MIL-STD-188-216A
20 FEBRUARY 1993

SUPERSEDING
MIL-STD-188-216
16 MARCH 1987

MILITARY STANDARD

INTEROPERABILITY STANDARDS FOR DATA ADAPTER CONTROL MODE

AMSC N/A **AREA TCTS**

DISTRIBUTION STATEMENT A. Approval for public release; distribution is unlimited.

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 Information Systems Agency (DISA), formerly known as the Defense Communications Agency (DCA) published DCA circulares (DCACs) 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 a common standards for tactical and long haul communications published in the MIL-STD-188-100 series.

4. This document is the result of JCS action requiring that the technical characteristics of Data Adapter Control Mode (DACM) procedures previously contained in various specifications be updated and published in the MIL-STD-188 series of standards.

5. This military standard (MIL-STD) is approved and will be used by the Office of the Secretary of Defense, the Military Departments, the chairman of the Joint chiefs of Staff and the Joint Staff, the Unified and Specified Commands, The Defense Agencies, and DoD Field Activities.

6. The DACM was previously described in Joint Tactical Communications Office (JTCO) document TT-A3-9013-0048B and MIL-STD-188-216.

7. This document supersedes paragraphs 3.2.2 through 3.2.4,3.2.5, and 3.2.6, and Appendix I of the JTCO specification TT-A3-9013-0048B.

CONTENTS

CONTENTS

CONTENTS

CONTENTS

(This page intentionally left blank.)

1. SCOPE

1.1 Purpose. The purpose of this document is to establish technical standards and Design Objectives (DOs) that are necessary to ensure interoperability and to promote commonality for communications equipment and subsystems using Data Adapter Control Mode (DACM) procedures. Another purpose of this document is to establish acceptable overall system performance in order to satisfy diverse user requirements without the restrictions caused by interface interoperability problems. Message formats specified for use by the DACM are defined in Allied Communications Procedures (ACP-127), Communications Instructions Tape Relay Procedures; Defense Operating Instruction (DOI)-103, Defense Special Security Communications System (DSSCS) Operating Instructions (U) System/Data Procedures; and Joint Army Navy Allied Procedures (JANAP-128), Automatic Digital Network (AUTODIN) Operating Procedures.

1.2 Scope. This document specifies the minimum requirements necessary to develop a Data Adapter Control Mode protocol procedure. It is not the intent of this document to specify any particular hardware or software design or implementation. Message formats are not specified in this standard.

1.3 Application. This document is applicable to the design and development of new equipment, assemblages, and systems using DACM. This document is applicable also to the engineering and operation of existing DACM systems. It is not intended that existing DACM systems be immediately converted to comply with the standards contained in this document. New DACM systems and those undergoing major modification or rehabilitation shall comply with the standards contained in this document subject to applicable requirements of current procurement regulations. DACM can be used over common long haul and tactical communications circuits. In this case, both this document and Military Standard (MIL-STD)-188-100 shall apply.

1.4 Objectives. The objectives of this document are to provide system performance requirements that ensure interoperation of equipment and systems consistent with military requirements; to achieve the necessary degree of performance and interoperation in the most economical way; and to prevent proliferation of equipment serving the same or a similar function. The variety of equipment shall be the minimum necessary to effectively support the missions of the government in accordance with Department of Defense Directive (DODD) 4630.5, Compatibility and Commonality of Equipment for Tactical Command, Control, and Communications. These objectives will be accomplished by continuing efforts in the following areas:

a. Standardizing user-to-user performance characteristics.

b. Standardizing the type of signals at various interface points in the applicable system.

c. Specifying maximum permissible degradation of a signal in the process of transmission and allocating the permissible degradation among various parts of a system.

d. Defining performance parameters without specifying the technology that should be used to obtain the required performance.

1.5 System standards and DOs. The parameters and other requirements specified in this document are mandatory system standards if the word "shall" is used in connection with the parameter value or requirement under consideration. Nonmandatory system parameters and DOs are indicated as optional by the word "should" in connection with the parameter value or requirement under consideration. For a definition of the terms "system standards" and "design objective," see Federal Standard (FED-STD)-1037, Glossary of Telecommunications Terms. Information paragraphs, shown as notes, have been included to better define methods currently in use with the DACM.

