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DEPARTMENT OF DEFENSE INTERFACE STANDARD

CONNECTIONLESS DATA TRANSFER APPLICATION LAYER STANDARD

AMSC N/A AREA DCPS

FOREWORD

This military standard is approved for use by all Departments and Agencies of the Department of Defense (DoD).

This military standard is produced by the Information Transfer Management Panel (IXMP). The MIL-STD-2045 document series was established within the DCPS Standardization Area to allow for the enhancement of commercial standards or the development of standards that are unique to DoD.

Specific details and instructions for establishing a MIL-STD-2045 document, as well as profile development guidelines, are documented in the IXMP Management Plan. IXMP Working Groups (WGs) are responsible for standard development, formal service and agency coordination, and approval.

This military standard does not supersede the scope of Allied Communication Publication (ACP) 123 with US SUPP-1. ACP 123 with US SUPP-1 addresses message handling communications protocol and procedures for the exchange of military messages.

The Preparing Activity (PA) for this standard is USACECOM, ATTN: AMSEL-SE-CD (Mr. E. Robinson), Fort Monmouth, NJ 07703. The custodians for the document are identified in the Defense Standardization Program, "Standardization Directory (SD-1)" under Standardization Area Data Communication Protocol Standards (DCPS).

Beneficial comments (recommendations, additions, deletions) and any pertinent data that may be of use in improving this military standard should be addressed to the PA at the above address by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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1. SCOPE

1.1 Purpose. This military standard presents the minimum essential technical parameters in the form of a mandatory system standard and optional design objectives for interoperability and compatibility among digital message transfer devices (DMTDs), between DMTDs and applicable command, control, communications, computers, and intelligence (C4I) systems and among C4I systems using digital data for information transfer over limited bandwidth communication channels.

1.2 Scope. This military standard addresses part of the communications protocol and procedures for the exchange of digital data among DMTDs, between DMTDs and C4I systems, and among C4I systems participating in inter- and intra-Service tactical networks. The material is presented in the context of the Open Systems Interconnection (OSI), as documented in national and international standards.

1.3 Application guidance. This military standard applies to the design, construction, and development of new equipment and systems, and to the retrofit of existing equipment and systems.

1.4 System standards and design. The parameters and other requirements specified in this military standard are mandatory if the word *shall* is used in connection with the parameter value or requirement under consideration. Non-mandatory objectives are indicated in parentheses after a standardized parameter value or by the word *should* in connection with the parameter value or requirement under consideration.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3, 4, and 5 of this standard. This section does not include documents cited in other sections of this standard or recommended for additional information as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they shall meet all specified requirements documents cited in sections 3, 4, and 5 of this standard, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this military standard to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the current issue of the DoD Index of Specifications and Standards (DoDISS) and supplements thereto, cited in the solicitation (see 6.2).

STANDARDS:

FEDERAL:

FED-STD-1037	*Glossary of Telecommunication Terms*

MILITARY:

MIL-STD-188-220	*Interoperability Standard for Digital Message Transfer Device Subsystems*
MIL-STD-6040	*United States Message Text Format (USMTF)*

NATIONAL SECURITY AGENCY CENTRAL SECURITY SERVICE:

DOI-103	Defense Special Security Communications System (DSSCS) Operating Instructions System - Data Procedures DOI-103

[Unless otherwise indicated, copies of federal and military standards are available from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.]

2.2.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this military standard to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation.

Joint Interoperability of Tactical Command and Control Systems, Variable Message Format Technical Interface Design Plan (Test Edition) (VMF TIDP TE)

Variable Message Format Interface Operating Procedures (VMF IOP)

[These documents are available from the Joint Interoperability and Engineering Organization (JIEO), Center for Standards, Information Standards Directorate (TBCA), 10701 Parkridge Blvd. Reston, VA 22091-4398.]

2.3 Non-Government publications. The following documents form a part of this military standard to the extent specified herein. Unless otherwise specified, the issues of the documents that are DoD- adopted are those listed in the issue of the DoDISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS are the issues of the documents cited in the solicitation (see 6.2).

INTERNATIONAL ORGANIZATION for STANDARDIZATION (ISO):

ISO 7498-1	*Information Processing Systems -- Open Systems Interconnection -- Basic Reference Model.*

[ISO standards are available from the American National Standards Institute, Inc., 1430 Broadway, New York, NY 10018.]

OTHER:

Lempel-Ziv-Welch	A technique for high performance data compression", Terry A. Welch, IEEE Computer, Vol. 17, No. 6, pp. 8-19, June 1984
Lempel-Ziv 1977	A universal algorithm for sequential data compression", J. Ziv and A. Lempel, IEEE Transactions on Information Theory, Vol IT-23, No. 3, pp 337-343, May 1977.

2.4 Order of precedence. In the event of a conflict between the text of this military standard and the references cited herein, the text of this military standard takes precedence. Nothing in this MIL-STD, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. DEFINITIONS

3.1 Definitions of terms. Definitions of terms used in this military standard are specified in FED-STD-1037.

3.2 Abbreviations and acronyms. Abbreviations and acronyms used in this military standard are defined below. In addition, those listed in the current edition of FED-STD-1037 that are pertinent to standards referenced by this document have been included for the convenience of the reader.

ACP	Allied Communication Publication
ALP	Application Layer Protocol
ANSI	American National Standards Institute
ASCII	American Standard Code for Information Interchange
C	Consecutive Repeatable Indicator
C4I	Command, Control, Communications, Computers, and Intelligence
CANTCO	Cannot Comply
CANTPRO	Cannot Process
CNR	Combat Net Radio
DARPA	Defense Advanced Research Projects Agency
DCPS	Data Communication Protocol Standards
DFI	Data Field Identifier
DISA	Defense Information Systems Agency
DL	Data-Link Layer
DMTD	Digital Message Transfer Device
DoD	Department of Defense
DoDISS	Department of Defense Index of Specifications and Standards
DOI	DSSCS Operating Instruction
DSSCS	Defense Special Security Communications System
DTG	Date-Time Group
DUI	Data Use Identifier
FAD	Functional Area Designator
FED-STD	Federal Standard
FIPS	Federal Information Processing Standard
FPI	Field Presence Indicator
FRI	Field Recurrence Indicator
FSC	Federal Supply Classification
GOSIP	Government Open Systems Interconnection Profile
GPI	Group Presence Indicator
GRI	Group Recurrence Indicator
HAVCO	Have Complied
HLEN	Header Length
I	Information; Iterative Repeatable Indicator
IEEE	Institute of Electrical and Electronics Engineers, Inc.
IOP	Interface Operating Procedure
IP	Internet Protocol
ISO	International Organization for Standardization
IXMP	Information Transfer Management Panel
JIEO	Joint Interoperability and Engineering Organization
LSB	Least Significant Bit
LZ	Lempel-Zev
LZW	Lempel-Ziv-Welch
M	Mandatory
MIL-STD	Military Standard
MMTU	Minimum Message Transfer Unit
MR	Machine Receipt

MSB	Most Significant Bit
MSS	Maximum Segment Size
(*n*)	Repeatability Factor
NITFS	National Imagery Transmission Format System
O	Optional
OPRACK	Operator Acknowledge
ORR	Operator Response Required
OSI	Open Systems Interconnection
P/F	Poll/Final
PDU	Protocol Data Unit
POSIT	Profiles for Open Systems Internetworking Technologies
QOS	Quality Of Service
R	Repeatable Field Indicator
R/C	Receipt/Compliance
RI	Routing Indicator
Rn	Repeatable Field Within Group N
SD-1	Standardization Directory 1
SH	Segmentation/Reassembly Header
TADIL	Tactical Digital Information Link
TBD	To Be Determined
TCP	Transmission Control Protocol
TIDP-TE	Technical Interface Design Plan (Test Edition)
UDP	User Datagram Protocol
UMF	User Message Format
VMF	Variable Message Format
WILCO	Will Comply

4. GENERAL REQUIREMENTS

4.1 Application Layer Users In the context of this MIL-STD, the user of the application layer is the application process that requires the communications services to effect information exchange (the transfer of digital data) between end systems.

4.2 Interoperability. Interoperability of the application entity between end systems shall be achieved by implementing the application layer protocol specified in this MIL-STD. This standard defines the minimum essential data communications parameters and protocol conventions that are necessary to support the handling and exchange of single messages or concatenated messages [a series of messages that are combined together in a single user data block for delivery to the same destination(s)] over subnetworks and point-to-point links.

4.3 Application-layer services provided. The application layer protocol shall provide the following services to the application process in order to facilitate the reliable exchange and distribution of messages of data between end user systems:

a. identification of intended communications partners by name;

b. identification of privacy/security mechanisms required;

c. passing of quality-of-service parameters (performance and non-performance parameters);

d. synchronization of cooperating application processes;

e. message handling (distribution, receipting, and monitoring);

f. identification of constraints on data syntax (character sets, data structure); and

g. message or data transfer via connectionless operation.

5. SPECIFIC REQUIREMENTS

5.1 Application layer The application layer shall provide the simplified message-handling protocol.

5.2 Application protocol data unit. The application protocol data unit shall be composed of an application header and user data, as shown in Figure 1.

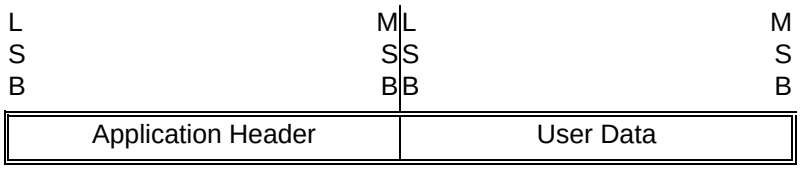

FIGURE 1. Application protocol data unit structure.

5.3 Application Header. The application header shall consist of the fields shown in Table I. The application header may contain two categories of fields, mandatory (M) and conditional (C). A conditional field is dependent upon the presence or absence of other fields. The order of fields shall follow that shown in Table I. The application header shall always be a multiple of 8 bits. If an application header is not a multiple of 8 bits, it shall be zero-filled so that it becomes a multiple of 8 bits.

TABLE I. Application Header.

Field Name	CAT	Group Code	Repeat Code	Description/ Resolution	Maximum Field Size (bits)
VERSION	M			MIL-STD-2045-47001 VERSION NUMBER	4
FPI	M			COMPRESSION TYPE	1
DATA COMPRESSION TYPE					2
GPI	M			ORIGINATOR ADDRESS GROUP	1
FPI		G1			1
UNIT REFERENCE NUMBER		G1			24
FPI		G1			1
UNIT NAME		G1			448
GPI	M			RECIPIENT ADDRESS GROUP (See Paragraph 5.6.3a)	1
GRI		G2	R1C(N) 0<N<=16		1
FPI		G2	R1		1
UNIT REFERENCE NUMBER		G2	R1		24

TABLE I. Application Header (Continued).

FPI		G2	R1		1
UNIT NAME		G2	R1		448
GPI	M			INFORMATION ADDRESS GROUP (See Paragraph 5.6.3a)	1
GRI		G3	R2C(16 - N)		1
FPI		G3	R2		1
UNIT REFERENCE NUMBER		G3	R2		24
FPI		G3	R2		1
UNIT NAME		G3	R2		448
GRI	M		R3C(16)	MESSAGE HANDLING GROUP	1
USER MESSAGE FORMAT	M		R3		4
GPI	M		R3	MESSAGE IDENTIFICATION GROUP	1
FUNCTIONAL AREA DESIGNATOR		G4	R3		4
MESSAGE NUMBER		G4	R3		7
FPI		G4	R3		1
MESSAGE SUBTYPE		G4	R3		7
FPI	M		R3		1
FILE NAME			R3		448
FPI	M		R3		1
MESSAGE SIZE			R3		20
OPERATION INDICATOR	M		R3		2
RETRANSMIT INDICATOR	M		R3		1
MESSAGE PRECEDENCE CODE	M		R3		3
SECURITY CLASSIFICATION	M		R3		2
FPI	M		R3		1
CONTROL/RELEASE MARKING			R3		14
GPI	M		R3	ORIGINATOR DTG	1
YEAR		G5	R3		7
MONTH		G5	R3		4
DAY		G5	R3		5
HOUR		G5	R3		5

TABLE I. Application Header (Continued).

