NOTE: The cover page of this standard has been changed for administrative reasons. There are no other changes to this document.

MIL-STD-188-256
16 AUGUST 1985

DEPARTMENT OF DEFENSE INTERFACE STANDARD

INTEROPERABILITY AND PERFORMANCE STANDARDS FOR DIGITAL SIGNALING AND SUPERVISION OF TACTICAL COMMUNICATIONS SYSTEMS

TCTS

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DEPARTMENT OF DEFENSE
Washington, DC 20301

Interoperability and Performance
Standards for Digital
Signaling and Supervision
of Tactical Communications
Systems

MIL-STD-188-256

1. This Military Standard is approved and mandatory for use by all Departments and Agencies of the Department of Defense in accordance with the Memorandum of the Office of the Under Secretary of Defense for Research and Engineering, dated 16 August 1983. (See Appendix.)

2. Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to:

Commander
U.S. Army Communications - Electronics Command
Center for Systems Engineering and Integration
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by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

FOREWORD

1. Originally, Military Standard 188 (MIL-STD-188) covered technical standards for tactical and long haul communications, but later evolved through revisions (MIL-STD-188A, MIL-STD-188B) into a document applicable to tactical communications only (MIL-STD-188C).

2. The Defense Communications Agency (DCA) published DCA Circulars (DCAC) promulgating standards and engineering criteria applicable to the long haul Defense Communications System (DCS) and to the technical support of the National Military Command System (NMCS).

3. As a result of a Joint Chiefs of Staff (JCS) action, standards for all military communications are now being published in a MIL-STD-188 series of documents. The MIL-STD-188 series is subdivided into a MIL-STD-188-100 series covering common standards for tactical and long haul communications, a MIL-STD-188-200 series covering standards for tactical communications only, and a MIL-STD-188-300 series covering standards for long haul communications only. Emphasis is being placed on developing common standards for tactical and long haul communications published in the MIL-STD-188-100 series.

4. This document contains technical standards and design objectives for digital signaling and supervision of tactical switched communications systems. The document covers digital loop signaling/supervision, in-band and common channel (out-of-band) trunk signaling/supervision, switched system numbering plan and routing, and switched system testing.

IDENTIFICATION OF INTERNATIONAL STANDARDIZATION AGREEMENT

Certain provisions of this standard (see 4.1) are the subject of international standardization agreements STANAG 4208 and STANAG 4214. When amendment, revision, or cancellation of this standard is proposed which will modify the international agreements concerned, the preparing activity will take appropriate action through international standardization channels including departmental standardization offices to change the agreement or make other appropriate accommodations.

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FIGURES

TABLES

1. SCOPE

1.1 Purpose. The purpose of this document is to promulgate technical design and engineering parameters in the form of mandatory system standards and optional design objectives that are considered necessary to ensure interoperability and to promote compatibility and commonality among tactical digital circuit switching equipment. It is also the purpose of this document to establish a level of performance for tactical digital switching equipment considered necessary to satisfy the requirements of a majority of users. The technical parameters promulgated by this document represent, in general, minimum interoperability and performance characteristics which may be exceeded in order to satisfy specific requirements.

It is not the purpose of this document to serve as a stand-alone, comprehensive reference containing all technical parameters and other details required for the design of new equipment or the preparation of specifications. Therefore, parameters for such items as size and weight limitations, connectors, cable assemblies, or power supplies are not contained in this document. These parameters and other design details have to be established, based on specific requirements, and have to be carefully tailored in accordance with the policies of DoD Directive (DoDD) 4120.21.

This document is not intended to be an engineering textbook or a reference handbook for digital switching equipment. It is assumed that users of this document have a basic technical background in the design and engineering of digital switching systems.

It is not the purpose of this document to inhibit advances in communications technology. Such advances are facilitated by not specifying the technology that should be used in the design and development of digital switching systems to meet the required standards.

1.2 Application. This document applies to the design and development of new land based tactical digital switching equipment. This document applies also to the engineering, installation, and programming of land based tactical digital switching equipment.

1.3 Objective. The main objectives of this document are to ensure interoperability of tactical digital switching equipment consistent with military requirements, to provide a degree of system performance acceptable to a majority of users of tactical digital switching equipment, and to achieve the necessary degree of interoperability, performance and compatibility in the most economical way.

1.4 System standards and design objectives. The parameters and other requirements specified in this document are mandatory system standards (see Appendix) if the word "shall" is used in connection with the parameter value or requirement under consideration. Nonmandatory design objectives are indicated by parenthesis after a standardized parameter value or by the word "should" in connection with the parameter value or requirement under consideration. For a definition of the terms "System Standard" and "Design Objective" see Federal Standard (FED-STD) 1037.

2. REFERENCED DOCUMENTS

2.1 Government documents.

2.1.1 Standards. Unless otherwise specified the following standards of the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DoDISS) specified in the solicitation form a part of this standard to the extent specified herein.

FEDERAL

FED-STD-1037	Glossary of Telecommunication Terms

2.1.2 Other Government documents and publications. The following other Government documents and publications form a part of this standard to the extent specified herein.

North Atlantic Treaty Organization (NATO) Standardization Agreements (STANAG).

STANAG 4208	The NATO Multichannel Tactical Digital Gateway - Signalling Standards
STANAG 4214	International Routing and Directory for Tactical Communications Systems

(Copies of standards and publications required by contractors in connection with specific aquisition functions should be obtained from the contracting activity or as directed by the contracting officer.)

2.2 Order of precedence. In the event of a conflict between the text of this standard and the references cited herein, the text of this standard shall take precedence.

3. DEFINITIONS

3.1 Definition of terms. Definition of terms used in this document shall be as specified in FED-STD-1037.

3.2 Abbreviations and acronyms. The abbreviations and acronyms used in this document are defined as follows:

ACK	-	acknowledge
ATB	-	all-trunks-busy
DAS	-	direct access service
DCA	-	Defense Communications Agency
DCAC	-	Defense Communications Agency Circular(s)
DCS	-	Defense Communications System
DoD	-	Department of Defense
EOD	-	end-of-dial
EOM	-	end-of-message
FED-STD	-	Federal Standard(s)
Hz	-	hertz
ID	-	identification
kb/s	-	kilobit(s) per second
MIL-STD	-	Military Standard(s)
ms	-	millisecond(s)
NAK	-	non-acknowledge
NATO	-	North Atlantic Treaty Organization
NMCS	-	National Military Command System
SOM	-	start-of-message
STANAG	-	standardization agreement (of the NATO)
SYNC	-	synchronization
SZ-ACK	-	seize-acknowledge

4. GENERAL REQUIREMENTS

4.1 NATO interoperability.

4.1.1 Routing and directory. Routing and directory between and among tactical communications systems of NATO member nations shall comply with the applicable requirements of the current edition of STANAG 4214.

NOTE: STANAG 4214 specifies the routing prefixes and their application to routing calls from one NATO tactical communications network or system to other NATO networks or systems.

4.1.2 Gateway signaling. The gateway signaling standards used in the exchange of traffic between two tactical digital communication systems of NATO member nations via a gateway shall comply with the applicable requirements of the current edition of STANAG 4208.

NOTE: STANAG 4208 specifies the common channel signaling standards and procedures which are necessary for interoperation between two tactical digital systems of NATO member nations via a gateway.

4.2 Digital loop signaling and supervision. Digital loop signaling and supervision (see Figure 1) information shall be sent at the digital loop bit rate of 32 kilobits per second (kb/s) or 16 kb/s. All signaling and supervisory information shall be coded or repeated as stated in 5.1.1.

4.2.1 Required switch functions.

4.2.1.1 Codeword detection. Switches shall continuously monitor active digital loops for the presence of the RELEASE codeword and idle digital loops for the presence of the SEIZE codeword. During the traffic phase, the codeword detector for CUE shall remain enabled. Other codewords shall be detected at appropriate points in a signaling sequence.

4.2.1.2 Rate change. Rate change shall be used by the switches to change the bit rate from 32 kb/s to 16 kb/s. When processing a call request, the switch shall determine whether or not the execution of rate change is required by checking the subscriber terminal classmarks and the contents of trunk signaling messages as appropriate. If rate change is required, the switch shall direct the terminal to change its bit rate from 32 kb/s to 16 kb/s. Subsequent supervision of the channel by the switch shall remain at the 32 kb/s rate.

4.2.1.3 Half-duplex mode. When processing a call request, the switches shall determine whether the call is to be completed in the normal full-duplex mode or in the half-duplex mode by checking the subscriber terminal classmarks and the contents of trunk signaling messages, as appropriate. If the half-duplex mode is required and if a digital path is available between the calling and called terminal, the switch shall direct the

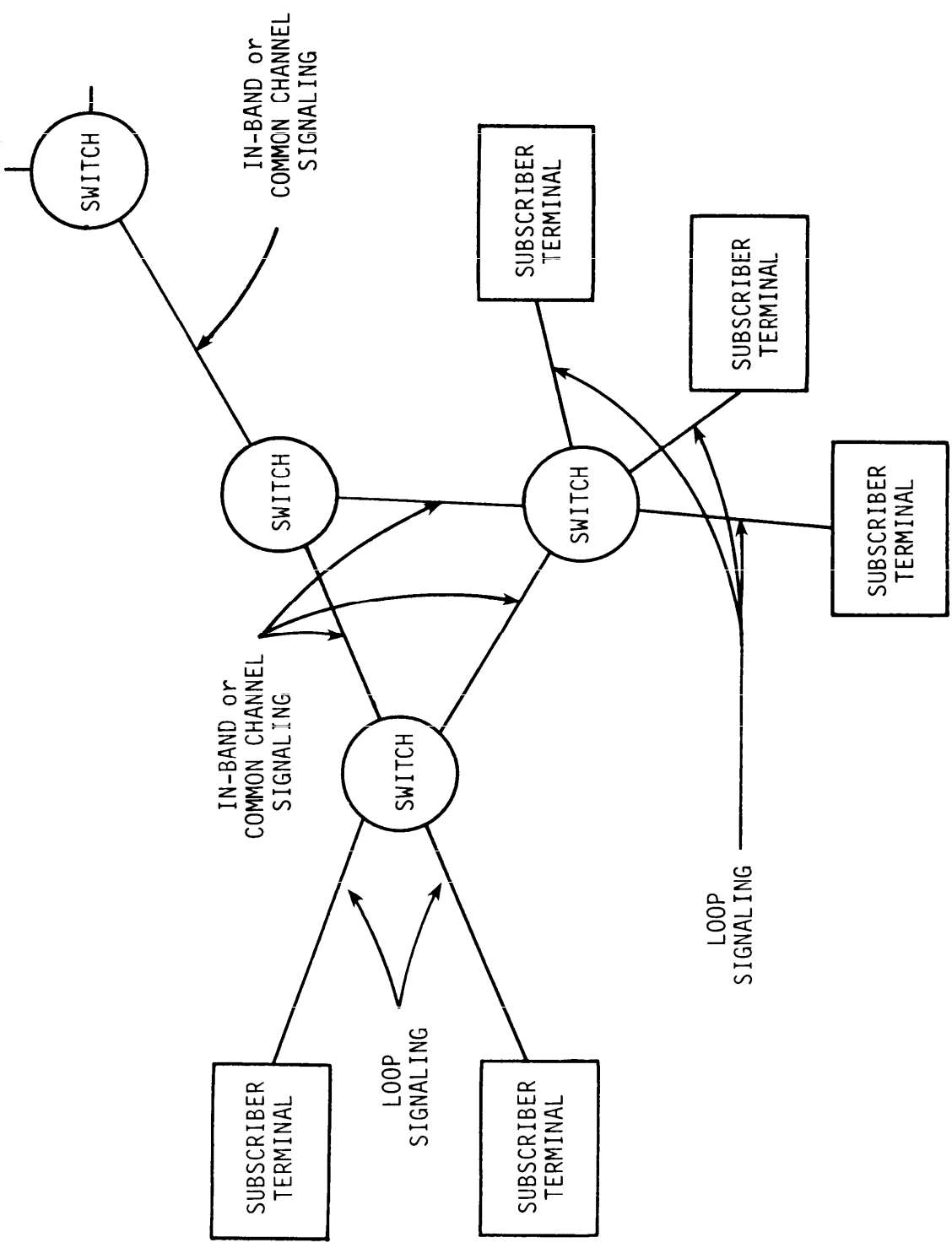


FIGURE 1. Block diagram of switching network digital signaling overview.

terminal to change its bit rate to 16 kb/s (if not already at 16 kb/s rate) and to enter the half-duplex transmission mode when beginning the traffic phase. Subsequent supervision of the channel by the switch shall remain at the normal channel rate.

