missile is in positive sensor or visual contact with the controlling C^2 JU. The operator inputs at the C^2 JU directly affect the airframe's control surfaces for course, speed, and altitude changes in real time. The other class is missile control where the JU equipped RPV/missile may or may not be in positive sensor contact with the controlling C^2 JU and the operator's inputs are flight profile and target position data. In this case, the missile executes the profile sequentially to reach the assigned target.

In the RPV class of control the real-time changes to a RPV/missile's control surfaces are transmitted in the J12.2 message.

The missile class of control includes the ability to specify targets that are not in sensor contact with the launching unit, such as in over-the-horizon targeting. The J12.3 message fully supports this procedure by supplying the sequential flight path and altitude to the target's position.

Transfer control of RPV and missiles is TBD.

4.12.1.3.14 AUTOMATIC CARRIER LANDING SYSTEM/AUTOMATIC LANDING SYSTEM PRECISION DIRECTION

The ACLS/Automatic Landing System (ALS) procedure is used for precise aircraft control during the final phases of landing. This direction may either be to cockpit displays and/or coupled to the autopilot for hands-off control to touchdown. The J12.1I word is used for general guidance in flight phases prior to initiation of the precision phase of the recovery. The J12.2 message then provides the precise course guidance required.

4.12.1.3.15 EXERCISE INDICATOR IN CONTROL MESSAGES

The Exercise Indicator and the Identity Amplifying Descriptor fields in the J12.0 and J12.6 message always refer to the track or sensor target. The Specific Type must also be considered artificial and for exercise purposes. No other data in the messages shall be artificial. (See paragraph 4.4.2.1.1 for the relationship between the Exercise Indicator, Identity, and Identity Amplifying Descriptor fields.)

4.12.1.4 CONDITIONAL RADIO SILENCE AIR CONTROL PROCEDURES

All JUs have the capability to select the Conditional Radio Silence mode of terminal operation. This mode is described in subsection 3.3, JTIDS/MIDS technical characteristics. JUs will have the capability to receive Link 16 data while the terminal is set to Conditional Radio Silence. Controlling C^2 JUs not in conditional radio silence will have the capability to transmit J-Series messages to JUs operating in the Conditional Radio Silence mode. The C^2 JU system may be automated to provide modified processing of J12 series messages, such as assumed responses, assigning modified R/C values, or developing J10.2 Engagement Status messages. If this automation is implemented, it shall depend upon receipt of a J2.2 message with the Network Participation Status Indicator field set to value 3 from a controlled nonC^2 JU. This will identify that the nonC^2 JU is in Conditional Radio Silence mode. Procedures for controlling nonC^2 JUs in the Conditional Radio Silence mode are described below.

a. Mission Assignments. The J12.0 Mission Assignment messages are transmitted in accordance with paragraph 4.12.1.3.1 and the J12.0 transmit/receive rules. However, since a conditional radio silence JU will not respond with either a machine receipt or an operator response, the C^2 JU must accommodate for the lack of a response. This can be accomplished either by system design or operational procedures. Any new J12.0 message transmitted will negate any previous J12.0 message.

b. Vectoring. All J12.1 Vector messages addressed to a Conditional Radio Silence nonC^2 JU shall be transmitted with the R/C field set to value 1, Original Order, so that no response is required.

c. Engagement Status. While controlling a JU operating in the Conditional Radio Silence mode, it is assumed that the nonC^2 JU will comply with J12.0 mission assignments, unless operator observation indicates otherwise, even though a WILCO response is not received. Since it is assumed that the nonC^2 JU will comply with the last J12.0 message transmitted, a J10.2 Engagement Status message corresponding to the last J12.0 message transmitted (see Tables 4.11-3 and 4.11-4) shall be transmitted either automatically or by operator action. T/R rules for the J10.2 message are the same regardless of the conditional radio silence status.

4.12.1.5 WEATHER OVER TARGET MESSAGE

The J17.0 Weather Over Target message is used to inform or update previously reported tactically significant weather data that exists in a target area.