MINUTE		G5	R3		6
SECOND		G5	R3		6
FPI		G5	R3	DTG EXTENSION	1
DTG EXTENSION		G5	R3		12
GPI	M		R3	PERISHABILITY DTG	1
YEAR		G6	R3		7
MONTH		G6	R3		4
DAY		G6	R3		5
HOUR		G6	R3		5
MINUTE		G6	R3		6
SECOND		G6	R3		6
GPI	M		R3	ACKNOWLEDGMENT REQUEST GROUP	1
MACHINE ACKNOWLEDGE REQUEST INDICATOR		G7	R3		1
OPERATOR ACKNOWLEDGE REQUEST INDICATOR		G7	R3		1
OPERATOR REPLY REQUEST INDICATOR		G7	R3		1
GPI	M		R3	RESPONSE DATA GROUP	1
YEAR		G8	R3	DTG OF MESSAGE BEING ACKNOWLEDGED	7
MONTH		G8	R3		4
DAY		G8	R3		5
HOUR		G8	R3		5
MINUTE		G8	R3		6
SECOND		G8	R3		6
FPI		G8	R3	DTG EXTENSION	1
DTG EXTENSION		G8	R3		12
RECEIPT/COMPLIANCE		G8	R3	RESPONSE TO ACKNOWLEDGE REQUEST	3
FPI		G8	R3		1
CANTCO REASON CODE		G8	R3		3
FPI		G8	R3		1
CANTPRO REASON CODE		G8	R3		6

TABLE I. Application Header (Continued).

FPI		G8	R3		1
REPLY AMPLIFICATION		G8	R3		350
GPI	M		R3	REFERENCE MESSAGE DATA GROUP	1
GRI		G9	R3/R4C(4)		1
FPI		G9	R3/R4		1
UNIT REFERENCE NUMBER		G9	R3/R4		24
FPI		G9	R3/R4		1
UNIT NAME		G9	R3/R4		448
YEAR		G9	R3/R4		7
MONTH		G9	R3/R4		4
DAY		G9	R3/R4		5
HOUR		G9	R3/R4		5
MINUTE		G9	R3/R4		6
SECOND		G9	R3/R4		6
FPI		G9	R3/R4	DTG EXTENSION	1
DTG EXTENSION		G9	R3/R4		12
FUNCTIONAL AREA DESIGNATOR		G9	R3/R4		4
MESSAGE NUMBER		G9	R3/R4		7

5.4 Application header formatting. The application header shall use a variable format syntax and format structure. The syntax and formatting procedures are defined below.

5.5 Syntax. The application header consists of an ordered collection of bits (ones and zeros). A group is a combination of two or more related fields designated as a group. There are two types of groups, "G" groups and "R" groups. A "G" group is a combination of related fields. An "R" group is a repeatable combination of related fields. Presence and recurrence indicators as defined below shall be allowed in groups. The following syntax fields shall be used in the selection of fields to be transmitted:

a. Field Presence Indicators (FPIs). An FPI is a one-bit field used to indicate the presence or absence of the following field.

b. Field Recurrence Indicators (FRIs). An FRI is a one-bit field used to indicate the repeatability of a field.

c. Group Presence Indicators (GPIs). A GPI is a one-bit field used to indicate the presence or absence of the following group.

d. Group Recurrence Indicators (GRIs). A GRI is a one-bit field used to indicate the repeatability of a group.

5.5.1 Field Presence Indicator. The FPIs are used to indicate the presence (FPI=1) or absence (FPI=0) of the following field and are not used for mandatory fields or single bit fields. These indicators are transparent to the user, allowing the user to send only those fields containing information when use of those fields is not mandatory.

5.5.2 Field Recurrence Indicator. Fields may be designated as repeatable through a 1-bit FRI. If a field is preceded by an FPI, FPI=1 shall precede the first occurrence of the FRI and is not present for following repetitions. If the FPI=0, neither the FRI nor the field is present in the application header. An FRI=1 indicates the recurrence of the field after this iteration. An FRI=0 indicates the field will not occur after this iteration.

5.5.3 Group Presence Indicator. A group is a combination of related fields. FPIs, FRIs, GPIs, and GRIs shall be allowed in groups. If a group is preceded by a GPI, then the GPI indicates the presence (GPI=1) or absence (GPI=0) of the group.

5.5.4 Group Recurrence Indicator. An "R" group is repeatable and shall be preceded by a GRI. A "G" group is not repeatable and shall not be preceded by a GRI. If an "R" group is preceded by a GPI, GPI=1 shall precede the first occurrence of the GRI and is not present for following repetitions. If the GPI=0, neither the GRI nor the group is present in the application header. A GRI=1 indicates the recurrence of the group after this iteration. A GRI=0 indicates the group will not occur after this iteration.

5.5.5 End-of-literal field marker. The end-of-literal field marker, a 7-bit ANSI ASCII DELETE character (1111111), is used to indicate the end of free-text, character-oriented, literal fields only. The maximum literal field size is specified for each such field in Table I. Either the end-of-literal field marker or the field maximum length shall signify the end of a text field. The application header processing software shall be capable of recognizing both conditions.

5.5.6 Data-field construction procedures. The following construction procedures prescribe the sequence in which the application header fields are linearly joined before passing data to the next lower protocol layer. The header is constructed with elemental data fields ordered as specified in this standard. The data elements for the application header are as specified in this standard. There are two representations for data elements: 7-bit ANSI ASCII characters and binary numbers. All fields shall be joined LSB first. The LSB of the first data field or field/group indicator shall be LSB-justified within the first byte of the message buffer. The LSB of each successive data field shall be concatenated to the MSB of the preceding data field. The characters in a literal field are joined such that the LSB of the first character immediately follows the MSB of the previous field. The LSB of the second character immediately follows the MSB of the first character. This pattern is repeated until all characters of the field are joined. Figure 2 uses the first few fields of the application header (from Table I) as an example of the data field bit order. An example of a complete application header is provided in Appendix B. Bit No. 1 of Figure 2 maps to the LSB of the application header shown in Figure 1. Figure 2 is interpreted as follows:

BIT NO.	FIELD NAME	VALUE/CODE	MEANING
1 - 4	Version	1	MIL-STD-2045-47001B
5	FPI for Data Compression	0	NOT PRESENT
6	GPI for Originator Address Group	0	NOT PRESENT
7	GPI for Recipient Address Group	0	NOT PRESENT
8	GPI for Information Address Group	0	NOT PRESENT
9	GRI for Message Handling Group	0	NOT REPEATABLE
10 - 13	User Message Format	2	VMF K-Series
14	GPI for Message Identification Group	1	PRESENT
15 - 18	Functional Area Designator	7	COMBAT SERVICE SUPPORT

	OCTET 1								OCTET 2									
	2^0	----	----	----	----	----	----	2^7	2^0	----	----	----	----	----	----	2^7	2^0	2^1
	LSB			MSB						LSB			MSB		LSB			MSB
FIELD	VERSION				FPI	GPI	GPI	GPI	GRI	User Message Format				GPI	Functional Area Designator			
VALUE	1	0	0	0	0	0	0	0	0	0	1	0	0	1	1	1	1	0

FIGURE 2. Application protocol data field bit order (example).

5.5.6.1 ASCII data element. In a data element composed of a string of 7-bit ANSI ASCII characters, the left most character shall be stored in memory first.

5.5.6.2 Binary data element. In a data element composed of a binary code, it shall be stored as a single data field.

5.5.6.3 Header format notations. The header format is depicted in Table I; the notations used to describe the header format are as follows:

a. Category will display an "M" for those fields that are mandatory. All other fields are conditional.

b. Group Code The group codes in Table I represent a logical grouping of information that is implemented as a "G" group. "G" groups within a header will be notated as GN were N indicates that numbered grouping (i.e., G1 indicates the first "G" group within the header: etc.). Nested groups are indicated by "GN/GN" notation where the left-most group is the highest level of the nesting and the right-most group is the current, lowest level.

c. Repeat codes. The repeat codes in Table I denote group appearance, nesting of groups, and maximum repetitions. The following notations are used:

(1) R = Indicates this field is repeatable.

(2) RN = Indicates this field is part of a group that can be repeated, with N specifying the group number (that is, R1 indicates the first repeatable group in the message).

(3) C = Consecutive repeatability indicator specifies that the individual repeatable field or repeatable group of fields may be repeated only in a consecutive manner (for example, fields 3 and 4, followed immediately by fields 3 and 4). Consecutive repeating of a group of fields can occur only when the group is a single group (no nested groups) or the group is the innermost of several nested groups.

(4) I = Iterative repeatability indicator specifies that the repeatable group may be repeated only after consideration has been given to all embedded iterative and consecutive repeatables.

(5) (N) = Appears with the first field of a repeatable group, that is, R3C(16), and indicates the maximum number of appearances of

the group in the message. The example, R3C(16), indicates the third repeatable group of the message that will be repeated consecutively and can appear a maximum of sixteen times.

(6) RN/RN = Nested repeating groups. Example R3/R4 R4 is nested in R3.

5.6 Application Header fields.

5.6.1 Version. This field shall be a 4-bit binary codeword representing the version of the MIL-STD-2045-47001 header being used for the message. Table II lists the MIL-STD-2045-47001 revision indicated by the Version code.

TABLE II. Version Codes.

Code MSB - LSB	MIL-STD-47001 Revision
0000	MIL-STD-2045-47001
0001	MIL-STD-2045-47001B
0010-1111	Undefined

5.6.2 Data Compression Type. This field shall be a 2-bit binary codeword representing whether the data portion of the message has been Unix compressed (LZW algorithm) or compressed using the LZ-77 compression algorithm. Table III lists the Data Compression algorithm indicated by the Data Compression Type.

TABLE III. Data Compression Type Codes.

Code MSB-LSB	Compression Algorithm	Reference
00	LZW	Lempel-Ziv-Welch Compression Algorithm, Welch 1984
01	LZ-77	Lempel-Ziv Compression Algorithm, Lempel-Ziv 1977
10-11	Undefined	

5.6.3 Originator, Recipient, and Information Addressee fields. These fields shall contain addresses that represent the names of the originating and receiving person(s) or process(es). The receiving application layer shall use the recipient and information fields to determine how the message shall be handled or delivered after the decoding process. The value in these fields depends on the person or process receiving the message. If a person is to be designated, the fields shall uniquely identify the individual so that the message may be routed to a specific mailbox or terminal. If a process is to be designated, these fields shall uniquely identify the process. The process shall be associated with an end system to define the address uniquely. The following requirements apply to recipient and information addressee fields:

a. The recipient and information addressee fields shall be extendible to a combined total of 16 addressees.

b. When the recipient address is not present (GPI = 0), the message shall be broadcast in accordance with lower layer broadcast rules.

5.6.3.1 Unit Reference Number field. This field shall be a 24-bit binary code used by units on an interface to uniquely identify friendly military units. The applicable codes for this field depend on the setting of the User Message Format (UMF) field (paragraph 5.6.4) and are specified in appendices to this document as referenced in Table II. The Unit Reference Number field and the Unit Name field are mutually exclusive fields (one or the other, not both).

5.6.3.2 Unit Name field. This field shall be a variable size field up to a maximum of 448 bits. It shall be in a character-coded format and used to uniquely identify a friendly military unit. This field is divided into 64 groups of 7 bits each representing an ANSI ASCII character. Special characters are legal. ANSI ASCII Delete (1111111) may be used as an end of text marker.

5.6.4 User Message Format field. This field shall be a 4-bit binary codeword representing the message formats shown in Table IV. This field indicates the format of the message that is contained in the user data field and has association with the other message format-dependent fields, including, Functional Area Designator (FAD) (paragraph 5.6.5), Message Number (paragraph 5.6.6), Message Subtype (paragraph 5.6.7), CANTCO Reason, (paragraph 5.6.23), and CANTPRO Reason (paragraph 5.6.24). The applicable codes for these fields are associated with the corresponding User Message Format in appendices to this document as shown in Table IV.

TABLE IV. User Message Format Codes.