4.3 Digital in-band signaling and supervision. Digital in-band signaling (see Figure 1) shall utilize formatted messages transmitted at the 32 kb/s or 16 kb/s rate consistent with the basic digital channel rate. Signaling messages and supervisory signals shall be sent by codewords from the originating switch. Each codeword shall be sent consecutively 20 times. The receiving switch shall perform error detection and correction, assemble signaling messages, and perform the necessary processing actions. The receiving switch shall implement an error detection and correction procedure such that a CALL INITIATE message is received correctly with a probability of at least 0.9 on the first trial if the channel experiences a randomly distributed error rate of 1 in 10^3. The probability of the misrouting of a call request caused by mutilation of the address digits in a CALL INITIATE message shall not exceed 1 in 10^6 under the above error rate conditions.

4.4 Digital common channel signaling and supervision. Digital common channel signaling and supervision (see Figure 1) shall utilize formatted messages transmitted over a common signaling channel. These messages shall be utilized to control the disposition of all common traffic channels contained in a given trunk group which may be composed of 16 kb/s or 32 kb/s digital channels. Digital common channel signaling shall be implemented on a full-duplex basis with idle characters in between the fixed formatted signaling messages. The protocol for the exchange of signaling information shall provide for positive and negative acknowledgment of correct reception on a message-by-message basis. Messages shall be retransmitted upon request until acknowledged or until timed-out.

4.4.1 Message processing.

4.4.1.1 Message generation. Digital common channel signaling and supervisory messages shall be composed of 8-bit characters which shall be encoded into 16-bit blocks. (See 4.4.2.) The encoded blocks shall be transmitted bit-serially. The transmitting switch shall encode and transmit IDLE characters when trunk signaling messages are not transmitted. The start-of-message (SOM) character shall be transmitted as the first character of the message, and the end-of-message (EOM) character shall be transmitted as the last character. Immediately following transmission of an encoded character of a message, the next character of the message shall be transmitted. Transmission of a signaling message shall be completed by sending the encoded message parity character immediately following the transmission of the encoded EOM character. Following the transmission of the message parity character block, the switch shall transmit the next message in queue, or if none are queued, the switch shall transmit 16-bit blocks generated by encoding the IDLE character.

4.4.1.2 Message detection. On the receiving side of the signaling channel, the switch shall monitor for maintenance of character synchronization. The switch shall assume that character synchronization has been achieved when it decodes three consecutive error-free IDLE characters or a SOM character. The switch shall begin searching for character synchronization if neither an IDLE nor an SOM character is detected in a string of 100 (±10) consecutive received 16-bit blocks. The receiving switch shall count the number of message characters received after detection of SOM. If this count exceeds 40 characters without receiving EOM, the switch shall ignore subsequent non-IDLE or non-SOM characters and shall process received valid message or parity error characters (up to 40). This character count shall start each time an SOM is detected. If an SOM is detected within the accepted message length, without an intervening EOM, the switch shall treat the characters starting from the first SOM, up to and including the character immediately preceding the second SOM, as one message. The second SOM shall be assumed to be the beginning of the next message.

4.4.2 Error detection and correction scheme.

4.4.2.1 Coding. Digital common channel signaling messages shall be composed of 8-bit characters. The eighth bit of each message (or IDLE) character shall be set to produce odd parity. These 8-bit characters shall be encoded into 16-bit blocks by employing the error detection and correction coding scheme as defined in 5.3.3. The message parity field shall be set in accordance with 5.3.2.15. The message parity field shall be encoded into a 16-bit block in the same way as any other 8-bit character.

4.4.2.2 Error detection and correction. The receiving switch shall utilize the properties of the error detection and correction code to determine whether or not bit errors are present in a given 16-bit block. If affirmative, the switch shall correct up to two errors and then check the parity of the resulting message character. If no errors are found, or if the message character meets the parity condition after execution of forward error correction, the message character shall be processed.

5. DETAILED REQUIREMENTS

5.1 Digital loop signaling and supervision.

5.1.1 Signaling codewords. All digital loop signaling sequences shall employ 8-bit cyclically permutable codewords. The bit patterns for the 8-bit codewords shall be as stated in Table I. The codeword and transmission requirements for each signaling statement shall be as stated in Table II. Transmission of the bit patterns for the codewords shall be bit serial, reading from left to right. Transmission may start at any bit position. An 8-bit codeword shall be transmitted continuously until acknowledged or timed out as stated in 5.1.3, with the exception of the LOCKIN ACKNOWLEDGE (ACK) and RELEASE ACK codewords. The LOCKIN ACK and RELEASE ACK codewords shall be transmitted a minimum of 256 times. The maximum number of times that the LOCKIN ACK or RELEASE ACK codeword may be transmitted shall not exceed the number of times that these 8-bit codewords can be sent in one second. The CUE codeword shall be transmitted by the switch at the normal channel rate regardless of the bit rate (16 kb/s or 32 kb/s) or the transmission mode (full-duplex or half-duplex) employed for the call.

TABLE I. Bit patterns for digital signaling codewords.

Codeword	Bit Pattern for Codeword	Codeword	Bit Pattern for Codeword
1	1111 1111	19	1101 1000
3	1111 1100	20	1101 0010
4	1111 1010	21	1101 0100
5	1111 0110	22	1100 1010
6	1110 1110	23	1010 1010
14	1111 0000	31	1000 1000
15	1110 1000	32	1001 0000
16	1110 0100	33	1010 0000
17	1110 0010	34	1100 0000
18	1100 1100	36	0000 0000

TABLE II. Codeword assignments for digital loop signaling and supervision.

Signaling Statement		Codeword	Switch	
			Transmitted	Received
Digits	0	33		X
	1	14		X
	2	16		X
	3	3		X
	4	15		X
	5	34		X
	6	22		X
	7	6		X
	8	19		X
	9	32		X
Flash Override (FO)		21		X
Flash (F)		18		X
Immediate (I)		20		X
Priority (P)		17		X
Cue		3	X	
Release		4		X
Seize		5*		X
Digit (R)		5*		X
Rate Change		15	X	
Go-Half Duplex		16	X	
Go-Half Duplex ACK		17*		X
Rate Change ACK		17*		X
Ring Data		18*	X	
Ring ACK Data		18*		X
Force Clear		19	X	
Ring Voice		20*	X	
Ring ACK Voice		20*		X
Dial		21*	X	
Ring ACK		21*		X
Ring Trip		22*		X
Release ACK		22*	X	
Idle		23*	X	X
Interdigit		23*		X
Conference Request (C)		31*		X
End of Dial (EOD)		31*		X
Lockin		36*		X
Lockin ACK		36*	X	X

* In a few cases the codewords are used to represent more than one signaling statement. The ambiguity is resolved by considering the context of the signaling sequence involving the use of the codewords.

5.1.2 Supervisory tones. Supervisory tones shall be digitized at the switch prior to transmission to a digital subscriber terminal. The characteristics of the supervisory tones shall be as stated in Table III. Signal level per frequency shall be -14 dBm, ± 1 dB, and the tolerance for tone frequency shall be ±25 percent.

TABLE III. Characteristics of tones for digital loop supervisory signals.

Supervisory Signal	Digitized Frequency (Hz)	Interruption Pattern and Nominal Duration
Dial	425	Continuous, up to 10 seconds
Busy	425	500 ms on, 500 ms off, up to 10 seconds
Force Clear/ Preempt	425	As for busy signal
Error	425 & 1050	125 ms at 425 Hz, 125 ms at 1050 Hz, up to 10 seconds
Ringback	570	50 ms on, 50 ms off, for 2 seconds; then 2 seconds off, up to 180 seconds

5.1.3 Signaling time-outs. Loop signaling sequences and supervisory tones that are transmitted from a switch shall cease after a specified time interval if an expected response is not received from the terminal being signaled. Recommended time-out requirements are as stated in Table IV.

TABLE IV. Time-out specifications for digital loop signaling and supervision.

Switch Function	Nominal Time-out Period (seconds)	Action at End of Time-out
Sending dial tone, waiting for first digit, or waiting between digits	10	Send error tone; force clear
Call is terminated by one party, waiting for release by the other party	5	Send force clear tone; force clear
Sending busy or error tone, waiting for release	10	Force clear
Ring acknowledge received, waiting for ring trip	180	Force clear
Sending force clear, waiting for release	2	Lock-out; initiate fault alarm
General time-out, sending codeword, waiting for (automatic) response	2	Force clear
Sending cue, waiting for seize	2	Lock-out; initiate fault alarm

5.2 Digital in-band signaling and supervision.

5.2.1 Signaling messages. The types of digital in-band signaling messages sent and received by switches shall be as stated in Table V. These signaling messages shall be comprised of even parity, permutable, 8-bit codewords. The bit patterns for these codewords shall be as stated in Table I. The codeword format of the CALL INITIATE, CALL COMPLETE and CALL INCOMPLETE messages shall be as stated in Figure 2. The delimiter codeword shall be transmitted between every data field codeword in a message. The assignment of codewords for each data field shall be as stated in Table VI.

TABLE V. Digital in-band signaling messages.

Message	Remarks
Call Initiate - Lateral	Used to route a call request in accordance with the routing table
Call Initiate - Exit	Used to route a call to a designated switch for obtaining service features not available from local switch
Call Complete	Returned by the terminating switch to indicate that the requested function can be executed
Call Incomplete	Returned in lieu of call complete if the requested function cannot be performed for reasons stated in the message

CALL INITIATE

SOM	MSG TYPE	ORIGINATING SWITCH CODE	MSG NUMBER	SWITCH TYPE	SECURITY	PREC LEVELS	MODE

RATE	DEST RESTR	SAT LINK	CKT TYPE	TERM TYPE	DATA CHAR	PRIV *	CALLED ADDRESS	EOM

CALL COMPLETE

SOM	MSG TYPE	TERM TYPE	SWITCH TYPE	SECURITY	ECHO SUPP	CKT TYPE	CALL TYPE	EOM

CALL INCOMPLETE

SOM	MSG TYPE	REASON	EOM

* Privileges/Service features

FIGURE 2. Codeword format for digital in-band signaling call messages:

TABLE VI. Data field codeword assignments for digital in-band signaling messages.

Data Field	Codeword
SOM	31
Delimiter/Interdigit	23
Message Type	
Call Initiate - Lateral	18
Call Initiate - Exit	21
Call Complete	20
Call Incomplete	17
Test/Test ACK	19
Switch Code	
4-Digit Switch Code (See 5.4)	See decimal digit representation in this table
Switch Type	These fields are reserved for designation of switch type
Terminal Type	These fields are reserved for designation of terminal type
Security	These fields are reserved for security functions

TABLE VI. (Continued) Data field codeword assignments for digital in-band signaling messages.