1.6 Tailoring. As a minimum, only those features or functions specified herein, necessary to ensure interoperability among systems, shall be implemented in an equipment item. While every effort has been made to include all the features necessary for protocol implementation, certain aspects are dependent upon system application and must be tailored by the specification writer. These aspects include alarm functions, Mode VI block group size, data rates, codes, message formats, etc.

2. APPLICABLE DOCUMENTS

2.1 Government documents

2.1.1 Standards. The following standards form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto.

STANDARDS

FEDERAL

FED-STD-1037	Glossary of Telecommunication Terms

MILITARY

MIL-STD-188-100	Common Long Haul and Tactical Communication System Technical Standards
MIL-STD-188-171	Interoperability Standards for Information and Record Traffic Exchange MODE I
MIL-STD-188-172	Interoperability Standards for Information and Record Traffic Exchange MODE II
MIL-STD-188-173	Interoperability Standards for Information and Record Traffic Exchange MODE V
MIL-STD-188-174	Interoperability Standards for Information and Record Traffic Exchange MODE VI

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

JANAP-128	Automatic Digital Network (AUTODIN) Operating Procedures
DOI-103	Defense Special Security Communications System (DSSCS) Operating Instructions (U) System/Data Procedures

ACP-117	Allied Routing Indicator Book
ACP-127	Communications Instructions Tape Relay Procedures

2.1.2.1 Department of Defense Directives (DODD)

DODD 4630.5	Compatibility and Commonality of Equipment for Tactical Command, Control and Communications
DODD 5000.1	Defense Acquisition

2.1.2.2 Joint Tactical Communications Office (TRI-TAC)

TT-B1-1205-0085	Performance Specification for Switching Set, Message Automatic AN/GYC-7

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 takes precedence. Nothing in this standard, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.3 Source of documents

2.3.1 Government specifications, standards, and handbooks. Copies of the referenced federal and military specifications, standards, and handbooks are available from:

Department of Defense Single Stock Point
Commanding Officer
Naval Publications and Forms Center
5801 Tabor Avenue
Philadelphia, PA 19120-5099

For specific acquisition functions, these documents should be obtained from the contracting activity or as directed by the contracting activity.

2.3.2 Other Government documents. Copies or other Government documents required by contractors in connection with specification acquisition functions should be obtained from the contracting activity or as directed by the contracting activity.

3. DEFINITIONS

3.1 Definition of terms. Definition of terms used in this document shall be as specified in FED-STD-1037. Those definitions of terms unique to DACM and not defined in FED-STD-1037 are provided in the following subparagraphs.

3.1.1 ACK 31. The Data Adapter Control Block (DACB) positive acknowledgement sequence consisting of four contiguous characters, ACK ACK 31 31 (see Table III and 4.2.2).

3.1.2 Channel. A path along which signals can be sent (FED-STD-1037).

3.1.3 DA/MS. Connection of one of the following: DA to DA, DA to MS, MS to MS, or MS to DA.

3.1.4 DACB acknowledgement sequence. There are four DACB acknowledgement sequences (see 5.2.2):

a. ACK 31 (see 5.2.2.1).
b. WBT 31 (see 5.2.2.2),
c. DACB(INV) (see 5.2.2.3),
d. DACB(F) (see 5.2.2.4).

3.1.5 DACM. DACM is a synchronous character-oriented protocol designed for use prior to passage of data traffic. DACM establishes or determines the transmission characteristics under which data traffic may be passed and describes the data traffic that may be passed.

3.1.6 Excessive unexpected characters. A situation where a Data Adapter/Message Switch (DA/MS) receives 170 or more contiguous characters that are not acceptable when received.

3.1.7 Glare. A situation where DA/MS try to initiate DACM signaling to each other at the same time (see 5.6).

3.1.8 Handback. The process of going from the traffic mode back to the DACM.

3.1.9 Handover. The process of going from DACM to the traffic mode.

3.1.10 Information rate. The minimum number of bits (1's and 0's) per unit of time, usually seconds, required to convey useful information (for example, 2400 bps). This is also referred to as message rate.

3.1.11 Initiator. The party starting a procedure and leading in the steps of the procedure.

3.1.12 Loop rate. The rate at which bits are exchanged between a DA/MS and the transmission/cryptographic equipment.

3.1.13 Master-slave relationships. On circuit switched connections, calling station is the master, called station is slave. On dedicated connections, predefined data base parameters define the relationship. The master-slave relationship should not be confused with the initiator-responder relationship.