Type of Message Format	Code MSB - LSB	Message Format-Dependent Field/Code Reference
TADIL J (J-series message)	0000	TBD
Binary File	0001	Para 5.6.4.1
Variable Message Format (VMF) (K-series message)	0010	Appendix A
National Imagery Transmission Format System (NITFS)	0011	TBD
Forwarded Message	0100	Para 5.6.4.2
United States Message Text Format (USMTF)	0101	Para 5.6.4.3
(DOI 103)	0110	Para 5.6.4.4
Undefined	0111 - 1111	TBD

5.6.4.1 Binary File. The transfer of a binary file or data block is indicated by setting the UMF field to "1" (0001). The block of data being transferred is a "logical binary file" whose format and content is not dictated by the file system or specific software application resident in the interfacing host processors. The binary file data is placed in the User Data portion of the application protocol data unit. The file name is indicated in the File Name field (see para 5.6.8) and the file size is indicated in the Message Size field (see para 5.6.9). Except as indicated below, all other fields in the Message Handling Repeatable Group (R3) are used as defined in Appendix A (VMF). For file transfers, the GPI for the Message Identification Group (G4) shall be set to 0.

5.6.4.2 Forwarded Message. The forwarding of a message is indicated by setting the UMF field to "4" (0100). The forwarded message (including its application header) is placed in the User Data portion of the application protocol data unit. When forwarding a message, all header and message body information of the forwarded message shall not be modified. Except as indicated below, all other fields in the Message

Handling Repeatable Group (R3) are used as defined in Appendix A (VMF). For message forwarding, the GPI for the Message Identification Group (G4) shall be set to 0.

5.6.4.3 USMTF Messages. The format of USMTF messages is defined in MIL-STD-6040. The transfer of a USMTF file or data block is indicated by setting the code field to binary "5" (0101). The block of data being transferred is in USMTF format whose content is not dictated by the file system or software application resident in the interfacing host processors. For User Message Formats of this type the GPI for the Message Identification Group (G4) shall be set to 0.

5.6.4.4 DOI 103 Messages. The transfer of a DOI 103 file or data block is indicated by setting the code field to binary "6" (0110). The block of data being transferred is in USMTF format whose content is not dictated by the file system or software application resident in the interfacing host processors. For User Message Formats of this type the GPI for the Message Identification Group (G4) shall be set to 0.

5.6.5 Functional Area Designator field. This field shall contain a 4-bit binary codeword that identifies the functional area of a specific message using codewords. The Functional Area Designator combined with the Message Number field may be used to point to the applicable message of application processing. The applicable codes for this field depend on the setting of the User Message Format field (paragraph 5.6.4) and are specified in Appendix A as referenced in Table IV.

5.6.6 Message Number field This field shall contain a 7-bit binary codeword that represents the number that identifies a specific message within a functional area (see paragraph 5.6.5). The Message Number value shall range from 1 to 127. The message set depends on the setting of the User Message Format field (paragraph 5.6.4) and is specified in Appendix A as referenced in Table IV.

5.6.7 Message Subtype field This field shall contain a 7-bit binary codeword that represents the number that identifies a specific report within a message. The report set depends on the setting of the User Message Format field (paragraph 5.6.4) and is specified in Appendix A as referenced in Table IV.

5.6.8 File Name. The File Name field shall be a character coded, variable length field of up to 64 7-bit ANSI ASCII characters (448 bits). It indicates the name of the computer file or data block contained in the User Data portion of the application protocol data unit. The last four characters of the field may consist of a period followed by a three-character ending, indicative of the file type (e.g., .txt, .doc, .exe, .bin). Special characters are legal. An ANSI ASCII Delete (1111111) may be used as an end of text marker.

5.6.9 Message Size field. This field shall contain a 20-bit binary number indicating the size, in bytes, of the associated message. Within the user data, a message which is not a multiple of 8 bits, shall be zero-filled so that it becomes a multiple of 8 bits. This field is required when there is more than one occurrence of the Message Handling Group (R3 in Table I).

5.6.10 Operation Indicator field. This field shall be a 2-bit binary codeword, as shown in Table V, indicating the operational function of the message used in support of either an operation, exercise, or simulation.

5.6.11 Retransmit Indicator field. This shall be a one-bit field indicating whether a message is a retransmission. This field set to 1 shall affirm that the message is a retransmission. This field set to 0 shall indicate the negative.

5.6.12 Message Precedence field. This field shall be a 3-bit binary codeword indicating the relative precedence of a message as shown in Table VI.

TABLE V. Operation Indicator Codes.

Operation indicator	Code MSB - LSB
Operation	00
Exercise	01
Simulation	10
Undefined	11

TABLE VI. Message Precedence Codes.

Precedence	Code MSB - LSB	Explanation
Undefined	000-001	
Emergency command	010	Reserved for only the National Command Authority (NCA) and certain designated commanders of Unified and Specified Commands, and then only for certain designated emergency action command and control messages. These messages shall be processed ahead of all other traffic and interrupt lower precedence traffic.
Undefined	011	
Flash	100	Reserved for initial enemy contact messages or operational combat messages of extreme urgency.
Immediate	101	Reserved for messages relating to situations that gravely affect the security of national/allied forces or populace and that require immediate delivery to the addressee(s).
Priority	110	Reserved for messages that requires expeditious action by the addressee(s) and/or furnishes essential information for the conduct of operations in progress when routine precedence will not suffice.
Routine	111	Used for all types of messages that justify transmission by rapid means unless of sufficient urgency to require a higher precedence

5.6.13 Security Classification field. This field shall be a 2-bit codeword indicating the security classification of the message as shown in Table VII.

5.6.14 Control and Release Marking field. This field shall be a 14-bit binary field. It shall be encoded as two 7-bit ANSI ASCII characters indicating the restrictions or requirements for special handling, access control, and releasability of the message. Note: The list of data items for control and release markings was previously documented in DIA Manual 65-19.

TABLE VII. Security Classification Codes.

Classification	Code MSB - LSB
Unclassified	00
Confidential	01
Secret	10
Top secret	11

5.6.15 Originator Date-Time Group (DTG). These fields shall contain date and time information indicating the time, expressed in Zulu (Universal Time Coordinate) Time, that the message was prepared. This group combination shall be 33 bits long and shall contain data fields representing the year, month, day, hour, minute, and seconds of the message. Coding for each data field shall be as shown in Table VIII.

TABLE VIII Date-Time Group Codes.

Element	Code MSB - LSB	Bits
Year	0000000 - 1100011 (0 - 99, where 00-94 equates to 2000 - 2094 95-99 equates to 1995 - 1999)	7
Month	0001-1100 (1 - 12)	4
Day	00001 - 11111 (1 - 31)	5
Hour (24 hour clock)	00000 - 10111 (0 - 23)	5
Minute	000000 - 111011 (0 - 59)	6
Second	000000 - 111011 (0 - 59)	6

5.6.16 DTG Extension field. This field shall be a 12-bit binary field containing a value that uniquely identifies each message. This field is mandatory if more than one message is sent with the same Originator DTG.

5.6.17 Time Perishability DTG. The fields in this group provide the latest time the message is still of value. These fields shall be encoded as specified in paragraph 5.6.15.

5.6.18 Machine Acknowledge Request Indicator field. This field shall be a 1-bit binary codeword indicating whether the originator of a message requires a machine acknowledge for the message. This field set to 1 shall affirm that an acknowledgment is required. This field set to 0 shall indicate that a machine acknowledgment is not required.

5.6.19 Operator Acknowledge Request Indicator field. This field shall be a 1-bit binary codeword indicating whether the originator of a message requires an operator acknowledgment for the message from the recipient. This field set to 1 shall affirm that an operator acknowledgment from the recipient is required. This field set to 0 shall indicate the negative.

5.6.20 Operator Reply Request Indicator field. This field shall be a 1-bit binary codeword indicating whether the originator of a message requires an operator reply to the message. This field set to 1 shall affirm that an operator reply to the message is required. This field set to 0 shall indicate the negative.

5.6.21 Message Acknowledgment DTG. The fields in this group provide the date and time of the original message that is being acknowledged. These fields shall be encoded as specified in 5.6.15.

5.6.22 Receipt/Compliance field. This field shall be a 3-bit binary codeword representing the receipt/compliance (R/C) codes shown in Table IX.

TABLE IX. Receipt/Compliance (R/C) Codes.

Type of Receipt/Compliance	Code MSB - LSB	Used by	Explanation
Undefined	000		
Machine Receipt [MR]	001	Recipient	Automatically generated in response to a machine acknowledge request from the originator to indicate that the original message can be successfully processed at the ultimate destination
Cannot Process [CANTPRO]	010	Recipient	Automatically generated to indicate that an original message cannot be successfully processed at the ultimate destination
Operator Acknowledge [OPRACK]	011	Recipient	A positive operator-generated acknowledgment to indicate receipt of a message at the ultimate destination
Will Comply [WILCO]	100	Recipient	An operator reply generated to indicate that received message is understood and that the ultimate destination will comply
Have Complied [HAVCO]	101	Recipient	An operator reply generated to indicate that received message is understood and that the ultimate destination has complied
Cannot Comply [CANTCO]	110	Recipient	An operator reply generated to indicate that a received message cannot or will not be carried out
Undefined	111		

5.6.23 Cannot Comply (CANTCO) Reason field. This user-defined field shall be a 3-bit binary codeword indicating the reason that a recipient cannot comply with a particular message. The applicable codes for this field depend on the setting of the User Message Format field and are specified in appendices to this document as referenced in Table IV.

5.6.24 Cannot Process (CANTPRO) Reason field. This user-defined field shall be a 6-bit binary codeword indicating the reason that a particular message cannot be processed by a recipient or information addressee.

It shall be used only in R/C messages. The applicable codes for this field depend on the setting of the User Message Format field and are specified in Appendix A as referenced in Table IV.

5.6.25 Reply Amplification field. This field shall be a variable size up to a maximum of 350 bits. It shall be a character-coded field to provide textual data for an amplification of the recipient's reply to a message, if necessary. This field is divided into 50 groups of 7 bits each representing an ANSI ASCII character. Special characters are legal. ANSI ASCII Delete (1111111) may be used as an end of text marker.

5.6.26 Reference Message Data Group. This group is used to reference existing messages that are related to the subject message contained in the User Data portion of the application protocol data unit. The elements of this group are used to uniquely identify a reference message by specifying the originator address group, DTG, FAD, and message number. For example, if the subject message is a response to a previously exchanged request message, then the Reference Message Data Group may contain the originator, DTG, FAD, and message number of the request message.

5.7 Application header formatting rules and construction procedures. The case and condition syntax and procedures tabulated below shall be applied in the formatting and construction of the application header.

5.7.1 Case and conditionality statement syntax. The purpose of the case and conditionality statements is to rigorously and unambiguously define the construction rules for the application header so that it will be possible to achieve consistent construct implementations across multiple systems. They include cases for each use of the application header and the inter-element conditionalities within the application header for basic processing, defaults, legal entries, and special considerations.

5.7.1.1 Logical operators. Natural language does not lend itself to rigorous and unambiguous expression, therefore it is necessary to use well established logical operators to establish precise, mathematical meaning for logical relationships. The logical operators that will be used in this document are:

AND - separates two discrete values and evaluates to true if both of the discrete values are true.
OR - inclusive OR separates two discrete values and evaluates to true if at least one of the discrete conditions is true.
XOR - exclusive OR separates two discrete values and evaluates to true if and only if one, not both, of the discrete conditions is true.
NOT - a simple negation of the condition so that if A is true the NOT A would yield false.

The following truth table (Table X) illustrates the meaning of the logical operator definitions given above. The table shows, for example, that given both "A" and "B" as true, then "NOT A" will yield false. "A AND B" will yield true, "A OR B" will yield true, and "A XOR B" will yield false. "A AND B" in this example represents names or action designators.

TABLE X. Logical Operator Definitions.

A	B	NOT A	A AND B	A OR B	A XOR B
TRUE	TRUE	FALSE	TRUE	TRUE	FALSE
TRUE	FALSE	FALSE	FALSE	TRUE	TRUE
FALSE	TRUE	TRUE	FALSE	TRUE	TRUE
FALSE	FALSE	TRUE	FALSE	FALSE	FALSE

5.7.1.2 Application. Case and conditionality statements are used only to restrict the structure of the application header to a well-defined subset of the possible legal configurations that are specified by the application rules of application header construction.