Data Field	Codeword
Precedence Levels	
Flash Override	21
Flash	18
Immediate	20
Priority	17
Routine	34
Mode	
Full Duplex Mode Only	19
Default	34
Rate	
32 kb/s Rate Only	16
Default	34
Destination Restriction	These fields are reserved for destination restriction
Satellite Link Count	These fields are reserved for designation of the number of satellite links
Circuit Type	
Digital 32 kb/s	17
Digital 16 kb/s	21

TABLE VI. (Continued) Data field codeword assignments for digital in-band signaling messages.

Data Field	Codeword
Data Characteristics	
Not Applicable	34
Data Adapter	17
Facsimile Terminal	21
Voice Call, Dual Mode Terminal	18
Privileges/Service Features	
Conference Origination/Privilege	18
Direct Access Service (DAS) Call	17
None	34
Call Answer Requested	33
Called Address	
Call Initiate - Lateral Call Initiate - Exit	See decimal digit representation in this table
Echo Suppressor Confirmation	
Positive (Yes)	6
Negative (No)	34
Reason: Call Incomplete	
Invalid Destination/Route	15
Called Party Unavailable	6
Invalid/Unassigned Number	19
Incompatible Connection	32
All-Trunks-Busy (ATB) (Busy Release From Spill Forward Switch)	21
ATB (From Tandem Switch)	22
Loop Out of Service	18

TABLE VI. (Continued) Data field codeword assignments for digital in-band signaling messages.

Data Field	Codeword
Call Type	
Not Answered	6
Call Answered	34
Decimal Digit Representation	
0	34
1	17
2	16
3	19
4	15
5	33
6	18
7	6
8	14
9	32
Blank	21
EOM	36

5.2.2 Supervisory signals. The digital in-band supervisory signals sent and received by switches and their codeword assignments shall be as stated in Table VII.

TABLE VI. Life cycle environments (continued)

TABLE VII. Digital in-band supervisory signals.

Supervisory Signals	Codeword	Remarks
ACK	22	Continuous until replaced by next signal (minimum transmit time 250 ms)
Call Answer	36	When requested, this codeword shall indicate when a called party answers. Minimum transmission time is 500 ms at a 32 kb/s rate, 1 second at a 16 kb/s rate
Delimiter	23	Used as a filler between messages and between digits of a message. Minimum transmit time is 500 ms at a 32 kb/s rate and 1 second at a 16 kb/s rate
Idle	4	Continuous until seize
Non-ACK (NAK)	1	Used to request retransmission. Continuous until message retransmitted (5 seconds maximum)
Release or Release Due to Preempt	4	Continuous until seize
Release ACK	4	Continuous until seize
Seize	5	Continuous until SZ-ACK (5 seconds maximum)
Seize ACK (SZ-ACK)	3	Continuous until EOM codeword is received at the end of received message, at which time SZ-ACK is replaced with ACK/NAK. SZ-ACK will time-out if message is not received within 5 seconds

5.3 Digital common channel signaling and supervision. Digital common channel signaling and supervision shall be accomplished using the messages stated in Table VIII which shall have the structure described in 5.3.1 and shall be coded according to 5.3.2. Error detection and correction shall be performed as stated in 4.4.2 and 5.3.3.

5.3.1 Message structure. Signaling and supervisory messages shall consist of a fixed number of fields each comprised of one or more 8-bit characters. Each 8-bit character shall have six bits (bits 6, 5, 4, 3, 2, and 1) to carry trunk signaling information. The other two bits shall be reserved for control (bit 7) and parity (bit 8). Each message shall contain, as an absolute minimum, the SOM field, the message type field, the message number field, the EOM field, and the message parity field. Certain messages shall be expanded by inserting additional fields between the message type field and the EOM field. The messages and the fields and the order in which the fields are transmitted shall be as stated in Table IX.

5.3.2 Message coding.

5.3.2.1 SOM character field. The SOM character shall indicate the beginning of a trunk signaling message. The SOM character shall be defined as follows:

Bits							
8	7	6	5	4	3	2	1
1	0	1	1	1	1	1	1

5.3.2.2 Message type field. The message type field shall indicate the type of message which is being sent. The message type field, bits 8...1, shall be constructed and interpreted as stated in 5.3.2.2.1 through 5.3.2.2.3.

5.3.2.2.1 Parity bit. The parity bit, 8, shall be set to produce odd parity for the 8-bit character of the message type field.

5.3.2.2.2 Control bit. The control bit, 7, shall be set to "1".

5.3.2.2.3 Information bits. The information bits, 6...1, shall be constructed as stated in Table X.

TABLE VIII. Digital common channel signaling and supervisory messages.

Message Type	Message Application
ACK	Sent to indicate a message has been received without errors
ATB	Sent by a switch to which control has not been spilled forward when it encounters an ATB condition
Busy Release	Sent by a switch to which control has been spilled forward when it encounters an ATB condition
Call Answer	Sent by called switch when called party answers
Call Complete	Sent by called switch to cause all intermediate switches to cut through a path
Called Party Unavailable	Sent to indicate the called party is busy on a call of equal or higher precedence
Call Initiate	Sent to establish a call
Call Release	Sent to release trunks when calling or called party goes on-hook
Glare	Sent to indicate that a simultaneous seizure of the same trunk has occurred
Incompatible Connection	Sent by the called switch when an incompatibility exists between the incoming call and the called party's terminal

TABLE VIII. (Continued) Digital common channel signaling and supervisory messages.

Message Type	Message Application
Invalid Route	Sent by a switch when its translation table does not contain the area or switch code specified by a call initiate message
Loop-Back Trunk	Sent to have a trunk looped back on itself for testing purposes
Loop-Back Complete	Sent to indicate that the requested loop-back has been achieved
NAK	Sent to indicate a message has been received, but with errors; retransmission is requested
Out-Of-Service	Sent to indicate that the referenced trunk is marked out-of-service at the receiving switch
Preempt Release	Sent to release trunks due to a preemption
Unassigned Loop	Sent by the called switch when the called loop number is unassigned
Test Synchronization (SYNC)	Sent to verify character synchronization

TABLE IX. Fields contained in digital common channel signaling and supervisory messages.

MSGS / FIELDS	ACK	ALL TRUNKS BUSY	BUSY RELEASE	CALL ANSWER	CALL COMPLETE	CALLED PARTY UNAVAIL	CALL INITIATE	CALL RELEASE	GLARE	INCOMPAT CONNECT	INVALID ROUTE	NON-ACK	OUT OF SERVICE	PREEMPT RELEASE	UNASSIGN LOOP	LOOP BACK TRUNK	LOOP BACK COMPLETE	TEST SYNC
SOM 5.3.2.1	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
MESSAGE TYPE 5.3.2.2	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
MESSAGE NUMBER 5.3.2.3	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
TRUNK NUMBER 5.3.2.4		●	●	●	●	●	●	●		●	●			●	●	●	●	
CALLED NUMBER 5.3.2.5					●		●											
SWITCH DESIG 5.3.2.6							●											
CALL NUMBER 5.3.2.7							●											
MISC INFO 5.3.2.8							●											
PATH DEL/ DATA CHAR 5.3.2.9							●											
RETURNED INFO 5.3.2.10					●													
REJECT SWITCH 5.3.2.11											●							
SWITCH SEQUENCE 5.3.2.12											●							
ORIG SATELLITE 5.3.2.13																		
EOM 5.3.2.14	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
MESSAGE PARITY 5.3.2.15	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●

TABLE X. Coding of the message type field in digital common channel signaling and supervisory messages.

Bits						Message Type
6	5	4	3	2	1	
0	0	0	0	0	0	ACK
0	0	0	0	0	1	Call initiate
0	0	0	0	1	0	Call complete
0	0	0	0	1	1	Call answer
0	0	0	1	0	0	Invalid route
0	0	0	1	0	1	Called party unavailable
0	0	0	1	1	0	Unassigned number
0	0	0	1	1	1	ATB
0	0	1	0	0	0	Spare
0	0	1	0	0	1	Incompatible connection
0	0	1	0	1	0	Request trunk for in-band signaling
0	0	1	0	1	1	Reserved for security message
0	0	1	1	0	0	Spare
0	0	1	1	0	1	Glare
0	0	1	1	1	0	Out-of-service
0	0	1	1	1	1	Reserved for security message
0	1	0	0	0	0	Reserved for security message
0	1	0	0	0	1	Test sync
0	1	0	0	1	0	Loop-back trunk
0	1	0	0	1	1	Loop-back complete
0	1	0	1	0	0	Spare
0	1	0	1	0	1	Spare
0	1	0	1	1	0	Spare
0	1	0	1	1	1	Reserved for security message
0	1	1	0	0	0	Reserved for satellite message
0	1	1	0	0	1	Reserved for satellite message
0	1	1	0	1	0	Reserved for satellite message
0	1	1	0	1	1	Reserved for security message
0	1	1	1	0	0	Call release
0	1	1	1	0	1	Preempt release
0	1	1	1	1	0	Busy release
0	1	1	1	1	1	NAK
1	0	0	0	0	0	Spare
.	.	.	.	.	.	. . . . .
.	.	.	.	.	.	. . . . .
.	.	.	.	.	.	. . . . .
1	1	1	1	1	1	Spare

5.3.2.3 Message number field. The message number field shall indicate the message identification number. The message number field, bits 16...1, shall be constructed and interpreted as stated in 5.3.2.3.1 through 5.3.2.3.4. (See Figure 3.)

5.3.2.3.1 Parity bits. The parity bits, 16 and 8, shall each be set to produce odd parity for each of the two 8-bit characters of the message number field.

5.3.2.3.2 Control bits. The control bits, 15 and 7, shall each be set to "1".

5.3.2.3.3 Information bits. The information bits, 11, 10, 9, 6...1, shall indicate the sequence number with bit 11 the most significant bit and bit 1 the least significant bit.

5.3.2.3.4 Spare bits. The spare bits, 14, 13, and 12, shall each be set to "0".

5.3.2.4 Trunk number field. The trunk number field shall indicate the particular trunk to which the message refers. The trunk number field, bits 16...1, shall be constructed and interpreted as stated in 5.3.2.4.1 through 5.3.2.4.4. (See Figure 4.)

5.3.2.4.1 Parity bits. The parity bits, 16 and 8, shall each be set to produce odd parity for each of the two 8-bit characters of the trunk number field.

5.3.2.4.2 Control bits. The control bits, 15 and 7, shall each be set to "1".

5.3.2.4.3 Information bits. The information bits, 10, 9, 6...1, shall indicate the trunk number with bit 10 the most significant bit and bit 1 the least significant bit. If 0 is transmitted, the message shall be considered in error.

5.3.2.4.4 Spare bits. The spare bits, 14, 13, 12, and 11, shall each be set to "0".

5.3.2.5 Called number field. The called number field shall contain eleven 8-bit characters to accommodate up to 16 digits of a called number. If the called number has 7 through 13 digits, the unused digit positions shall contain the bit pattern of 1111. The first three digit positions shall contain the "prefix" (if any), which shall be coded and interpreted as stated in Table XI. The called number field, bits 88...1, shall be constructed and interpreted as stated in 5.3.2.5.1 through 5.3.2.5.4. (See Figure 5.)