3.1.14 Message synchronization. The process whereby the DA/MS sharing a connection cooperatively progresses from an unknown or ambiguous message state to a common known start-of-message state, i.e., to either sending the first block of a message or to expecting the next input block to be the first block of a message.

3.1.15 Responder. The party reacting to the start of a procedure and following in the execution of the procedure.

3.1.15 SYN

a. Traffic State idle character or sequence.

1. MODEs I and VI; even parity SYN character,
2. MODEs II and V; one or more logical 1,
3. MODE VII; Flag sequence.

b. DACM idle characters or sequence.

1. ESC; handover SYN character/s,
2. DC4; handback SYN character/s,
3. MARK State; handback State.

3.1.17 Traffic mode. The mode between DA/MS that message traffic (Modes I through VII) is sent.

3.2 Abbreviations and acronyms. Abbreviations and acronyms used in this document are as defined in FED-STD-1037. Those abbreviations and acronyms unique to this document and not defined in FED-STD-1037 are provided in Appendix B.

4. GENERAL REQUIREMENTS

4.1 Data adapter function. The Data Adapter function is to implement the Data Adapter Control Mode (DACM) which was designed originally for operation over the TRI-TAC system. Figure 1B illustrates a typical Circuit Switch (CS)/Message Switch (MS)/Data Adapter (DA) connection which will use the DACM. Message switches are capable of operation with a DA on a dedicated or circuit switched basis.

4.1.1 DACM network parameters. Data access to a DA/MS shall be accommodated on a duplex digital basis at one of the standard loop and information rates as listed in table I. In addition the DACM shall:

a. Require a duplex circuit.
b. Operate at any information rate during transmission.
c. Initially operate at an information rate of 2400 bps.

TABLE I. DTE to loop transformations.

INFO RATES (bps)	LOOP RATES (bps)				
	2400	4800	9600	16000	32000
45.45 (Baud)	X	X	X	X	X
50	X	X	X	X	X
75	X	X	X	X	X
150	X	X	X	X	X
300	X	X	X	X	X
600	X	X	X	X	X
1200	X	X	X	X	X
2000			X	X	X
2400	X	X	X	X	X
4000				X	X
4800		X	X	X	X
8000				X	X
9600			X	X	X
16000				X	X
32000					X

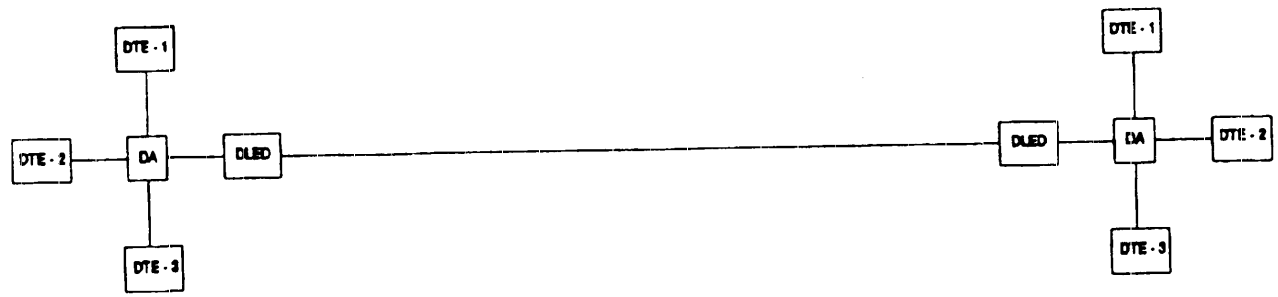
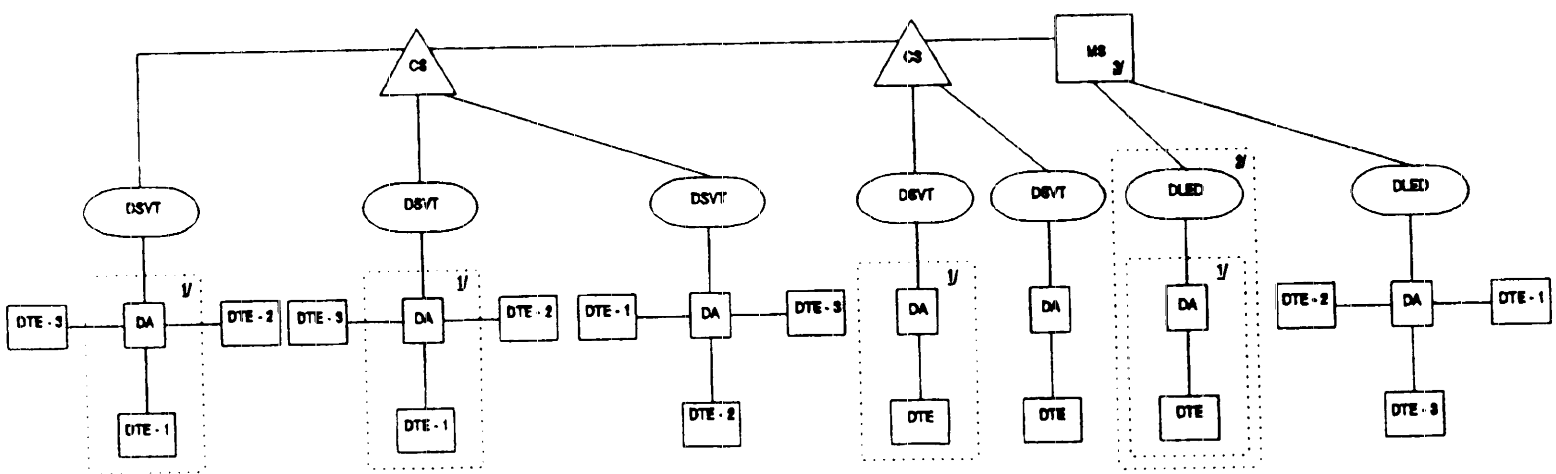