5.7.1.3 Reserved words. Case statements reserved words that will be used in this document are:

CASE -	Identifies the title (purpose) under which the statement is defined.
END CASE -	Ends the case statement.
IF...THEN...ELSE -	Describes conditions under which statements are valid. The statement always starts with "IF" and shall end with "ENDIF". An "IF" statement selects for execution, one or none of the enclosed sequence of statements depending on the (truth) value of one or more corresponding conditions.
ELSIF -	This keyword is used to extend the flexibility of the "IF...THEN...ELSE" construct. It is used when multiple conditions need to be evaluated in order to determine a logic path. Multiple "ELSIF" conditions are permitted. The general form is: IF *condition* THEN *sequence of statements* ELSIF *condition* THEN *sequence of statements* ELSE *sequence of statements* ENDIF
ENDIF -	Ends condition statement.

5.7.1.4 Cases. Case statements are a form of expressing a condition. The construct in this document indicates there shall be at least two alternatives, and only one alternative at a time shall be valid. Case statements are used when a condition statement becomes too complex. A case statement may include an "XOR" (Exclusive OR) operator when it is possible to accomplish the same purpose in one or more ways. A case statement may also include an "OR" operator when any, or all, of several data elements can be used.

5.7.1.5 Conditions. Condition statements define the conditions under which a data group, data element, or value in a data element may be used. The condition statement is very structured in its use. The following is an example of the format of a conditional statement:

```
IF (condition)
  THEN  (Sequence of Statements)
  ELSIF (condition)
  THEN (Sequence of Statements)
  ELSE (Sequence of Statements)
ENDIF
```

For the execution of an "IF" statement, the condition specified after "IF", and any conditions specified after other keywords are evaluated in succession until one evaluates to "TRUE", or all conditions are evaluated and yield "FALSE". If one condition evaluates to "TRUE", then the corresponding sequence of statements are executed. If all conditions evaluate to “FALSE” and an “ELSE” statement is present, the sequence of statements associated with the “ELSE” are executed; otherwise, none of the sequence statements are executed.

5.7.1.6 Defaults. Defaults will be defined only if the receiving system's default value is of concern to the interface.

5.7.1.7 Expected Response. The expected response by the system receiving an application header will depend on the content of the header fields and shall be stated as it relates to the case and conditionality statements for the header.

5.7.1.8 Special Considerations. Special considerations cover those exceptions that cannot be defined under the preceding paragraphs.

5.7.1.9 Application header receipt. Upon receipt of an application header, a system shall validate the presence of all mandatory groups and fields, determine that all occurrence category conditions are satisfied, and validate the legality of all field entries to determine the legality of the header. This receipt processing is required for each header. It is the responsibility of the receiving system to apply default values, if specified, in those fields unspecified by the transmitting system.

5.7.2 Cases and conditions for the application header.

5.7.2.1 Cases.

5.7.2.1.1 Case 1: Message is an original message.

THIS CASE REQUIRES
GPI for Group 8 [Response Data Group] shall be "0" (Not Present)
AND Message body shall be present
END CASE

5.7.2.1.2 Case 2: Message is an acknowledgment message.

THIS CASE REQUIRES
GPI for Group 8 [Response Data Group] shall be "1" (Present)
AND GPI for Group 6 [Perishability DTG Group] shall be "0" (Not Present)
AND GPI for Group 7 [Acknowledgment Request Group] shall be "0" (Not Present)
AND Message body shall not be present
END CASE

5.7.2.1.3 Case 3: Message is a Computer File/Data Block Transfer.

THIS CASE REQUIRES
UMF shall be "1" (Binary File)
AND GPI for Group 4 [Message Identification Group] shall be "0" (Not Present)
END CASE

5.7.2.1.4 Case 4: Message is a Forwarded Message.

THIS CASE REQUIRES
UMF shall be "4" (Forwarded Message)
AND GPI for Group 4 [Message Identification Group] shall be "0" (Not Present)
AND User Data shall be present
END CASE

5.7.2.1.5 Case 5: Message was compressed.

THIS CASE REQUIRES
FPI for Data Compression shall be "1" (Present)
AND GPI for Group 8 [Response Data Group] shall be "0" (Not Present)
AND User Data shall be present
END CASE

5.7.2.2 Conditions.

5.7.2.2.1 Condition 1: IF the Originator Address Group is not present, THEN an acknowledgment shall not be requested.

IF GPI for G1 [ORIGINATOR ADDRESS GROUP] is set to "0" (Not Present)
THEN GPI for G7 [ACKNOWLEDGMENT REQUEST GROUP] shall be set to "0" (Not Present)
ENDIF

5.7.2.2.2 Condition 2: IF the Bit-coded Unit Reference Number is present, THEN the Character-coded Unit Name shall not be present in the same address group.

IF FPI for Unit Reference Number is set to "1" (Present)
THEN FPI for Unit Name shall be set to "0" (Not Present)
ENDIF

5.7.2.2.3 Condition 3: IF the Bit-coded Unit Reference Number is not present, THEN the Character-coded Unit Name shall be present in the same address group.

IF FPI for Unit Reference Number is set to "0" (Not Present)
THEN FPI for Unit Name shall be set to "1" (Present)
ENDIF

5.7.2.2.4 Condition 4: IF the Character-coded Unit Name is present, THEN the Bit-coded Unit Reference Number shall not be present in the same address group.

IF FPI for Unit Name is set to "1" (Present)
THEN FPI for Unit Reference Number shall be set to "0" (Not Present)
ENDIF

5.7.2.2.5 Condition 5: IF the Character-coded Unit Name is not present, THEN the Bit-coded Unit Reference Number shall be present in the same address group.

IF FPI for Unit Name is set to "0" (Not Present)
THEN FPI for Unit Reference Number shall be set to "1" (Present)
ENDIF

5.7.2.2.6 Condition 6: IF the Recipient Address Group is not present, THEN the Information Address Group shall not be present AND message shall be a broadcast transmission.

IF GPI for R1 [Recipient Address Group] is set to "0" (Not Present)
THEN GPI for R2 [Information Address Group] shall be set to "0" (Not Present)
AND message shall be broadcast in accordance with lower layer broadcast protocols
ENDIF

5.7.2.2.7 Condition 7: IF Message Handling Group (R3) repeats, THEN Message Size shall be present.

IF there is more than one occurrence of Message Handling Group (R3)
THEN FPI for Message Size shall be set to “1” (Present)
ENDIF

5.7.2.2.8 Condition 8: IF the message is not a CANTCO, THEN CANTCO Reason Code cannot be present.

IF Receipt/Compliance is NOT set to "6" (CANTCO)
THEN FPI for CANTCO Reason Code shall be set to "0" (Not Present)
ENDIF

5.7.2.2.9 Condition 9: IF the message is not a CANTPRO, THEN CANTPRO Reason Code cannot be present.

IF Receipt/Compliance is NOT set to "2" (CANTPRO)
THEN FPI for CANTPRO Reason Code shall be set to "0" (Not Present)
ENDIF

5.7.2.2.10 Condition 10: IF the message is not an Operator Reply, THEN Reply Amplification cannot be present.

IF Receipt/Compliance is NOT set to "4" (WILCO)
AND Receipt/Compliance is NOT set to "5" (HAVCO)
AND Receipt/Compliance is NOT set to "6" (CANTCO)
THEN FPI for Reply Amplification shall be set to "0" (Not Present)
ENDIF

5.7.2.2.11 Condition 11: IF the Machine Acknowledgment OR Operator Acknowledgment OR Operator Reply Request Indicators are set to '1", THEN the Originator DTG group shall be present.

IF Machine Acknowledgment Request Indicator is set to "1"
OR Operator Acknowledgment Request Indicator is set to "1"
OR Operator Reply Request Indicator is set to "1"
THEN GPI for Group 5 [Originator DTG] shall be set to "1" (Present)
ENDIF

5.7.2.2.12 Condition 12: IF the Originator DTG is ambiguous, THEN the DTG Extension shall be present.

IF Originator DTG is equal to the Originator DTG of a previously sent message
THEN FPI for DTG Extension shall be set to "1" (Present)
AND DTG Extension shall be unique
ENDIF

5.7.2.3 Defaults. Default values for Message Precedence, Acknowledgments, and Message Classification shall be user defined.

5.7.3 Expected Response.

5.7.3.1 Machine Acknowledge Requested:

IF Machine Acknowledge Requested Indicator is set to “1"
THEN Response shall have Receipt/Compliance set to "1" (Machine Acknowledge)
OR Response shall have Receipt/Compliance set to "2" (CANTPRO)
ENDIF

5.7.3.2 Operator Acknowledge Requested:

IF Operator Acknowledge Requested Indicator is set to "1"
THEN Response shall have Receipt/Compliance set to "3" (Operator Acknowledge)
OR Response shall have Receipt/Compliance set to "2" (CANTPRO)
ENDIF

5.7.3.3 Operator Reply Requested:

IF Operator Reply Requested Indicator is set to "1"
THEN Response shall have Receipt/Compliance set to "4" (WILCO)
OR Response shall have Receipt/Compliance set to "5" (HAVCO)
OR Response shall have Receipt/Compliance set to "6" (CANTCO)
OR Response shall have Receipt/Compliance set to "2" (CANTPRO)
ENDIF

5.7.4 Special Considerations.

5.7.4.1 Perishable Data Check. Discard messages that are too old:

IF GPI for Group 6 [Perishable Data DTG] is set to "1"
AND Group 6 [Perishable Data DTG] is earlier than current DTG
THEN Message data shall be ignored
AND
IF Machine Acknowledgment Request indicator is set to '1"
THEN Response shall have Receipt/Compliance set to "2" (CANTPRO) with a CANTPRO Reason Code set to "25" (Message to Old Based On Perishability)
ENDIF
ENDIF

5.7.5 User data. This portion of the application protocol data unit shall contain the application process messages or data.

5.7.5.1 Message Acknowledgments. A message acknowledgment is a report back to the originator on a receiving station's receipt of and intentions with respect to a received message. Acknowledgment requests are directed to message recipients only; they do not apply to information addressees. Acknowledgments are implemented in the acknowledgment header format.

5.7.5.2 Acknowledgment header format. Machine and operator acknowledgment request indicators are used by the originator to request a specific response from the receiving station, or appropriate operator, for selective acknowledgment of message receipt and compliance with the message instructions. A receiving station responds to the originator by sending an acknowledgment header. Depending on the type of acknowledgment request from the originator or the type of system involved, the response may be machine-generated (automatic) or operator-generated (manual) or a combination of both. The acknowledgment header consists of the following groups and fields (see also paragraph 5.7.2.1.2):

a. Acknowledgment originator address group (G1)

b. Acknowledgment recipient address group (R1)

c. Message handling group (R3). Within message handling group, the response data group (G8), shall include the DTG of message being acknowledged and the R/C field.

5.7.5.3 Message accountability. The application header shall be used for the detection of duplicate messages and to associate an acknowledgment header with the original requesting message. The received fields of originator address group, originator DTG, and DTG Extension are used to uniquely identify a message. The originator shall guarantee the uniqueness of this combination of fields by ensuring that no original message is transmitted having the same DTG and DTG Extension.

a. Duplicate message check. The originator address group, originator DTG, and DTG Extension fields of each received message are compared with the corresponding fields of previous messages. Any duplicate messages (including retransmitted messages) shall be acknowledged if required and shall otherwise be ignored (discarded).

b. Acknowledgment matching. The originator address group, DTG of message being acknowledged, and DTG Extension fields of each received acknowledgment header are compared with the recipient address group, Originator DTG, and DTG Extension fields of previously originated messages that require acknowledgment. The message handling application will maintain DTG, Originator Address, and DTG Extension information about previously received messages for a period of time long enough to exhaust the message originator's retransmission timers. Acknowledgment headers that match original messages shall be processed; unmatched Acknowledgment headers shall be ignored (discarded).

5.7.5.4 Message retransmission. A retransmission capability shall be provided to enable the automatic retransmission of a message that has not received an acknowledgment when one was requested. Automatic Retransmissions shall only apply if a machine acknowledgment is requested. Any Application layer acknowledgment precludes message retransmission.

a. The number of automatic retransmissions shall be selectable with a range of 0 to 3. The parameter governing the number of retransmissions shall be separately selectable for each Originator DTG/DTG Extension combination.

b. A timer shall be provided to schedule the automatic retransmission. Expiration time shall be selectable with a range of 5 to 600 seconds. Upon expiration of the timer, provided an acknowledgment has not been received, the message shall be retransmitted by the originating system. If an acknowledgment is not received prior to expiration of the timer on the final retransmission, the operator shall be notified. Messages containing perishable data and requiring acknowledgment shall have the Perishability DTG set to a time later than the retransmit timeout.