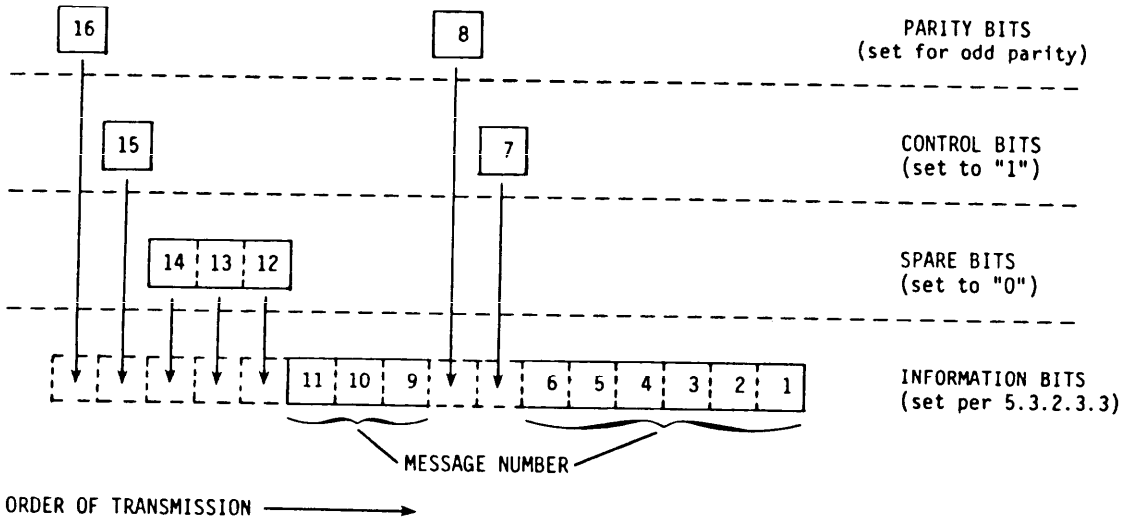


FIGURE 3. Message number field in digital common channel signaling and supervisory messages.

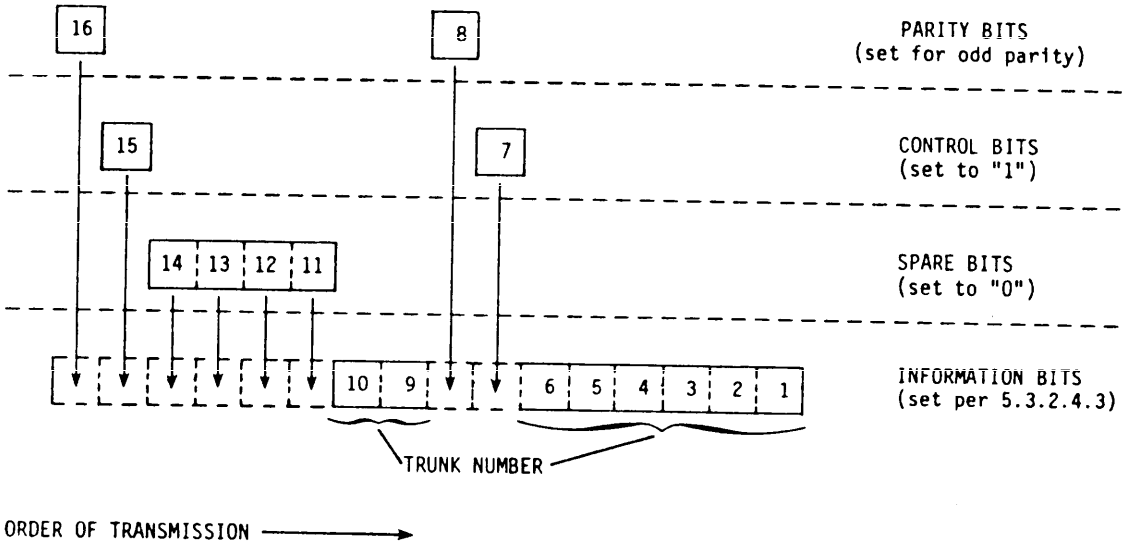


FIGURE 4. Trunk number field in digital common channel signaling and supervisory messages.

TABLE XI. Coding of prefix digits in called number field of digital common channel CALL INITIATE message.

Originating System	Digit Positions		
	16	15	14
AUTOVON	1111	0001	0001 - Voice 0010 - Data 0101 - Direct access voice 0110 - Direct access data
NATO Analog System	1111	0010	Any 4-bit binary number from 0 to 9 inclusive
NATO Digital System	Any 4-bit binary number except 1111	Any 4-bit binary number	Any 4-bit binary number
US Tactical Digital System	1111	0011	0000 - Default 0001 - Security function 0011 - Type I transmission required (see 5.3.2.8.10) 0100 - Security function 0101 - Commercial access 0111 - Type II transmission required (see 5.3.2.8.10)

5.3.2.5.1 Parity bits. The parity bits, 88, 80, 72, 64, 56, 48, 40, 32, 24, 16, and 8, shall be set to produce odd parity for each of the eleven 8-bit characters of the called number field.

5.3.2.5.2 Control bits. The control bits, 87, 79, 71, 63, 55, 47, 39, 31, 23, 15, and 7, shall each be set to "1".

5.3.2.5.3 Spare bits. The spare bits, 85 and 86, shall each be set to "0".

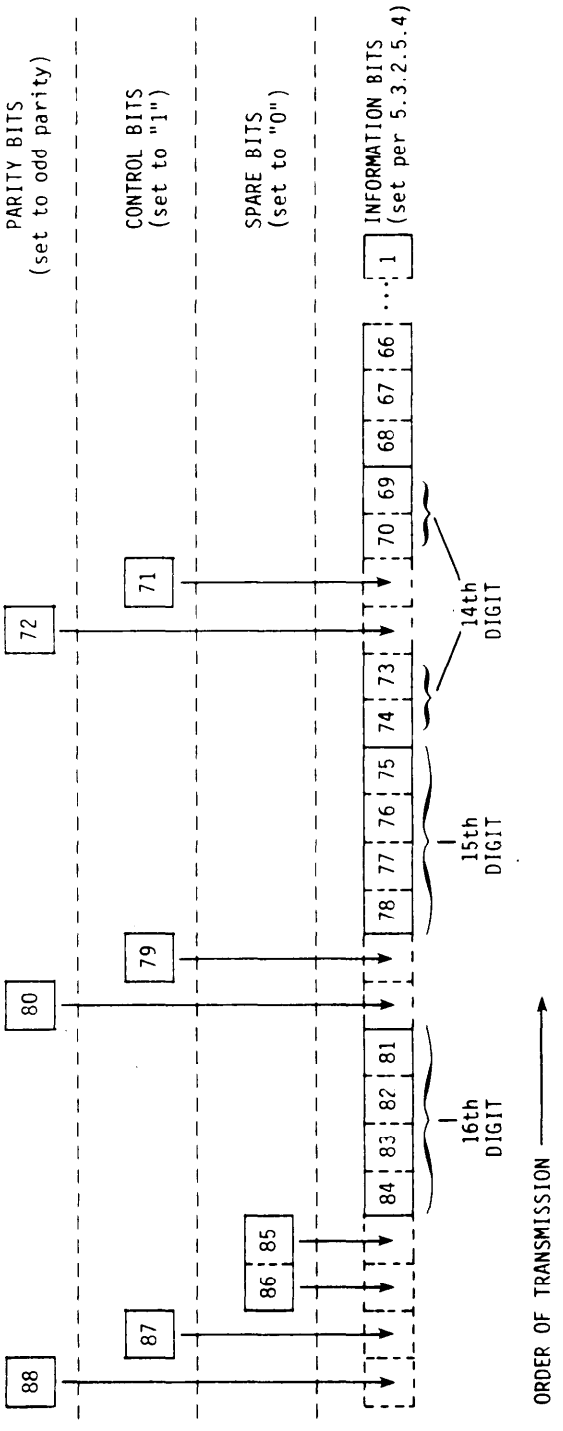


FIGURE 5. Called number field in digital common channel signaling and supervisory messages.

5.3.2.5.4 Information bits. The information bits in the called number field shall provide 16 digit positions as stated in Table XII. All called numbers shall be "position justified", e.g., the 10th digit position shall hold the first digit of the area code (if the area code is used) and the 7th digit position shall hold the first digit of the 7-digit subscriber address. Each 4-bit group, denoting a binary number, shall represent one called number digit. Transmission shall start with bit 88.

TABLE XII. Bit assignment for called number digits in digital common channel signaling and supervisory messages.

Bits				Digit Positions
84	83	82	81	16th
78	77	76	75	15th
74	73	70	69	14th
68	67	66	65	13th
62	61	60	59	12th
58	57	54	53	11th
52	51	50	49	10th
46	45	44	43	9th
42	41	38	37	8th
36	35	34	33	7th
30	29	28	27	6th
26	25	22	21	5th
20	19	18	17	4th
14	13	12	11	3rd
10	9	6	5	2nd
4	3	2	1	1st

5.3.2.6 Switch designator field. The switch designator field shall indicate the originating or terminating switch, or the switch which assumes the role of the originating or terminating switch with regard to signaling and routing. The switch designator field shall contain the MYX NNXX designation of the switch. (See 5.4) The switch designator field, bits 40...1, shall be constructed and interpreted as stated in 5.3.2.6.1 through 5.3.2.6.4 (see Figure 6), and bit 40 shall be the first bit transmitted.

5.3.2.6.1 Parity bits. The parity bits, 40, 32, 24, 16, and 8, shall be set to produce odd parity for each of the five 8-bit characters of the switch designator field.

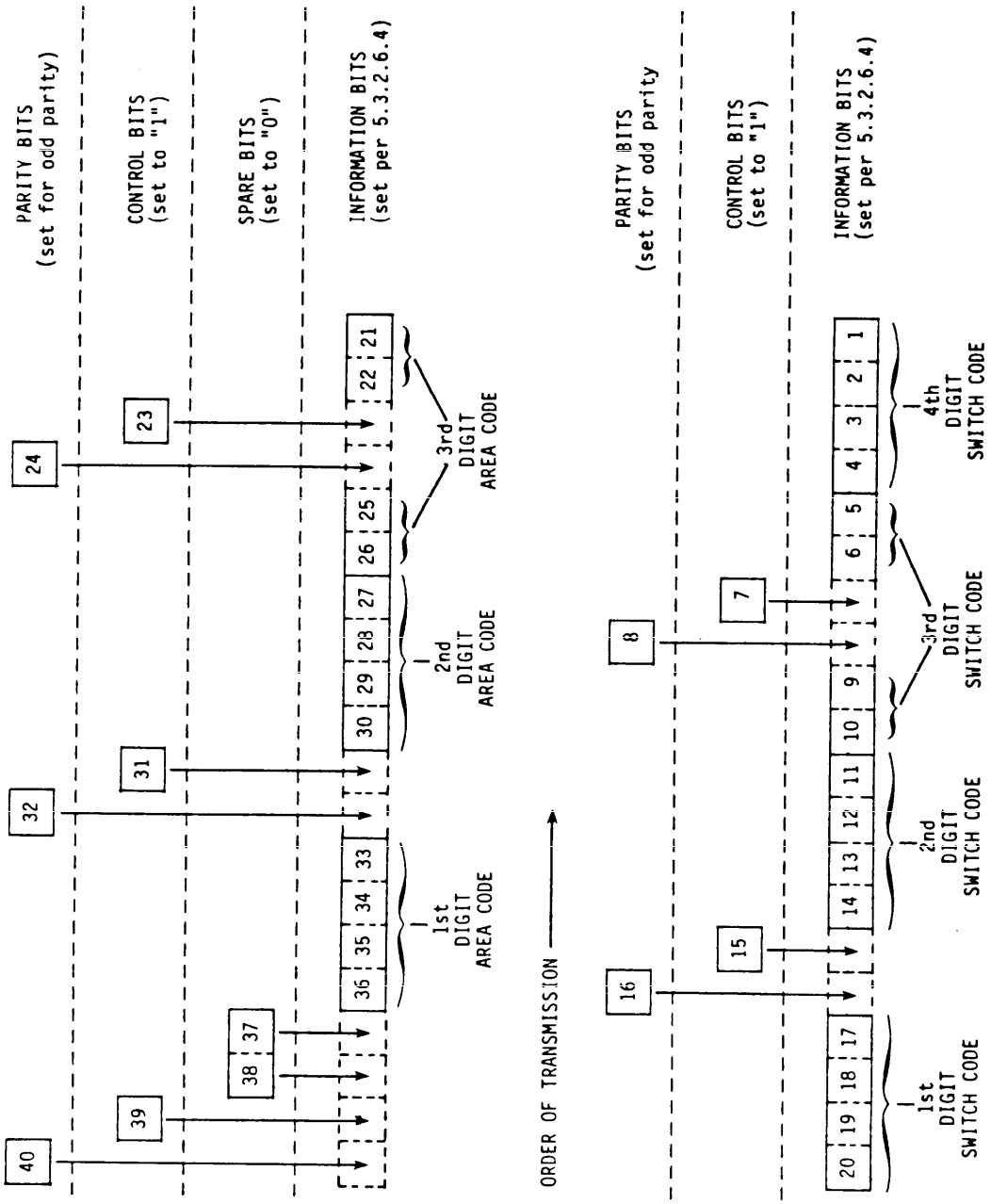


FIGURE 6. Switch designator field in digital common channel signaling and supervisory messages.

5.3.2.6.2 Control bits. The control bits, 39, 31, 23, 15, and 7, shall each be set to "1".

5.3.2.6.3 Spare bits. The spare bits, 38 and 37, shall each be set to "0".

5.3.2.6.4 Information bits. The information bits in the switch designator field shall indicate the 7-digit switch designator. Each four-bit group, denoting a binary number, shall represent one digit and shall be set as stated in Table XIII.

TABLE XIII. Switch designator field

Bits	Digit Positions	Numbering Plan
36 35 34 33	First digit of area code	M
30 29 28 27	Second digit of area code	Y
26 25 22 21	Third digit of area code	X
20 19 18 17	First digit of switch code	N
14 13 12 11	Second digit of switch code	N
10 9 6 5	Third digit of switch code	X
4 3 2 1	Fourth digit of switch code	X

5.3.2.7 Call number field. The call number field shall indicate the message number selected for a CALL INITIATE message by the originating switch (or the message number selected by a switch which changes the entry in the called number field). The format of the call number field shall be identical to that defined for the message number field. (See 5.3.2.3.)

5.3.2.8 Miscellaneous information field. The miscellaneous information field, bits 32...1, shall be constructed and interpreted as stated in 5.3.2.8.1 through 5.3.2.8.14 (see Figure 7) with bit 32 being the first bit to be transmitted.

5.3.2.8.1 Parity bits. The parity bits, 32, 24, 16, and 8, shall be set to produce odd parity for each of the four 8-bit characters of the miscellaneous information field.

5.3.2.8.2 Control bits. The control bits, 31, 23, 15, and 7, shall each be set to "1".

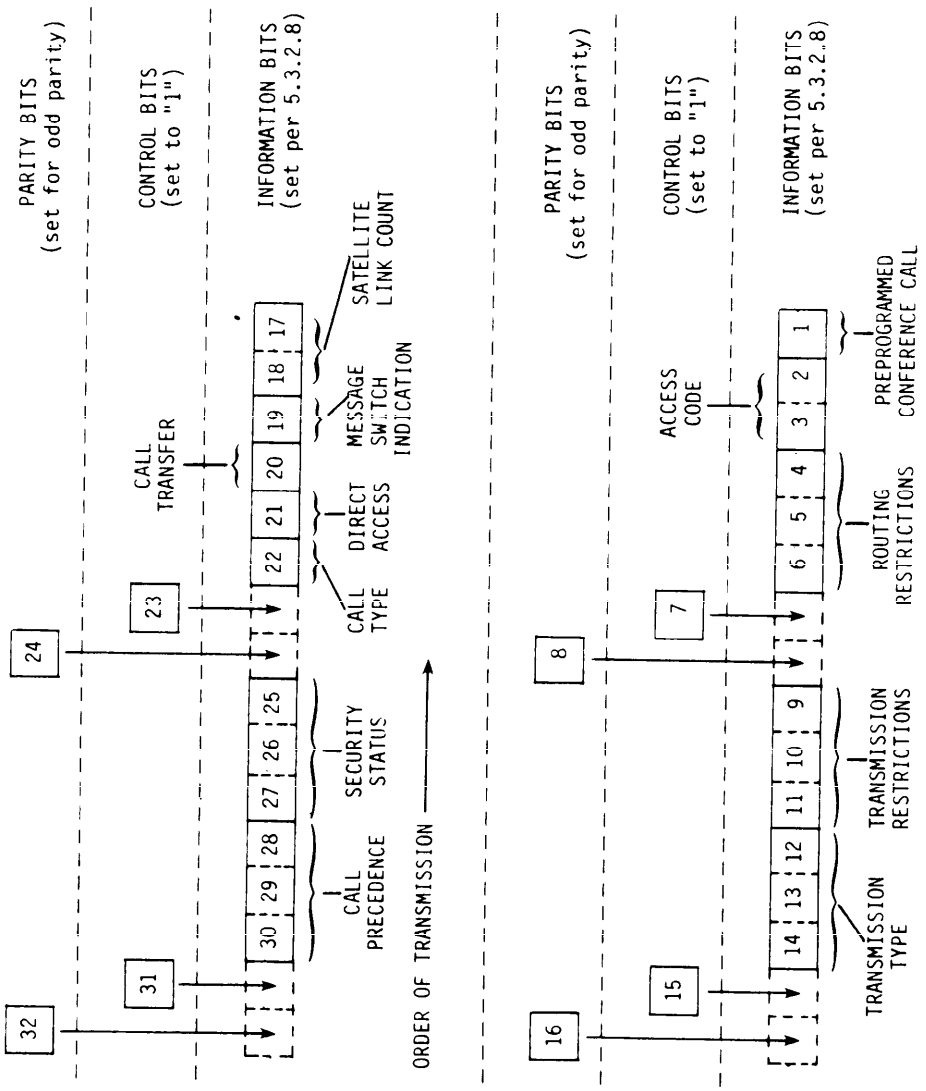


FIGURE 7. Miscellaneous information field in digital common channel signaling and supervisory messages.

5.3.2.8.3 Call precedence. The call precedence subfield, bits 30, 29, and 28, indicates the precedence of a call and shall be set as stated in Table XIV.

TABLE XIV. Call precedence subfield

Bits	Call Precedence
30 29 28	
0 0 0	Routine
0 0 1	Priority
0 1 0	Immediate
0 1 1	Flash
1 0 0	Flash override
1 0 1	Spare
1 1 0	Spare
1 1 1	Spare

5.3.2.8.4 Security status. The security status subfield, bits 27, 26, and 25, shall be reserved for security requirements. These bits shall each be set to "0" for a non-secure status.

5.3.2.8.5 Call type. The call type subfield, bit 22 shall be set to "0" for voice call and to "1" for a data call.

5.3.2.8.6 Direct access mode. The direct access mode subfield, bit 21, shall be set to "0" if the call was not originated in the direct access mode, and to "1" if the call was originated in the direct access mode.

NOTE: This entry in a message field indicates that the call was initiated by a subscriber using the DAS of a circuit switch which automatically initiates a direct call, that is, the dialing of a programmed subscriber number. This information is provided to allow the terminating circuit switch to take appropriate call processing action as required.

5.3.2.8.7 Call transfer. The call transfer subfield, bit 20, shall be set to "0" if the call is not being initiated as the result of a call transfer situation and set to "1" if the call is being initiated as the result of a call transfer situation.

5.3.2.8.8 Message switch indication. The message switch indication subfield, bit 19, shall be set to "0" if the call was not initiated by a message switch and to "1" if the call was initiated by a message switch.

5.3.2.8.9 Satellite link count. The satellite link count subfield, bits 18 and 17, shall be set as stated in Table XV.

TABLE XV. Satellite link count subfield

Bits		Number of Satellite Links
18	17	
0	0	0
0	1	1
1	0	2
1	1	3 or more

5.3.2.8.10 Transmission type. The transmission type subfield, bits 14, 13, and 12, indicates the type of transmission currently used by the call being initiated and shall be set as stated in Table XVI.

TABLE XVI. Transmission type subfield

Bits			Transmission Type
14	13	12	
0	0	0	Type I
0	0	1	Spare
0	1	0	Spare
0	1	1	Type IIIB
1	0	0	Type IIB
1	0	1	Type IIA
1	1	0	Type IIIA
1	1	1	Spare

NOTE: Type I indicates analog transmission (without analog-to-digital conversions).
Type II indicates digital transmission (without analog-to-digital conversions).
Type III indicates analog/digital transmission (with analog-to-digital conversions).
A indicates 16 kb/s bit rate.
B indicates 32 kb/s bit rate.

5.3.2.8.11 Transmission restrictions. The transmission restrictions subfield, bits 11, 10, and 9, indicates any special restrictions to be followed with respect to the transmission facilities to be used for call set-up and shall be set as stated in Table XVII.

TABLE XVII. Transmission restrictions subfield

Bits	Transmission Restrictions
11 10 9	
0 0 0	No special restrictions
0 0 1	Type I*
0 1 0	Type II*
0 1 1	Spare
1 0 0	Spare
1 0 1	Spare
1 1 0	Spare
1 1 1	Spare

*See note of Table XVI on page 34.

5.3.2.8.12 Routing restrictions. The routing restrictions subfield, bits 6, 5, and 4, indicates any special restrictions which are to be followed in call routing and shall be set as stated in Table XVIII.

TABLE XVIII. Routing restrictions subfield

Bits	Routing Restrictions
6 5 4	
0 0 0	No special restrictions
0 0 1	No 16 kb/s trunk
0 1 0	Spare
0 1 1	Spare
1 0 0	Spare
1 0 1	Spare
1 1 0	Spare
1 1 1	Spare

5.3.2.8.13 Access code. The access code subfield, bits 3 and 2, shall be set as stated in Table XIX.

TABLE XIX. Access code subfield

Bits		Access Code/Condition
3	2	
0	0	None
0	1	Spare
1	0	Full-duplex traffic mode
1	1	Spare

5.3.2.8.14 Preprogrammed conference call. The preprogrammed conference call subfield, bit 1, shall be set to "0" if the call is not a preprogrammed conference call and shall be set to "1" if the call is a preprogrammed conference call.

5.3.2.9 Path delay or data characteristics field. The path delay or data characteristics field is used to carry path delay information or data characteristics and shall be constructed and interpreted as stated in 5.3.2.9.1 or 5.3.2.9.2 (see Figure 8) with bit 16 as the first bit to be transmitted.

5.3.2.9.1 Voice call. If bit 22 in the miscellaneous information field is set to "0" (indicating a voice call), the path delay field, bits 16...1, shall be constructed and interpreted as stated in 5.3.2.9.1.1 through 5.3.2.9.1.8.

5.3.2.9.1.1 Parity bits. The parity bits, 16 and 8, shall be set to produce odd parity for each of the two 8-bit characters of the path delay field.