5.7.5.5 Message concatenation. This allows chaining of messages together, with abbreviated message headers, to decrease overhead and facilitate more efficient communications. When concatenating messages, the ORIGINATOR, RECIPIENT, and INFORMATION ADDRESS GROUPS shall be common for all concatenated messages and therefore will appear once in the Application Header. The MESSAGE HANDLING GROUP [R3] shall repeat to specify information about each concatenated message. Each occurrence of the MESSAGE HANDLING GROUP [R3] shall be matched to its respective message in the USER DATA portion. The total size of a concatenated message block, including application header, shall not exceed 1 megabyte (1,048,575 bytes).

5.8 Processing Factors.

5.8.1 Application process. The application process shall provide the application layer the bit-oriented or character-oriented messages that satisfy information exchange requirements.

5.8.2 Message formats. The message formats shall be user-defined. The user message indicator field in the application layer header provides a flag that specifies the message format that is being used in the application process.

5.8.3 Lower layer interactions. Several application layer fields are used to indicate a desire for special handling or quality of service from the lower layer protocols. The lower layer protocols should use these indications as guidance for providing the requested service.

5.8.3.1 Security Classification. This application layer field as described in Table VII provides the desired guidance to the lower layers for establishing security classification.

5.8.3.2 Message Precedence. This application layer field as described in Table VI provides the desired guidance to the lower layers for setting message transmission precedence.

5.8.3.3 Quality of Service. The Quality of Service (QOS) desired by the application layer is derived from multiple fields: Message Size, Message Precedence, Originator DTG, Time Perishability DTG, and Machine Acknowledgment Request Indicator. The following QOS parameters are mapped from these application layer fields:

a. Normal/High Throughput

b. Normal/Low Delay

c. Normal/High Reliability

These QOS parameters are based on the following conditions:

```
IF (Time Perishability DTG - Originator DTG) <= Perish
      AND Precedence <> Routine
THEN Delay = Low
ELSIF (Time Perishability DTG - Originator DTG) > Perish
      AND Message Acknowledgment Indicator = 1
      AND Message Size >= Message Size Threshold
THEN Reliability = High
ELSIF Message Size >= Message Size Threshold
      AND Delay = Normal
      AND Reliability = Normal
THEN Throughput = High
ELSE Delay = Normal,
AND Throughput = Normal
AND Reliability = Normal
ENDIF
```

where:

Message Size Threshold has a default value of (3*480 = 1440) bytes. Message Size Threshold shall be a parameter with a range of 1 to 1,048,575 bytes.

Perish shall be a parameter with a range of 1 to 10800 seconds.

5.8.3.4 Originator Address Group. This application layer group as described in paragraph 5.6.3 provides guidance to the lower layers for the originator address.

5.8.3.5 Recipient Address Group. This application layer group as described in paragraph 5.6.3 provides guidance to the lower layers for the destination address.

5.8.3.6 Message broadcast indicators. The lack of a Recipient Address group and the existence of an Information Address group as described in paragraph 5.6.3 provides guidance to the lower layers for broadcast options.

5.8.3.7 Destination port number. Port number 1581 (decimal) has been registered with the Internet Assigned Number Authority to indicate MIL-STD-47001 application layer processing. This 16-bit port number should be used by the lower layer protocol to identify the receiving application layer process as the MIL-STD-2045-47001 protocol.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Subject term (key word) listing. The following key words and phrases apply to this MIL-STD.

Application Header
Application Layer
CANTCO
CANTPRO
CASE
IF
Intranet
Message
MIL-STD-188-220
Selective Directed Broadcast
THEN
VMF TIDP

6.2 Issue of the DoD Index of Specifications and Standards When this military standard is used in procurement, the applicable issue of the DoDISS shall be cited in the solicitation.

APPENDIX A

APPLICATION HEADER FIELDS AND CODES FOR VARIABLE MESSAGE FORMATS

A.1 General

A.1.1 Scope. This appendix contains definition of the Variable Message Format (VMF) codes and values for application header fields that are dependent on the setting of the User Message Format field.

A.1.2 Application. This appendix is conditional based on the setting of the User Message Format field as indicated in paragraph 5.6.4 and Table IV of this standard. If the User Message Format field is set to "A2", this appendix is mandatory for application headers pertaining to VMF messages. For all other settings of User Message Format field, this appendix is optional.

A.2 Applicable Documents.

GOVERNMENT STANDARDS

None.

OTHER GOVERNMENT DOCUMENTS

Joint Interoperability of Tactical Command and Control Systems, Variable Message Format Technical Interface Design Plan (Test Edition) (VMF TIDP TE)

VOL I *VMF Overview*

VOL II *Data Element Dictionary*

VOL III *K-Series Message Formats*

Variable Message Format Interface Operating Procedures (VMF IOP)

A.3 Codeword Tables.

A.3.1 Unit Reference Number codewords. The VMF codes for the Unit Reference Number field shall be in accordance with the Joint VMF TIDP and assigned in accordance with the VMF IOP.

A.3.2 Functional Area Designator codewords. The VMF codes for the Functional Area Designator (FAD) field are defined in Table A-1. The FAD field is defined in paragraph 5.6.5 of this document. The combination of the FAD field and the Message Number field shall point to the message number that appears in the Message Descriptions of the Joint VMF TIDP, Volume III, Annex A. For example, if the USER MESSAGE FORMAT = 2 (VMF K-Series), FAD = 7 (Combat Service Support), and MESSAGE NUMBER = 1 (Medical Evacuation Request), then this corresponds to message number K07.1, Table A-1 ‘Message and Purpose Table’ of the Joint VMF TIDP Volume III.

A.3.3 Message Number codewords. The VMF codes for the Message Number field are listed in Volume III of the Joint VMF TIDP. The Message Number field is defined in paragraph 5.6.6 of this document.

A.3.4 Message Subtype codewords. The VMF codes for the Message Subtype field are listed in Volume II of the Joint VMF TIDP, Data Unit Identifier (DUI) REPORT/MESSAGE/OVERLAY TYPE. The Message Subtype field is defined in paragraph 5.6.7 of this document.

TABLE A-1. Functional Area Designator Codewords.

Functional Area	Code MSB - LSB
Network Control	0000
General Information Exchange	0001
Fire Support	0010
Air Operations	0011
Intelligence Operations	0100
Land Combat Operations	0101
Maritime Operations	0110
Combat Service Support	0111
Special Operations	1000
JTF Operations Control	1001
Air Defense/Air Space Control	1010
Undefined	1011-1111

A.3.5 CANTCO Reason codewords. The VMF codes for the CANTCO Reason field are defined in Table A-2. The CANTCO Reason field is defined in paragraph 5.6.23 of this document.

TABLE A-2. CANTCO Reason Codewords.

CANTCO reason	Code MSB - LSB
Communications problem	000
Ammunition problem	001
Personnel problem	010
Fuel problem	011
Terrain/Environment problem	100
Equipment problem	101
Tactical Situation problem	110
Other	111

A.3.6 CANTPRO Reason codewords. The VMF codes for the CANTPRO Reason field are defined in Table A-3. The CANTPRO Reason field is defined in paragraph 5.6.24 of this document.

A.3.7 Data Field Construction Procedures for VMF Messages/User Data. The following construction procedures prescribe the sequence in which the message fields are linearly joined to create the user data. The message is constructed with elemental data fields ordered as specified in the message descriptions provided in Annex A of Volume III of the Joint VMF TIDP. The data elements for the messages are also as specified in Volume II of the Joint VMF TIDP. There are two representations for data elements: 7-bit ANSI ASCII characters and binary numbers. All fields shall be joined LSB first. The LSB of the first data field or field/group indicator shall be LSB-justified within the first byte of the message buffer. The LSB of each successive data field or field/group indicator shall be the LSB of the user data shown in Figure 2 of this document. The characters in a literal field are joined such that the LSB of the first character immediately follows the MSB of the previous field. The LSB of the second character immediately follows the MSB of the first character. This pattern is repeated until all characters of the field are joined.

TABLE A-3. CANTPRO Reason Codes.

CANTPRO CODE	CANTPRO Reason	Code MSB LSB
0	Undefined	000000
1	Field content invalid	000001
2	CANTPRO CODE 2 -Message incorrectly routed	000010
3	CANTPRO CODE 3 -Address inactive	000011
4	CANTPRO CODE 4 -Reference point unknown to receiving agency	000100
5	CANTPRO CODE 5 -Fire units shall be controlled by receiving agency	000101
6	CANTPRO CODE 6 -Mission shall be controlled by receiving agency	000110
7	CANTPRO CODE 7 -Mission number unknown by receiving agency	000111
8	CANTPRO CODE 8 -Target number unknown by receiving agency	001000
9	CANTPRO CODE 9 -Schedule number unknown by receiving agency	001001
10	CANTPRO CODE 10 -Incorrect controlling address for a given track number	001010
11	CANTPRO CODE 11 -Track number not in own track file	001011
12	CANTPRO CODE 12 -Invalid according to given field	001100
13	CANTPRO CODE 13 -Message cannot be converted	001101
14	CANTPRO CODE 14 -Agency file full	001110
15	CANTPRO CODE 15 -Agency does not recognize this message number	001111
16	CANTPRO CODE 16 -Agency cannot correlate message to current file content	010000
17	CANTPRO CODE 17 -Agency limit exceeded on repeated fields or groups	010001
18	CANTPRO CODE 18 -Agency computer system inactive	010010
19	CANTPRO CODE 19 -Addressee unknown	010011
20	CANTPRO CODE 20 - Can’t forward (agency failure)	010100
21	CANTPRO CODE 21 - Can't forward (link failure)	010101
22	CANTPRO CODE 22 -Illogical juxtaposition of header fields	010110

TABLE A-3. CANTPRO Reason Codes (continued).

23	Cannot uncompress Unix (LCZ) compressed data	010111
24	Cannot uncompress LZ-77 compressed data	011000
25	Message too old, based on Perishability	011001
26-63	Undefined	011010-111111

APPENDIX B

EXAMPLE OF APPLICATION LAYER PDU AND VMF MESSAGE CONSTRUCTION

B.1 General.

B.1.1 Scope. This appendix provides examples illustrating the construction of the Application Layer Protocol Data Unit (PDU) and VMF Message data buffers (or streams).

B.1.2 Application. This appendix is not a mandatory part of MIL-STD-2045-47001. The information contained herein is preliminary and intended for guidance only.

B.2 Example Application Layer PDU Construction. This section provides an example illustrating the construction of the Application Layer PDU data buffer (or stream).

B.2.1 Application Layer Data Exchange. The relationship of the Application Layer to other communication layers is shown in Figure B-1. A layered communication model is used in this example for consistency with the principles of the ISO OSI reference model. The model discussed here is tailored to focus attention specifically on the Application Layer, and the data it produces. A user of the Application Layer exchanges user data with its peer at another node by sending and receiving the User Data via the Application Layer. The Application Layer sends and receives the User Data transparently by producing and exchanging an Application Layer Protocol Data Unit (PDU) with its peer at another node. The Application Layer PDU consists of the Application Header concatenated with the User Data, and is sent and received via lower communication layers. The lower communication layers send and receive the User Data transparently over a variety of communications media.