5.3.2.9.1.2 Control bits. The control bits, 15 and 7, shall each be set to "1".

5.3.2.9.1.3 Path delay. Bits 14, 13, 12, and 11 shall be used to indicate the path delay of the call. Switches capable of accounting for path delays of terrestrial interswitch links shall set these bits as stated in Table XX. Switches which do not account for propagation delays on terrestrial links shall enter the code "1000" in the event that a satellite link is used to forward the CALL INITIATE message (which contains the path delay field); otherwise, the code "0000" shall be entered.

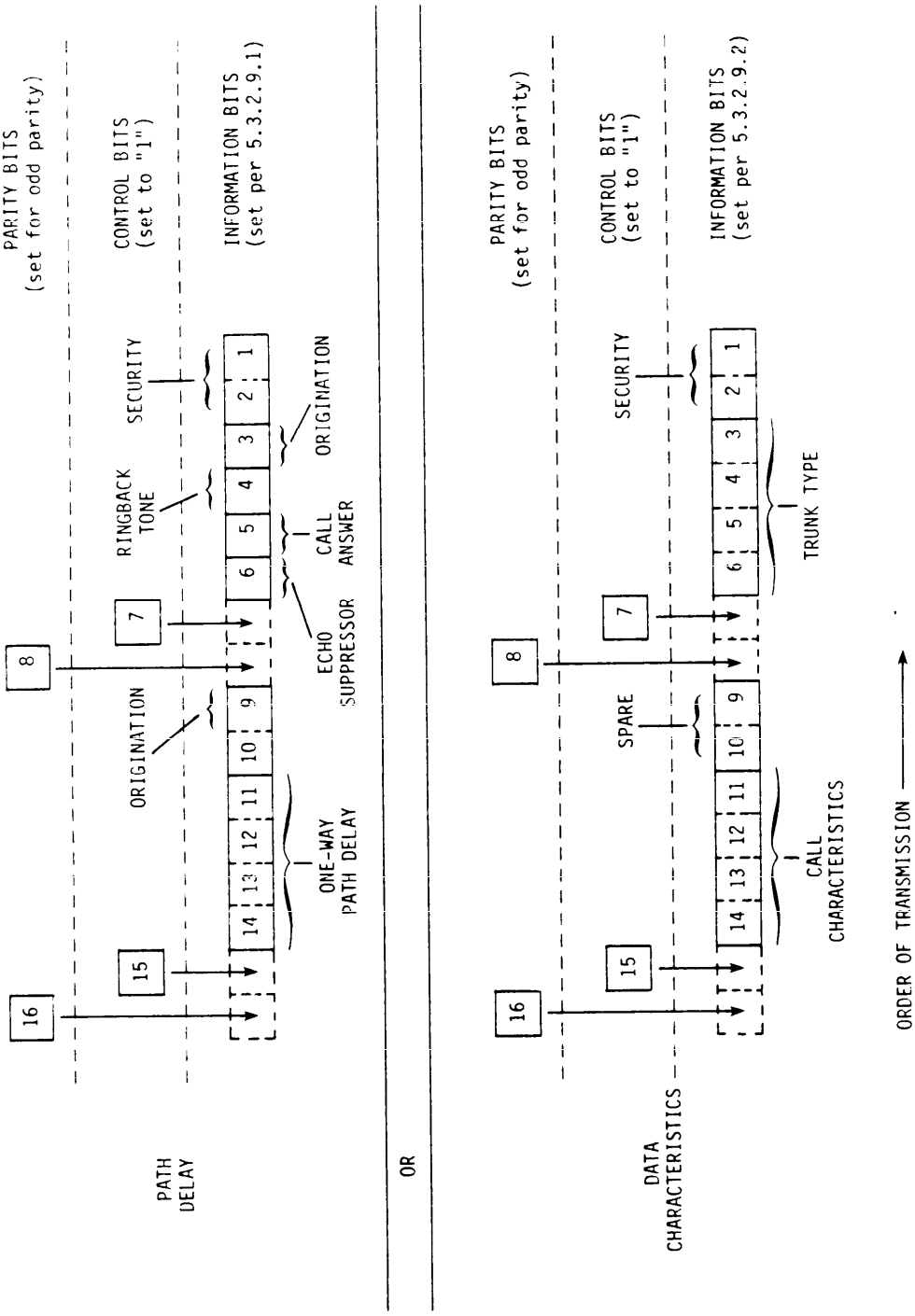


FIGURE 8. Path delay or data characteristics field in digital common channel signaling and supervisory messages.

TABLE XX. Coding of path delay in digital common channel signaling and supervisory messages.

Bits				Two-Way Path Delay (ms)	Bits				Two-Way Path Delay (ms)
14	13	12	11		14	13	12	11	
0	0	0	0	0	1	0	0	0	40 or more
0	0	0	1	5	1	0	0	1	Spare
0	0	1	0	10	1	0	1	0	Spare
0	0	1	1	15	1	0	1	1	Spare
0	1	0	0	20	1	1	0	0	Spare
0	1	0	1	25	1	1	0	1	Spare
0	1	1	0	30	1	1	1	0	Spare
0	1	1	1	35	1	1	1	1	Spare

5.3.2.9.1.4 Origination. Bit 9 shall be set to "1" if the call was originated by a 2-wire analog voice terminal, including calls received via a 4-wire trunk serving 2-wire switches or 2-wire terminals, or both. Bit 3 shall be set to "1" if the voice call was originated by a multi-mode (voice/data) terminal (that is, voice-to-data switchover can be expected if the called terminal also has a multi-mode capability). Nonapplicable entries shall be set to "0".

5.3.2.9.1.5 Echo suppressor. Bit 6 shall be set to "1" if an echo suppressor is available and can be switched in or activated on the analog 4-wire circuit which will carry the voice traffic from a 2-wire loop or trunk. This flag bit should be set by the originating switch, but if not set there, it shall be set to "1" by the first switch in the route which controls echo suppressors, but only if the transmission is analog at that switch. Any switch may reserve echo suppressors along the forward route, but only the switch which sets bit 6 to "1" shall enable the suppressor. (See 5.3.2.10.5.)

NOTE: If the path delay exceeds 40 ms (including satelite links) echo suppressors may be required.

5.3.2.9.1.6 Call answer. Bit 5 shall be set to "1" if the terminating switch is expected to return a CALL ANSWER message.

5.3.2.9.1.7 Ringback tone. Bit 4 shall be set to "1" if the terminating switch is expected to return an in-band ringback tone.

5.3.2.9.1.8 Security. Bits 2 and 1 shall be reserved for security requirements. These bits shall each be set to "0" for a non-secure call.

5.3.2.9.2 Data call. If bit 22 in the miscellaneous information field is set to "1" (indicating a digital data call), the data characteristics field, bits 16...1, shall be constructed and interpreted as stated in 5.3.2.9.2.1 through 5.3.2.9.2.3.

5.3.2.9.2.1 Parity bits. The parity bits, 16 and 8, shall be set to produce odd parity for each of the two 8-bit characters of the data characteristics field.

5.3.2.9.2.2 Control bits. The control bits, 15 and 7, shall each be set to "1".

5.3.2.9.2.3 Information bits. The information bits, 14...9 and 6...1, shall be set according to the following rules. In the case of a call request from a message switch to another message switch via the circuit switching network, the originating message switch shall set the bits 14, 13, 12, 11, 10, and 9 to transfer certain call characteristics to the called message switch. Intermediate circuit switches shall ignore the setting of these bits. The bits 6, 5, 4, and 3 shall be set by the calling message switch to inform the circuit switch, which serves the called message switch, of the type of trunk to be used in completing the call. The trunk type shall be binary encoded with bit 6 the most significant bit and bit 3 the least significant bit. The code "0000" shall be entered if a digital connection is requested. In the case of a circuit switch to circuit switch or circuit switch to message switch call the bits shall be set by the originating switch. Bit 14 shall be set to "1" if the calling terminal is compatible with the message switch. Bit 13 shall be set to "1" if the call is initiated by a facsimile set. Bit 12 and 11 are reserved for special message service. Non-applicable entries, bits 14, 13, 12, and 11 shall be set to "0". Bits 10, 9, 6, 5, 4, and 3 are spare bits and shall be set to "0". In both cases bits 2 and 1 are reserved for security functions and shall be set to "0" for a non-secure call.

5.3.2.10 Returned information field. The returned information field shall be used to carry all information not contained in other fields of the CALL COMPLETE message. The returned information field, bits 24...1, shall be constructed and interpreted as stated in 5.3.2.10.1 through 5.3.2.10.9. (See Figure 9.)

5.3.2.10.1 Parity bits. The parity bits, 24, 16, and 8, shall be set to produce odd parity for the three 8-bit characters of the returned information field.

5.3.2.10.2 Control bits. The control bits, 23, 15, and 7, shall each be set to "1".

5.3.2.10.3 Spare bits. The spare bits, 19, 18, 17, 9, and 1, shall each be set to "0".

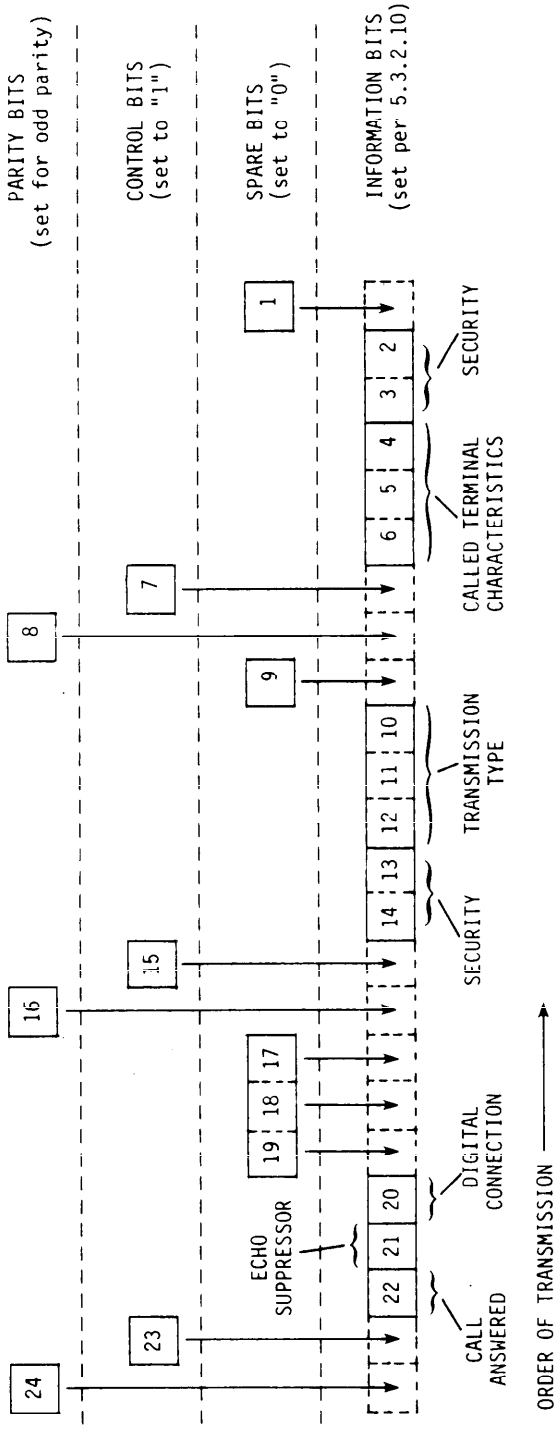


FIGURE 9. Returned information field in digital common channel signaling and supervisory messages.

5.3.2.10.4 Call answered. Bit 22 shall be set to "0" if the call is not considered answered (call answer message follows) and shall be set to "1" if the call is considered answered.