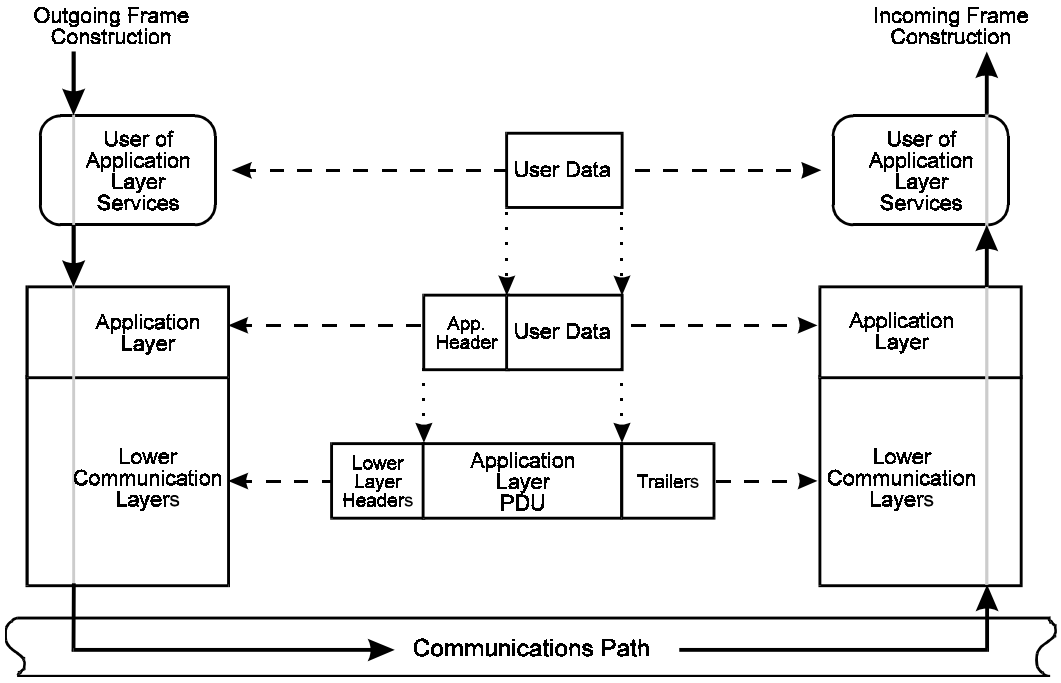

FIGURE B-1. Application layer interaction with other communications layers.

The format of the Application Layer PDU is defined in terms of the actual data buffer or data stream used to exchange the PDU between the Application Layer and the lower communication layers. The rationale for using the PDU's data buffer/stream to define the format is 1) for consistency with industry standard commercial communications hardware and software (e.g., UNIX implementations of TCP/IP), which exchange data with other software when sending or receiving as a buffer or stream of octets; 2) to provide a definition independent of the specifics of any other communication layer, consistent with the OSI ISO model principle of making communication layers independent; and 3) to avoid differences in the bit representations used to implement communications on different media. For example, on Ethernet LAN media each octet is sent least significant bit first, but on FDDI media each octet is sent most significant bit first. To achieve a universal definition of the PDU format, its representation is defined independent of the other communication layers. The relationship of the Application Layer PDU's data buffer/stream to the Application Layer is depicted in Figure B-2. The Application Layer PDU is defined as a buffer or stream of octets. The rational for treating the PDU as a series of octets is for consistency with the way communications data is handled by industry standard commercial communications hardware and software and for independence from platform-dependent byte ordering issues. The Application Header and the User Data are each individually defined as a series of octets for the same reasons.

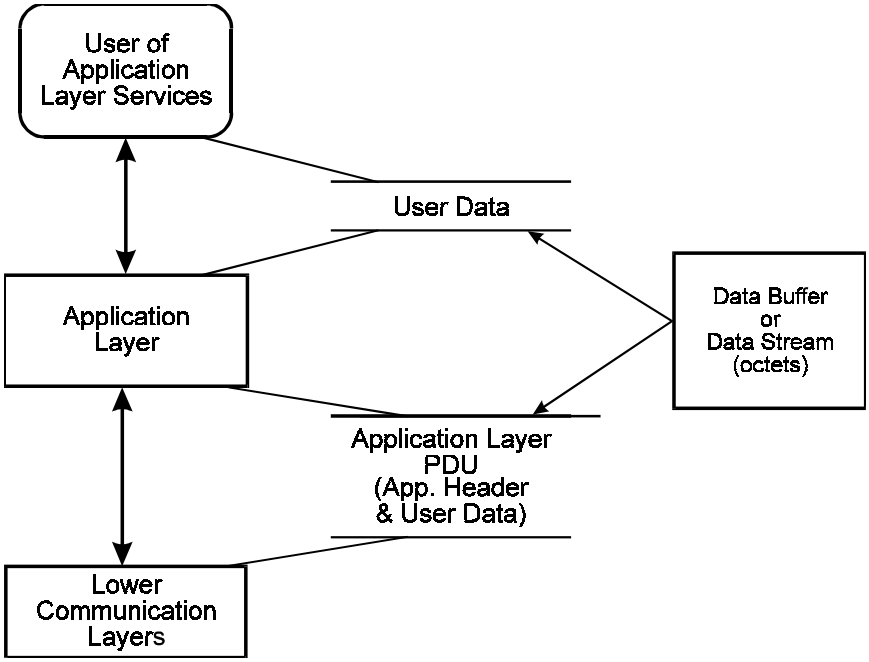

FIGURE B-2. Exchange of application layer PDU between communications layers.

B.2.2 Example. The construction of an Application Layer PDU is illustrated by the example in Table B-1. The first four columns of the table provide a description of each field in the example, the field length in bits, and the value of the field in both decimal and binary representations. The last four columns show the physical encoding of the Application Layer PDU. In the fifth column, Field Fragments, the bits of each field are placed in octets. The bit(s) of each field are positioned in an octet such that the LSB of the field is positioned in the least significant unencoded bit of the octet, the next LSB of the field is placed in the next least significant unencoded bit of the octet, and repeated until all of the bits of the field have been encoded. When an octet is filled before all the bits of a field are encoded, the process is continued encoding the next octet with the remaining bits of the field. This field/octet encoding procedure is performed starting with the first field and octet, and repeated for each successive field and individual octet, in order, until the encoding is completed. When a field has groups, the field encoding procedure is

performed starting with the first group, and repeated for each successive group and individual octet, in order, until the encoding of the field is completed. The Unit Name field illustrates the encoding of a field with groups. Note the LSB of a field or octet is defined as the bit having the weight of 2^0 when the field or octet is represented as a numeric value. X's are used to identify bits that are not associated with the field being encoded. The sixth column, Octet Value - Binary, assembles the bits contributed by successive fields into complete octets, represented in binary. The seventh column, Octet Value - Hexadecimal, represents the octet value in hexadecimal. The last column, Octet Number, numbers the octets from first to last starting with 0.

When all fields have been encoded, any remaining unencoded bits in the last octet are filled with zeroes (zero padded). The Application Header is individually encoded and zero padded. The User Data is individually encoded and zero padded before it is passed to the Application Layer to have the Application Header added.

Unit Name is a variable length field. It can be terminated either with an end of text marker, or by using the maximum number of bits. In this example, the field is terminated with the Application Header end of text marker, the ANSI ASCII Delete character.

The Application Header is followed by the User Data. The User Data is shown as a single 10-octet message to complete the Application Layer PDU.

TABLE B-1. Example Construction of Application Layer PDU.

FIELD				OCTET BUFFER/STREAM			
TITLE	LENGTH (Bits)	VALUE (Dec)	VALUE (Binary) MSB 2^n LSB 2^0	FIELD FRAGMENTS MSB 2^7 LSB 2^0	OCTET VALUE (Binary) MSB 2^7 LSB 2^0	OCTET VALUE (Hex)	OCTET NO
Application Header							
Version	4	1	0001	XXXX0001			
FPI	1	0	0	XXX0XXXX			
Data Compression Type	2	NA					
GPI for Originator Address	1	1	1	XX1XXXXX			
FPI for Unit Reference Number	1	1	1	X1XXXXXX			
Unit Reference Number	24	207	000000000000000011001111	1XXXXXXX	11100001	E1	0
				01100111	01100111	67	1
				00000000	00000000	00	2
				X0000000			
FPI for Unit Name	1	1	1	1XXXXXXX	10000000	80	3
Unit Name (Note 1)	448 max	UNITA					
	7	85	1010101	X1010101			
	7	78	1001110	0XXXXXXX	01010101	55	4
				XX100111			
	7	73	1001001	01XXXXXX	01100111	67	5
				XXX10010			
	7	84	1010100	100XXXXX	10010010	92	6
				XXXX1010			
	7	65	1000001	0001XXXX	00011010	1A	7
				XXXXX100			
End of text marker (ANSI ASCII DEL)	7	127	1111111	11111XXX	11111100	FC	8
				XXXXXX11			
GPI for Recipient Address	1	1	1	XXXXX1XX			
GRI for Recipient Address	1	0	0	XXXX0XXX			
FPI for Unit Reference Number	1	1	1	XXX1XXXX			

Note 1: One and only one of the fields Unit Name and Unit Reference Number are to be present. Unit Name is shown present only for illustrative purposes, and is incorrectly shown with the Unit Reference Number also present.

TABLE B-1. Example Construction of Application Layer PDU (Continued).

FIELD				OCTET BUFFER/STREAM			
TITLE	LENGTH (Bits)	VALUE (Dec)	VALUE (Binary) MSB 2^n LSB 2^0	FIELD FRAGMENTS MSB 2^7 LSB 2^0	OCTET VALUE (Binary) MSB 2^7 LSB 2^0	OCTET VALUE (Hex)	OCTET NO
Unit Reference Number	24	3	000000000000000000000011	011XXXXX	01110111	77	9
				00000000	00000000	00	10
				00000000	00000000	00	11
				XXX00000			
FPI for Unit Name	1	0	0	XX0XXXXX			
Unit Name	448	NA					
GPI for Information Address Group	1	0	0	X0XXXXXX			
GRI for Information Address Group	1	NA					
FPI for Unit Reference Number	1	NA					
Unit Reference Number	24	NA					
FPI for Unit Name	1	NA					
Unit Name	448	NA					
GRI for Message Handling Group	1	0	0	0XXXXXXX	00000000	00	12
User Message Format	4	2	0010	XXXX0010			
GPI for Message Identification Group	1	1	1	XXX1XXXX			
Functional Area Designator	4	2	0010	010XXXXX	01010010	52	13
				XXXXXXX0			
Message Number	7	1	0000001	0000001X	00000010	02	14
FPI for Message Subtype	1	0	0	XXXXXXX0			
Message Subtype	7	NA					
FPI for File Name	1	0	0	XXXXXX0X			
File Name	448	NA					
FPI for Message Size	1	0	0	XXXXX0XX			
Message Size	20	NA					
Operation Indicator	2	1	01	XXX01XXX			
Retransmission Indicator	1	0	0	XX0XXXXX			
Message Precedence Codes	3	2	010	10XXXXXX	10001000	88	15
				XXXXXXX0			
Security Classification	2	0	00	XXXXX00X			
FPI for Control/Release Marking	1	0	0	XXXX0XXX			

TABLE B-1. Example Construction of Application Layer PDU (Continued).

FIELD				OCTET BUFFER/STREAM			
TITLE	LENGTH (Bits)	VALUE (Dec)	VALUE (Binary) MSB 2^n LSB 2^0	FIELD FRAGMENTS MSB 2^7 LSB 2^0	OCTET VALUE (Binary) MSB 2^7 LSB 2^0	OCTET VALUE (Hex)	OCTET NO
Control/Release Marking	14	NA					
GPI for Originator DTG	1	1	1	XXX1XXXX			
Year	7	96	1100000	000XXXXX	00010000	10	16
				XXXX1100			
Month	4	7	0111	0111XXXX	01111100	7C	17
Day	5	3	00011	XXX00011			
Hour	5	16	10000	000XXXXX	00000011	03	18
				XXXXX10			
Minute	6	27	011011	011011XX	01101110	6E	19
Second	6	55	110111	XX110111			
FPI for DTG Extension	1	0	0	X0XXXXXX			
DTG Extension	12	NA					
GPI for Perishability	1	0	0	0XXXXXXX	00110111	37	20
Year	7	NA					
Month	4	NA					
Day	5	NA					
Hour	5	NA					
Minute	6	NA					
Second	6	NA					
GPI for Acknowledgment Request	1	1	1	XXXXXXX1			
Machine ACK. Request Indicator	1	1	1	XXXXXX1X			
Operator ACK. Request Indicator	1	0	0	XXXXX0XX			
Operator Reply Request Indicator	1	0	0	XXXX0XXX			
GPI for Response Data Group	1	0	0	XXX0XXXX			
Year	7	NA					
Month	4	NA					
Day	5	NA					
Hour	5	NA					
Minute	6	NA					

TABLE B-1. Example Construction of Application Layer PDU (Continued).

FIELD				OCTET BUFFER/STREAM			
TITLE	LENGTH (Bits)	VALUE (Dec)	VALUE (Binary) MSB 2^n LSB 2^0	FIELD FRAGMENTS MSB 2^7 LSB 2^0	OCTET VALUE (Binary) MSB 2^7 LSB 2^0	OCTET VALUE (Hex)	OCTET NO
Second	6	NA					
FPI for DTG Extension	1	NA					
DTG Extension	12	NA					
Receipt Compliance	3	NA					
FPI for CANTCO Reason Code	1	NA					
CANTCO Reason Code	3	NA					
FPI for CANTPRO Reason Code	1	NA					
CANTPRO Reason Code	6	NA					
FPI for Reply Amplification	1	NA					
Reply Amplification	350	NA					
FPI for Reference Message Data Group	1	0		XX0XXXXX			
GRI	1	NA					
FPI for Unit Reference Number	1	NA					
Unit Reference Number	24	NA					
FPI for Unit Name	1	NA					
Unit Name	448	NA					
Year	7	NA					
Month	4	NA					
Day	5	NA					
Hour	6	NA					
Minute	6	NA					
Second	6	NA					
FPI for DTG Extension	1	NA					
DTG Extension	12	NA					
Functional Area Designator	4	NA					
Message Number	7	NA					
(Zero Padding)			00	00XXXXXX	00000000	00	21
User Data							
Message 1	10*8						22-31

B.3 Example VMF Message Construction. This section provides an example illustrating the construction of the VMF Message data buffer (or stream).

B.3.1 VMF Message Data Exchange. The relationship of the VMF Messaging Services to other communication layers is shown in Figure B-1. A layered communication model is used in this example for consistency with the principles of the ISO OSI reference model. The model discussed here is tailored to focus attention specifically on VMF Messaging Services, and the data it produces. A user of VMF Messaging Services exchanges Message Content with its peer at another node by sending and receiving the Message Content via the VMF Messaging Services. VMF Messaging Services sends and receives the Message Content by converting the Message Content to Message Data and exchanging the Message Data with its peer at another node. The VMF Message Data is sent and received via lower communication layers. The lower communication layers send and receive the VMF Message Data transparently over a variety of communications media. Note that VMF Messaging Services would ordinarily use Application Layer services from the lower communication layers to send and receive Message Data. The Message Data would then appear in the Application Layer PDU's User Data field.

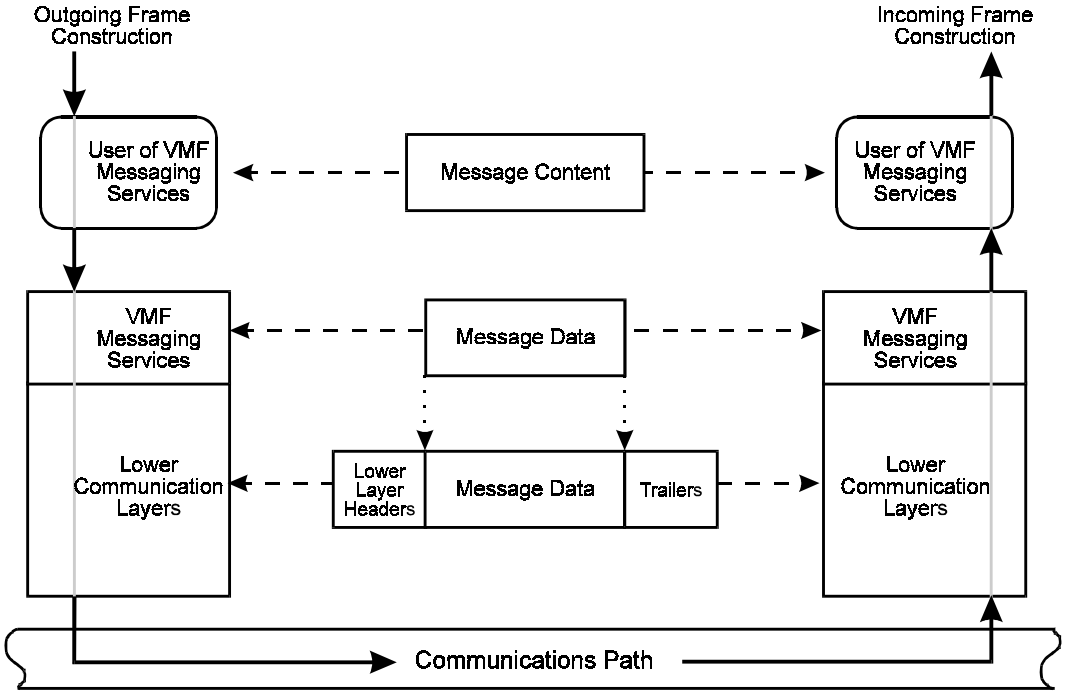

FIGURE B-3. VMF message services interaction with other communications layers.

The format of the Message Data is defined in terms of the actual data buffer or data stream used to exchange the Message Data between the VMF Messaging Services and the lower communication layers. The rationale for using the Message Data's data buffer/stream to define the format is 1) for consistency with industry standard commercial communications hardware and software (e.g., UNIX implementations of TCP/IP), which exchange data with other software when sending or receiving as a buffer or stream of octets; 2) to provide a definition independent of the specifics of any other communication layer, consistent with the OSI ISO model principle of making communication layers independent; and 3) to avoid differences in the bit representations used to implement communications on different media. For example, on Ethernet LAN media each octet is sent least significant bit first, but on FDDI media each octet is sent most significant bit first. To achieve a universal definition of the Message Data format, its representation is defined independent of the other communication layers. The relationship of the Message Data's data

buffer/stream to the VMF Messaging Services is depicted in Figure B-4. The Message Data is defined as a buffer or stream of octets. The rational for treating the Message Data as a series of octets is for consistency with the way communications data is handled by industry standard commercial communications hardware and software and for independence from platform-dependent byte ordering issues.

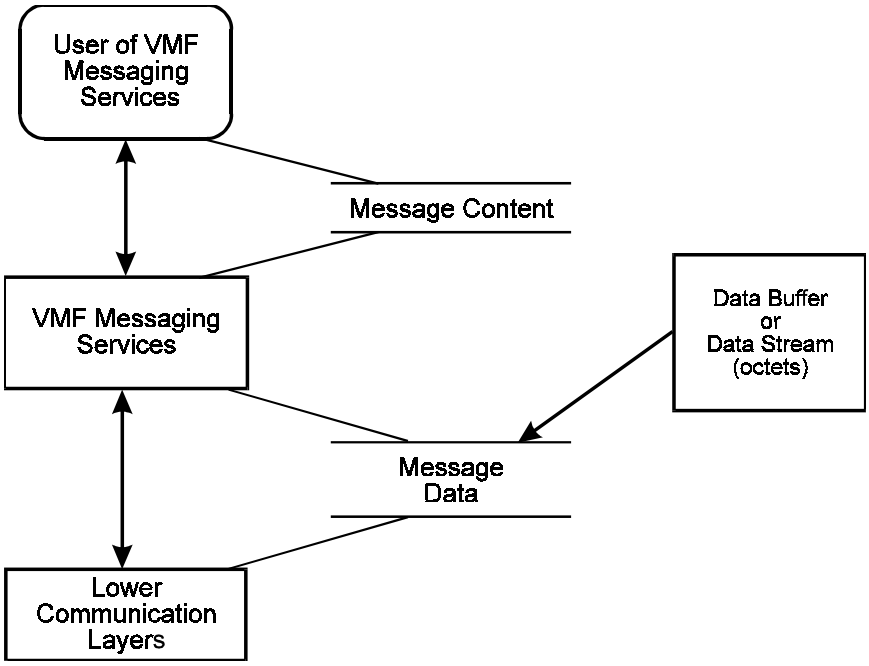

FIGURE B-4. Exchange of message data between communications layers.

B.3.2 Example. The construction of VMF Message Data is illustrated by the example in Table B-2. The first four columns of the table provide a description of each field in the example, the field length in bits, and the value of the field in both decimal and binary representations. The last four columns show the physical encoding of the VMF Message Data. In the fifth column, Field Fragments, the bits of each field are placed in octets. The bit(s) of each field are positioned in an octet such that the LSB of the field is positioned in the least significant unencoded bit of the octet, the next LSB of the field is placed in the next least significant unencoded bit of the octet, and repeated until all of the bits of the field have been encoded. When an octet is filled before all the bits of a field are encoded, the process is continued encoding the next octet with the remaining bits of the field. This field/octet encoding procedure is performed starting with the first field and octet, and repeated for each successive field and individual octet, in order, until the encoding is completed. When a field has groups, the field encoding procedure is performed starting with the first group, and repeated for each successive group and individual octet, in order, until the encoding of the field is completed. The Target Number field illustrates the encoding of a field with groups. Note the LSB of a field or octet is defined as the bit having the weight of 2^0 when the field or octet is represented as a numeric value. X's are used to identify bits that are not associated with the field being encoded. The sixth column, Octet Value - Binary, assembles the bits contributed by successive fields into complete octets, represented in binary. The seventh column, Octet Value - Hexadecimal, represents the octet value in hexadecimal. The last column, Octet Number, numbers the octets from first to last starting with 0.

When all fields have been encoded, any remaining unencoded bits in the last octet are filled with zeroes (zero padded). Each VMF Message is individually encoded and zero padded.

TABLE B-2. Example Construction of VMF Message Data.
(Sample message is from the VMF TIDP-TE, Volume III, Reissue 2, August 1996.)

FIELD				OCTET BUFFER/STREAM			
TITLE	LENGTH (Bits)	VALUE (Dec)	VALUE (Binary) MSB 2^n LSB 2^0	FIELD FRAGMENTS MSB 2^7 LSB 2^0	OCTET VALUE (Binary) MSB 2^7 LSB 2^0	OCTET VALUE (Hex)	OCTET NO
Check Fire Type	3	0	000	XXXXX000			
Check Fire/Cancel Check Fire Command	3	1	001	XX001XXX			
FPI	1	1	1	X1XXXXXX			
Group 1	7	65 (A)	1000001	1XXXXXXX	11001000	C8	1
				XX100000			
Group 2	7	66 (B)	1000010	10XXXXXX	10100000	A0	2
				XXX10000			
Group 3	14	31	00000000011111	111XXXXX	11110000	F0	3
				00000011	00000011	03	4
				XXXXX000			
FPI (Observer Unit Reference Number)	1	0	0	XXXX0XXX			
Observer Unit Reference Number	24	NA					
FPI (First Unit Unit Reference Number)	1	0	0	XXX0XXXX			
First Unit Unit Reference Number	24	NA					
GPI (DTG)	1	0	0	XX0XXXXX			
Effective Hour	5	NA					
Effective Minute	6	NA					
Effective Second	6	NA					
FPI	1	0	0	X0XXXXXX			
Launcher Message Sequencing Number	7	NA					
(Zero Padding)	1	0	0	0XXXXXXX	00000000	00	5

APPENDIX C

SEGMENTATION/REASSEMBLY PROTOCOL

C.1 General.

C.1.1 Scope. Segmentation/reassembly is a protocol intended for use with certain military applications running over UDP. Data transfers larger than the maximum segment size (MSS) permitted for UDP shall be segmented and reassembled in accordance with the procedures set forth in the following paragraphs. Data transfers that are smaller than the MSS do not require segmentation/reassembly and do not carry the segmentation/reassembly header unless an end-to-end acknowledgment is required.

C.1.2 Application. This appendix is a mandatory part of MIL-STD-2045-47001. The segmentation and reassembly protocol shall be supported within end systems.

C.2 Applicable Documents.

RFC 791	Internet Protocol -- DARPA Internet Protocol Specification
RFC 896	User Datagram Protocol
RFC 1122	Requirements for Internet Hosts -- Communication Layers

C.3 Overall Operation. The data transfers, which are larger than the designated MSS, shall be segmented by the source device prior to transmission, and reassembled at the destination device prior to delivery to the application. An end-to-end acknowledgment shall be employed to ensure reliable delivery of all segments in a connectionless transport environment.

C.3.1 Maximum Segment Size. The MSS shall be calculated using the equation below with the following variables as defined.