5.3.2.10.5 Echo suppressor. Bit 21 shall be set to "0" if an echo suppressor is not inserted at the originating side of the path and shall be set to "1" if an echo suppressor is inserted at the originating side of the path. The terminating switch shall make an affirmative entry only if the associated CALL INITIATE message identifies a calling 2-wire voice terminal (see 5.3.2.9.1.4) and contains a nonzero satellite link count in the miscellaneous information field (see 5.3.2.8.9) or a stated path delay of "40 ms or more" in the path delay field. (See 5.3.2.9.1.3.)

5.3.2.10.6 Digital connection. Bit 20 shall be set to "0" if any analog-to-digital conversion takes place between the originating and terminating equipment and shall be set to "1" if the entire connection between the originating and terminating equipment is digital.

5.3.2.10.7 Called terminal security. Bits 14, 13, 3, and 2 shall be reserved for security requirements. These bits shall each be set to "0" for a non-secure call.

5.3.2.10.8 Transmission type. Bits 12, 11, and 10 shall be coded and interpreted the same as bits 14, 13, and 12, respectively, of the transmission type subfield in the miscellaneous information field (see 5.3.2.8.10) of the CALL INITIATE message which initiated the call.

5.3.2.10.9 Called terminal (and trunk) characteristics. Bits 6, 5, and 4 shall be set as stated in Table XXI.

TABLE XXI. Called terminal characteristics

Bits	Definition
6 5 4	
0 0 0	Type I*
0 0 1	Type IIIA*
0 1 0	Type IIIB*
0 1 1	Reserved for security functions
1 0 0	Type I* - insert echo suppressor
1 0 1	Type IIA*
1 1 0	Type IIB*
1 1 1	16 kb/s, half-duplex

* See note of Table XVI on page 34.

5.3.2.11 Rejecting switch field. The rejecting switch field shall be used to identify the switch that was unable to process the CALL INITIATE message and returns the INVALID ROUTE message. The rejecting switch field shall contain the MYX NNXX designation of the rejecting switch. (See 5.4.) The format of this field shall be identical to that defined for the switch designator field. (See 5.3.2.6.)

5.3.2.12 Switch sequence field. The switch sequence field shall be used to indicate the number of switches involved in an invalidly routed call. The rejecting switch shall set the switch sequence field to "0" and as switches receive the INVALID ROUTE message, they shall increment the switch sequence field setting by "1". The switch sequence field shall be formatted as stated in 5.3.2.12.1 through 5.3.2.12.3.

5.3.2.12.1 Parity bit. The parity bit, 8, shall be set to produce odd parity for the 8-bit character of the switch sequence field.

5.3.2.12.2 Control bit. The control bit, 7, shall be set to "1".

5.3.2.12.3 Information bits. The information bits, 6...1, shall indicate the binary count of the switches in the route, with bit 6 the most significant bit and bit 1 the least significant bit.

5.3.2.13 Originating satellite terminal and channel ID field. The 32-bit originating satellite terminal and channel ID field shall be reserved for use with satellite links.

5.3.2.14 EOM character field. The EOM character shall be the penultimate character of a trunk signaling message. This character shall be defined as follows:

Bits							
8	7	6	5	4	3	2	1
1	0	1	0	0	0	0	1

5.3.2.15 Message parity field. Bits 1 through 7 of the message parity field shall be set to produce even column parity on bits 1 through 7 of all message fields from SOM to EOM inclusive. (See Table IX.) Bit 8 of the message parity field shall be set to produce odd parity of bits 1 through 8 of the message parity field.

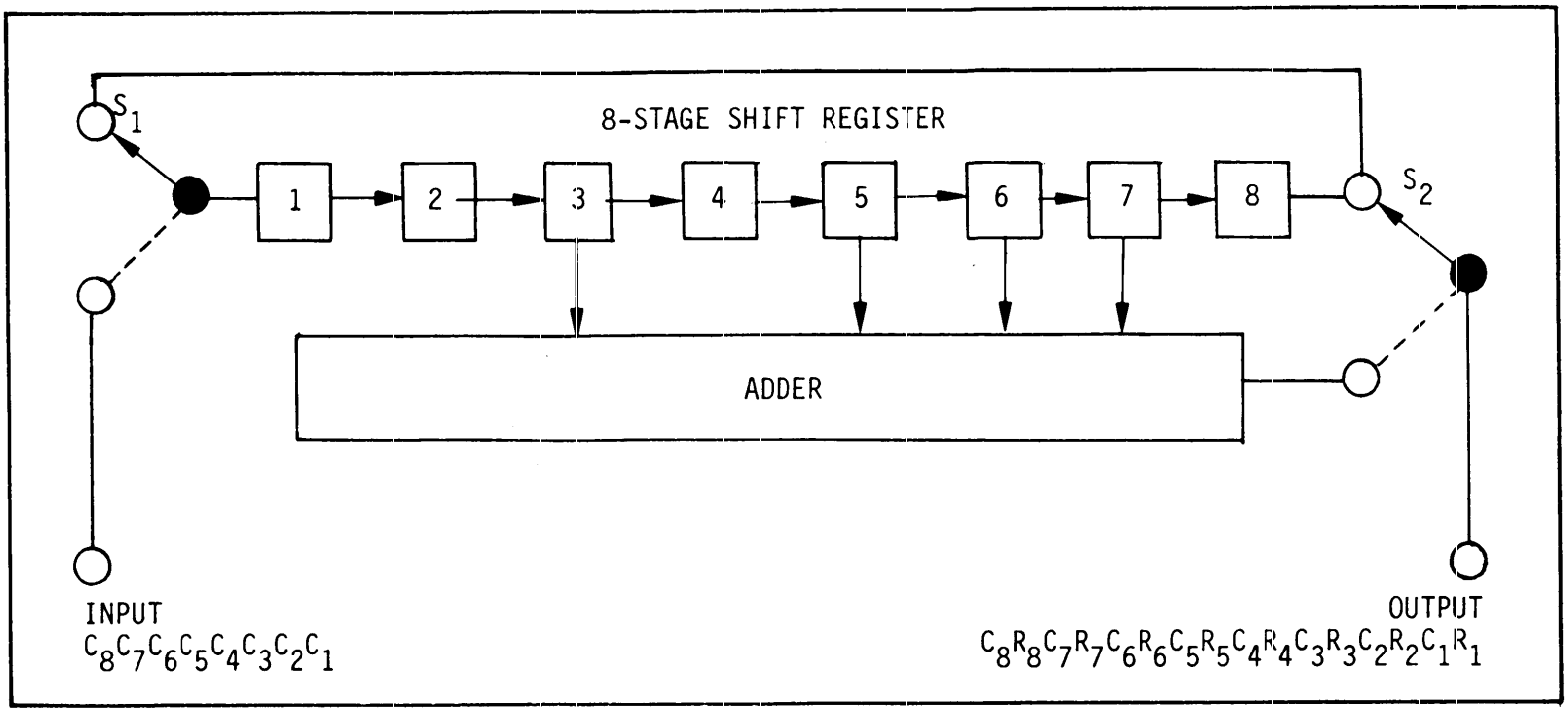
5.3.3 Error detection and correction scheme.

5.3.3.1 Message encoding. The switch shall encode message characters by employing a quasi-cyclic (16, 8) encoder which adds eight redundancy bits to every 8-bit message character.

NOTE: The coder is implemented by employing the coding circulant QC (16, 8) - 00010111. The functional operation of the encoder is shown in Figure 10. This particular functional description is not intended to constrain design choices, provided that the functional characteristics stated in 5.3.3.1 through 5.3.3.3 are satisfied.

5.3.3.2 Message decoding. The switch shall separate the character bits (C-bits) and redundancy bits (R-bits) in the 16-bit block and subsequently reencode the eight C-bits in the same manner as specified in 5.3.3.1. The received eight R-bits and the newly generated eight R-bits shall be added modulo-2 to the received eight R-bits. If this process yields ALL-ZEROS, the 8-bit character, C1...C8, shall be considered to be correct, provided that the parity bit (C8) and the control bit (C7) also adhere to the applicable rules.

5.3.3.3 Error detection and correction. The switch shall be capable of detecting and correcting up to two errors in the character bits (C-bits).



An 8-bit character $C_1C_2...C_8$ is shifted into the 8-stage shift register via switch S_1 (while the adder circuit is being cleared and the output switch S_2 is inhibited). When the register is loaded, S_1 is placed in the upper position to close the circulation path. Then, the 8-bit character $C_1C_2...C_8$ is shifted in a closed loop fashion, and for every bit-shift, S_2 alternates between the upper and lower position to release a C-bit from the shift register followed by an R-bit from the adder. The resulting output is a 16-bit block $R_1C_1...R_7C_7R_8C_8$.

NOTE: This functional diagram and description are examples and are not intended to constrain design choices provided that the functional characteristics stated in 5.3.3.1 through 5.3.3.3 are satisfied.

FIGURE 10. Functional description of encoding scheme for error detection and correction.

5.4 Switched systems numbering plan. Switches shall be capable of correctly functioning with the numbering plan given in Table XXII and performing the functions stated in 5.4.1 through 5.4.7. "B" shall be a blank digit represented by the bit position 1111, "M" shall be any number from two to eight inclusive, "Y" shall be a zero or one, "X" shall be any number from zero to nine inclusive, "NN" shall be any two-digit number from 22 to 99 inclusive and "XX" shall be any two-digit number from 00 to 99 inclusive.

NOTE: The switched systems numbering plan reflects only the technical capability of the switching equipment. Certain restrictions may be placed on the numbering plan by operational requirements.

TABLE XXII. Numbering plan for the address portion in called number field of CALL INITIATE message.

Digit Positions												
13	12	11	10	9	8	7	6	5	4	3	2	1
B	B *	B	M	Y	X	N 9	N 9	X X	X X	X X	X X	X X

* For future expansion and NATO use see 4.1.1.

5.4.1 Direct dialing. Switches shall be capable of direct dialing to allow subscribers to dial another subscriber by dialing the area code of the called party (if outside of the calling subscriber's area code) followed by the switch code and the line number of the called party.

5.4.2 Fixed directory dialing. Switches shall be capable of fixed directory calls. An intra-area directory number shall be accessed by dialing the digits "99" followed by the remaining 5-digits. The format of the remaining 5-digits shall be JXJXZ for individual subscribers and XXIXX for units. In these formats, "J" shall be any number from seven to nine inclusive, "X" shall be any number from zero to nine inclusive, "Z" shall be any number from zero to 3 inclusive and "I" shall be any number from zero to six inclusive. A fixed directory number outside of the geographical area covered by the calling subscriber's area code shall be accessed in the same manner as above, except that the area code shall preceed the called fixed directory number.

5.4.3 Abbreviated dialing. Switches shall be capable of intraswitch dialing. When using the NN-XX-XXX numbering plan a subscriber shall have to dial only the last three digits of the 7-digit number.

5.4.4 Interswitch dialing. A switch shall complete interswitch calls when the subscriber dials the digit "9" followed by the 7-digit number (or 10 or 13-digit number if outside the calling subscriber's area code).

5.4.5 Attendant access. It shall be possible for any subscriber to access a switch attendant of the local switch that serves the subscriber by dialing the digit "0". It shall be possible for any subscriber to access the attendant of the remote switch by dialing the following digits: the digit "9", the remote switch area code (if outside of the calling subscriber's area code), the remote switch code, and the digits ""011".

5.4.6 Commercial access. If the commercial access function is implemented in the switch, access to a commercial system shall be by dialing the digit "5" followed by EOD. After this procedure, the commercial number may be dialed.