MMTU	:	Minimum Data Transfer Unit size of the Internet
SH	:	Segmentation/Reassembly header size
UDP	:	UDP header size
IP	:	IP header size

MSS = MMTU - (SH + UDP + IP)

It is desirable that IP datagrams, which will be transmitted across multiple subnetworks, do not exceed 576 octets. A MSS of 496 octets will assure that IP fragmentation will not occur at IP router/gateway devices. The following components take on maximized constant values based on the definitions provided within this appendix:

SH	= 12 octets.
UDP	= 8 octets
IP	= 60 octets

C.3.2 End-to-End Acknowledgment. A partial acknowledgment scheme shall be employed in which correctly received segments are acknowledged, even if all segments comprising a data transfer have not been received. Every data segment shall contain a last segment number from which the destination device may estimate the time required to receive all segments of a given data transfer. A receive timer is set during which the receiving unit is waiting for the expected segments of a data transfer to be arrived correctly. When this timer expires, all segments correctly received shall be acknowledged through a bit map in the segmentation/reassembly header. Upon successful receipt of all segments, the data transfer

shall be reassembled and transferred to the application layer. The source device shall only retransmit those segments that the receiver indicates are missing (via Partial Acknowledgment).

C.3.3 Interface with Other Layers. The segmentation/reassembly protocol interfaces with the application layer protocol (ALP) and the protocol in the next layer down, which is the User Datagram Protocol (UDP) in the Transport Layer. The parameters exchanged between both the upper and lower layer protocols are the same as the parameters defined by the UDP upper layer protocol interface. Two of the UDP-specified interface parameters are the source and destination ports. If the segmentation/reassembly header is present, the destination port number shall be a well-known, unique port number (1624). The source port number provided to UDP shall be the same port number provided by the upper layer protocol to the segmentation/reassembly protocol. If the segmentation/reassembly header is not present, the source and destination port numbers provided to UDP shall be the same as those provided by the upper layer protocol to the segmentation/reassembly protocol.

C.3. Source Device Procedures (Segmentation). All data transfers received from the application which exceed the MSS shall be segmented. The data transfer is segmented and a segmentation/reassembly header is appended to each segment. A serial number shall be assigned and copied into the header of each segment of that data transfer. Each information segment is then sequentially sent starting with segment number equal to 1. The originator shall indicate in the segmentation header whether the data transfer requires an end-to-end acknowledgment (Type field = 000) or does not require an end-to-end acknowledgment (Type field = 010). A retransmission timer shall be used for segment retransmission when end-to-end acknowledgment is invoked. If the retransmission timer expires without the receipt of at least a partial acknowledgment, an Acknowledgment Request shall be issued to the recipient requesting for segments acknowledgment status. If no response to the Acknowledgment Request, the source device shall resend the Acknowledgment Request. If no response to the Acknowledgment Request after N number of tries, the data transfer shall be aborted and an error indication shall be returned to the upper layer process or application. If no end-to-end-acknowledgment is needed the originator shall assume the transmission completed successfully when the retransmission timer expires.

C.3.5 Destination Device Procedures (Reassembly). Upon receipt of a segment of a new data transfer, the recipient shall set an accumulation timer during which it expects to receive coming segments from the sender. If the accumulation timer expires before receiving all expected segments, a partial Acknowledgment (100) shall be sent to the sender indicating in the segment Acknowledgment bit map which segments of the data transfer have been received correctly. Otherwise, the timer shall be stopped. For a data transfer which requires an end-to-end acknowledgment, a Partial Acknowledgment or a Complete Acknowledgment shall be sent to the sender when all expected segments of the data transfer have been received correctly.

The recipient shall accumulate segments of a data transfer with the same serial number from the same source IP address and reassemble that data transfer when all segments have been successfully received, using segment numbers to indicate segment position relative to the whole data transfer. Segmentation/reassembly headers shall be removed. The whole data transfer is then passed to the upper layer process indicated by the port number.

C.4 Segmentation/Reassembly Protocol Data Unit Format

C.4.1 Common Segmentation/Reassembly Header. Figure C-1 depicts the Segmentation/Reassembly header that precedes all protocol data units (PDUs) defined in this appendix.

C.4.1.1 Source Port. This 16-bit port number identifies the originating upper layer process to which a reply should be addressed.

Source Port			Destination Port
Type	HLEN	P/F	Serial Number

FIGURE C-1: Segmentation/reassembly header.

C.4.1.2 Destination Port. This 16-bit port number identifies the receiving upper layer process. The Internet Address Numbering Authority has port number 1624 (decimal) registered for the Segmentation/Reassembly protocol (keyword: udp-SR-port).

C.4.1.3 Type. This field identifies the type of header in use in accordance with the three-bit sequences below.

Bits	Decimal Value	Interpretation
000	0	End-to-end Acknowledgment required
010	2	End-to-end Acknowledgment not required
100	4	Partial Acknowledgment
110	6	Complete Acknowledgment Throughout Appendix
001	1	Abort Request
101	5	Abort Confirm
011	3	Acknowledgment request
111	7	Undefined

C.4.1.4 Header Length (HLEN). This 4-bit field indicates the total length of the segmentation/reassembly header in 32-bit words.

C.4.1.5 Poll / Final (P/F). This 1-bit field is used to request an immediate response.

a. When a Data segment is received with the P/F bit set to “1”, the receiving unit shall immediately respond with a Partial Acknowledgment Throughout Appendix, or a Complete Acknowledgment with P/F bit set to “1”.

b. When an Abort Request segment is received with the P/F bit set to “1”, the receiving unit shall immediately return an Abort Confirm segment with P/F bit set to “1”.

C.4.1.6 Serial Number. This 16-bit number is assigned by the originating device and uniquely identifies the data transfer of which this segment forms a part.

C.4.2 Data Segment. Data transfers that are larger than the MSS are segmented and sent to the destination addressee as the data portion of the Data segment. The length of the data portion shall be the same for all segments of a data transfer except for the last segment, which may be shorter. Two types of Data segments may be used by the source addressee to indicate whether end-to-end acknowledgment is required or not required. If end-to-end acknowledgment is used by the sending addressee, the destination addressee shall respond with a complete Acknowledgment after correctly receiving all segments of a data transfer. The format of the Data segment is shown in the Figure C-2.

Source Port			Destination Port
Type	HLEN	P/F	Serial Number
Segment Number			Last Segment Number
Data Portion			

Type = 000 or 010

FIGURE C-2: Data segment.

Where:

Source Port:	16 bits
Destination Port:	16 bits
Type:	03 bits
HLEN (Header Length):	12 bits
P/F:	01 bit
Serial Number:	16 bits
Segment Number:	16 bits
Last Segment Number:	16 bits

C.4.2.1 Segment Number. This 16-bit number identifies the segment's position in the whole data transfer and is assigned by the originating device. It is used by the receiving unit in the reassembly process.

C.4.2.2 Last Segment Number. This 16-bit number indicates the total number of segments in the data transfer identified by the serial number.

C.4.3 Partial Acknowledgment. A Partial Acknowledgment is used by the recipient to inform the originator of which segments have been received. The format of the Partial Acknowledgment segment is shown in Figure C-3.

<table>
<tr><td colspan="3">Source Port</td><td colspan="2">Destination Port</td></tr>
<tr><td>Type</td><td>HLEN</td><td>P/F</td><td colspan="2">Serial Number</td></tr>
<tr><td colspan="3">Starting Segment No.</td><td>Bit Map</td><td>Padded</td></tr>
</table>

Type = 100

FIGURE C-3: Partial acknowledgment segment.

Where:

Source Port:	16 bits
Destination Port:	16 bits
Type:	03 bits
HLEN (Header Length):	12 bits
P/F:	01 bit
Serial Number:	16 bits
Starting Segment Number:	16 bits
Bit Map:	1- variable bits
Padded:	0 - 31 bits

C.4.3.1 Starting Segment Number. This 16-bit number indicates that all segments prior to this number have been successfully received in sequence.

C.4.3.2 Acknowledgment Segments Bitmap. The bits in this field are used to indicate which segments of a data transfer have been successfully received at the receiving unit. A bit set (binary 1) means the segment has been correctly received. Binary "0" indicates the segment was not correctly received. These bits are relative to the Starting Segment Number. The first (most-significant) bit of this field corresponds to the Starting Segment Number and will always set to "0". The last (least significant) bit of this field shall set to binary "1" to indicate the last segment that has been received correctly. This field is extensible in 32-bit increments. Unused bits added to pad the field to a 32-bit boundary shall be set to "0".

C.4.4 Complete Acknowledgment Segment. The Complete Acknowledgment segment is used by the destination addressee to inform the source device that all segments of a data transfer associated with the serial number were received correctly. No data field shall be permitted with the Complete Acknowledgment. The format of the Complete Acknowledgment segment is shown in Figure C-4 below.

Source Port			Destination Port
Type	HLEN	P/F	Serial Number

Type = 110

FIGURE C-4: Complete acknowledgment segment.

Where:

Source Port:	16 bits
Destination Port:	16 bits
Type:	03 bits
HLEN (Header Length):	12 bits
P/F:	01 bit
Serial Number:	16 bits

C.4.5 Abort Request**.** The Abort Request shall be used to abort the transfer of a data transfer. Either the data transfer originator or its recipient may initiate the abort action. No data field shall be permitted with the Abort Request. All segments associated with the Serial Number shall be discarded. The format of the Abort Request / Confirm is shown in Figure C-5.

Source Port			Destination Port
Type	HLEN	P/F	Serial Number

Type = 001 or 101

FIGURE C-5: Abort request / confirm segment.

Where:

Source Port:	16 bits
Destination Port:	16 bits
Type:	03 bits
HLEN (Header Length):	12 bits
P/F:	01 bit
Serial Number:	16 bits

C.4.6 Abort Confirm. After receiving an Abort Request, the receiving addressee shall confirm its acceptance of the abort by transmitting an Abort Confirm. No data field shall be permitted with the Abort Confirm. All segments, which have the same Serial Number as identified in the Abort Request, previously received shall be discarded.

C.4.7 Acknowledgment Request. An Acknowledgment Request shall be used by the data transfer originator to request the acknowledgment status of all previous transmitted Data segments. Upon receiving an Acknowledgment Request, the receiver shall return a Partial Acknowledgment to the sender. The format of the Acknowledgment Request is shown in Figure C-6.

Source Port			Destination Port
Type	HLEN	P/F	Serial Number
Last Sent Segment No.			Padded

Type = 011

FIGURE C-6: Acknowledgment request segment.

Where:

Source Port:	16 bits
Destination Port:	16 bits
Type:	03 bits
HLEN (Header Length):	12 bits
P/F:	01 bit
Serial Number:	16 bits
Last Sent Segment Number:	16 bits
Padded:	16 bits

C.4.7.1 Last Sent Segment Number. This 16-bit number is used in the Acknowledgment Request segment to indicate the highest segment number that had been sent at the time of the Acknowledgment Request segment is issued.

CONCLUDING MATERIAL

a. Preparing Activity:

US Army Communication Electronics Command (USACECEOM) – CR1

b. Custodians:

Army:	CR
Navy:	OM
Air Force:	02
DLA:	DH
DISA:	DC1
DIA:	DI
NSA:	NS
Other:	North American Aerospace Defense Cmd. (NORAD) & US Space Cmd. (USSPACECOM): US

c. Review Activities:

OASD	DO, IR, MA, SE
Army	AC, IE, PT, TM1, TM3
Navy	CG, CH, EC, MC, ND, TD
Air Force	03, 11, 13, 33
NIMA	MP
DOT	OST

d. Project number:

DCPS-00101

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1,2, 3, and 8. In block 1, both the document number and revision letter should be given.
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I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER MIL-STD-2045-47001B	2. DOCUMENT DATE *(YYMMDD)* 980120

3. DOCUMENT TITLE Interoperability Standard for Digital Message Transfer Device Subsystems

4. NATURE OF CHANGE *(Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)*

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME *(Last, First, Middle Initial)*	b. ORGANIZATION	
c. ADDRESS *(Include Zip Code)*	d. TELEPHONE *(Include Area Code)* (1) Commercial (2) DSN *(If applicable)*	7. DATE SUBMITTED *(YYMMDD)*

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