5.4.7 AUTOVON access. It shall be possible for any subscriber to access AUTOVON by using a seven or ten digit numbering plan of the form MYX-NNX-XXXX. "M", "Y" and "X" shall be as indicated in 5.4. "N" shall be any number from two to nine inclusive.

5.5 Switched systems routing. The requirements stated in 5.5.1 through 5.5.7 apply only to those systems that use table driven deterministic routing schemes.

5.5.1 Originating switch. Each switch shall store, for each valid switch code and for all valid area codes, an outgoing primary trunk group and outgoing ordered alternate trunk groups. When a call is originated, the switch shall determine, from the number of the called party, the primary trunk group to be used in forwarding the call. The switch shall scan the primary trunk group for an idle trunk. If an idle trunk is available in the primary trunk group, the call shall be forwarded toward its destination using the idle trunk. If no idle trunk is available in the primary trunk group, the call shall be processed by scanning the alternate trunk groups in order. If an idle trunk is found in any alternate trunk group, the call shall be forwarded using that trunk. If no idle trunk is found in either the primary or any alternate trunk group and the call is of ROUTINE precedence, an ATB signal shall be returned toward the calling subscriber from the controlling switch. If no idle trunk is available in either the primary or any alternate trunk group and the call has a precedence higher than ROUTINE, the switch shall initiate a preemptive search in accordance with 5.5.4.

5.5.2 Intermediate switch. When a call is advanced to a switch that does not directly serve the called subscriber and when control of the call has not been forwarded to the switch (i.e., spill forward control), the switch shall act as an intermediate switch. An intermediate switch shall attempt to forward the call to the terminating switch using a trunk from the primary trunk group associated with the terminating switch. If no idle trunks are available or if the satellite control parameter threshold

would be exceeded by completing the call using a trunk from the primary trunk group, the intermediate switch shall attempt to forward the call over a trunk from each alternate trunk group in order, unless the switch is not classmarked for alternate area routing. If no idle trunk is available in any alternate trunk group and the call is of ROUTINE precedence, or if the satellite control parameters threshold would be exceeded if a trunk from an alternate trunk group were used, then an ATB signal shall be returned to the controlling switch. If an idle trunk is not found in either the primary trunk group or any of the alternate trunk groups and the call is of a precedence higher than ROUTINE, the intermediate switch shall initiate a preemptive search in accordance with 5.5.4. If an ATB signal is returned to the controlling switch by an intermediate switch, the controlling switch shall mark its outgoing trunk group as unavailable for forwarding this call and shall then attempt to forward the call over the next alternate trunk group. Identification of switches already traversed by a call shall be accomplished by comparing an incoming CALL INITIATE message with all CALL INITIATE messages currently in storage. The originating switch called number and call number fields of the CALL INITIATE messages shall be compared. If a match is found in both fields between the incoming CALL INITIATE message and a CALL INITIATE message already in storage, then a "ring around" condition exists, and an ATB signal shall be returned to the controlling switch.

5.5.3 Spill forward switch. Switches should be capable of operating in a spill forward mode. The requirement of spill forward control shall be directable to one or a combination of trunk groups through trunk group classmarking. The spill forward mode shall always be used when crossing area code boundaries and when the switches connected by the trunk group crossing the boundary are switches that are capable of operating in a spill forward mode.

5.5.4 Precedence handling. A preemptive search shall be initiated if a call is of a precedence higher than ROUTINE and an initial search of the primary and alternate trunk groups to be used in forwarding the call does not find an idle trunk or a trunk without excessive path delays. The preemptive search shall scan, in order, the primary and alternate trunk groups to determine if there is an idle trunk. If there is an idle trunk, the trunk group has not been marked as unavailable for the call, and the trunk group is acceptable, then the call shall be forwarded using the first idle, acceptable, and available trunk encountered. If there is no idle, acceptable, and available trunk in any of the trunk groups, all groups shall again be scanned to determine the lowest preemptable, acceptable, and available trunk over the set of primary and alternate trunk groups. The lowest preemptable, acceptable, and available trunk shall be used to forward the call. If no preemptable, available, and acceptable trunk can be found in any of the set of trunk groups, an ATB signal shall be returned to the originating switch and then by the originating switch to the calling party.

5.5.5 Invalid route. In the event that a switch receives a CALL INITIATE message from another switch for which it cannot find a route, an INVALID ROUTE message shall be returned to the switch from which the CALL INITIATE message was received in the trunk signaling channel. The INVALID ROUTE message shall be forwarded to the next previous switch in the path of the call. Receipt of an INVALID ROUTE message at a switch shall cause the switch to report the event as required.

5.5.6 Alternate area routing. When multiple paths exist to a distant area (area code), the routing selected shall be based upon the switch code NNXX. (See 5.4.) Alternate area routing tables that have the capability to store multiple switch codes NNXX shall be provided. The alternate area routing table shall identify a first preferred and a second preferred routing capability.

5.5.7 Routing table update. Switches shall provide the capability to attendants of inserting, correcting, and deleting routing table information.

5.6 Switched system testing.

5.6.1 Digital loop testing. Switches shall have the capability of performing periodic loop testing on idle loops.

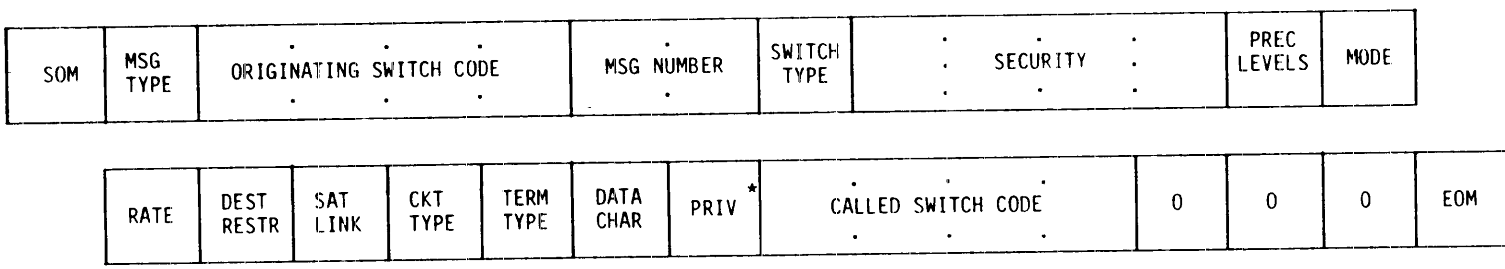
5.6.2 Digital in-band testing. Digital in-band testing shall be accomplished in accordance with 4.3 using the in-band TEST and TEST ACKNOWLEDGE messages. The codeword format of the TEST and TEST ACKNOWLEDGE messages shall be as stated in Figure 11. The assignment of codewords for each data field shall be as stated in Table VI, and the bit patterns for these codewords shall be as stated in Table I.

5.6.3 Digital common channel testing. Digital common channel testing shall be accomplished in accordance with 4.4 and 5.3 using the digital common channel TEST SYNC, LOOP-BACK TRUNK, and LOOP-BACK COMPLETE messages.

5.6.3.1 TEST SYNC message. The TEST SYNC message shall be sent on the common signaling channel to verify character synchronization and in-service state of the signaling channel. The TEST SYNC message shall be sent after gaining IDLE character synchronization during initial set-up of a link, or after regaining synchronization after periods of loss of frame synchronization. The TEST SYNC message shall also be sent periodically but at least once every four seconds during times when no other signaling messages are being sent. The fields of the TEST SYNC message shall be constructed as stated in 5.3.1.

5.6.3.2 LOOP-BACK TRUNK and LOOP-BACK COMPLETE messages. The LOOP-BACK TRUNK message may be employed in support of interswitch diagnostics. The LOOP-BACK COMPLETE message shall be returned by the switch receiving the LOOP-BACK TRUNK message after performing the requested loop-back process. The fields of both the LOOP-BACK TRUNK and LOOP-BACK COMPLETE messages shall be as stated in 5.3.1.

TEST and TEST ACKNOWLEDGE



* Privileges/Service features

FIGURE 11. Codeword format for digital in-band signaling test messages.

Custodians:

Army - CR
Navy - EC
Air Force - 90

Review activities:

Army - SC
Navy - EC, MC
Air Force - 90
DCA - DC
NSA - NS
JTC^{3}A

User activities:

Army
Navy
Air Force

Preparing activity:

Army - CR
(Project TCTS-2560)

International interest:

NATO

APPENDIX

MEMORANDUM FROM THE UNDER SECRETARY OF DEFENSE FOR RESEARCH AND ENGINEERING, 16 AUGUST 1983, SUBJECT: MANDATORY USE OF MILITARY TELECOMMUNICATIONS STANDARDS IN THE MIL-STD-188 SERIES.

This Appendix contains information related to MIL-STD-188-256 and is a mandatory part of this standard.

THE UNDER SECRETARY OF DEFENSE
WASHINGTON, D.C. 20301

RESEARCH AND
ENGINEERING

16 AUG 1983

MEMORANDUM FOR ASSISTANT SECRETARY OF THE ARMY (INSTALLATIONS, LOGISTICS & FINANCIAL MANAGEMENT)
ASSISTANT SECRETARY OF THE NAVY (SHIPBUILDING & LOGISTICS)
ASSISTANT SECRETARY OF THE AIR FORCE (RESEARCH DEVELOPMENT & LOGISTICS)
COMMANDANT OF THE MARINE CORPS
DIRECTOR, DEFENSE COMMUNICATIONS AGENCY
DIRECTOR, NATIONAL SECURITY AGENCY

SUBJECT: Mandatory Use of Military Telecommunications Standards in the MIL-STD-188 Series

On May 10, 1977, Dr. Gerald Dinneen, then Assistant Secretary of Defense(C^3I), issued the following policy statement regarding the mandatory nature of the MIL-STD-188 series telecommunications standards:

"...standards as a general rule are now cited as 'approved for use' rather than 'mandatory for use' in the Department of Defense.

This deference to the judgment of the designing and procuring agencies is clearly appropriate to standards dealing with process, component ruggedness and reliability, paint finishes, and the like. It is clearly not appropriate to standards such as those in the MIL-STD-188 series which address telecommunication design parameters. These influence the functional integrity of telecommunication systems and their ability to efficiently interoperate with other functionally similar Government and commercial systems. Therefore, relevant military standards in the 188 series will continue to be mandatory for use within the Department of Defense.

To minimize the probability of misapplication of these standards, it is incumbent upon the developers of the MIL-STD-188 series to insure that each standard is not only essential but of uniformly high quality, clear and concise as to application, and wherever possible compatible with existing or proposed national, international and Federal telecommunication standards. It is also incumbent upon the users of these standards to cite in their procurement specifications only those standards which are clearly necessary to the proper functioning of the device or systems over its projected lifetime."

This statement has been reviewed by this office and continues to be the policy of the Department of Defense.

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INSTRUCTIONS: In a continuing effort to make our standardization documents better, the DoD provides this form for use in submitting comments and suggestions for improvements. All users of military standardization documents are invited to provide suggestions. This form may be detached, folded along the lines indicated, taped along the loose edge *(DO NOT STAPLE)*, and mailed. In block 5, be as specific as possible about particular problem areas such as wording which required interpretation, was too rigid, restrictive, loose, ambiguous, or was incompatible, and give proposed wording changes which would alleviate the problems. Enter in block 6 any remarks not related to a specific paragraph of the document. If block 7 is filled out, an acknowledgement will be mailed to you within 30 days to let you know that your comments were received and are being considered.

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3a. NAME OF SUBMITTING ORGANIZATION	4. TYPE OF ORGANIZATION *(Mark one)*
	☐ VENDOR ☐ USER ☐ MANUFACTURER ☐ OTHER *(Specify)*: _____
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