FIGURE 1A. Data transmission via point-to-point.



NOTE 1/ Although the DA and DTE are shown as individual equipment, they may be combined in one unit.

NOTE 2/ Although the COMSEC is shown as a separate function, the COMSEC may be an integral part of the DA/DTE.

NOTE 3/ The MS contains the DA function.

FIGURE 1B. Data transmission via circuit switch and message switched circuits.

4.1.2 Circuit establishment. The DACM should be used to set up circuit parameters. The circuit initialization DACM shall progress through the following five states.

a. Idle line.
b. Idle synchronization.
c. Idle rate DACM (at this time Data Adapter Control Blocks (DACBs) are transmitted).
d. Handover synchronization.
e. Traffic mode.

4.1.3 Parameter changes. The changing of circuit parameters shall progress through the following five states.

a. Traffic mode.
b. Handback synchronization.
c. Message rate DACM (at this time DACBs are transmitted).
d. Handover synchronization.
e. Traffic mode.

4.2 Operation. The DACM is a duplex synchronous operation. The DACM consists of synchronization characters, control characters, DACB characters and rate change MARK. All characters of the DACM consist of eight bits (see table II).

4.2.1 Synchronization idle characters. There are two synchronization characters: DC4 and ESC. These characters have an even number of logical 1 bits per character (see table II).

4.2.2 Control characters. There are two sets of control sequences each consisting of four contiguous characters (see tables II and III). Each character of the four character sequence shall contain an even number of logical 1 bits. These sequences are:

a. WBT WBT 31 31.
b. ACK ACK 31 31.

TABLE II. DACM 8 bit characters.

BITS		b_8	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
		b_7	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
		b_6	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1
		b_5	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
b_4 b_3 b_2 b_1	ROW	COLUMN	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0 0 0 0	0				SP						NUL			0		P		
0 0 0 1	1					1		Q				DC1			A			
0 0 1 0	2					2		R			STX 2/	DC2			B			
0 0 1 1	3		ETX 2/	DC3			C							3		S		
0 1 0 0	4			DC4 3/		4		T							D			
0 1 0 1	5						E				ENQ			5		U		
0 1 1 0	6		ACK 1/				F							6		V		
0 1 1 1	7		INV			7		W							G			
1 0 0 0	8					8		X							H			
1 0 0 1	9						I					EM 2/		9		Y		
1 0 1 0	10						J									Z		
1 0 1 1	11			ESC 3/											K			
1 1 0 0	12						L											
1 1 0 1	13														M			
1 1 1 0	14			WBT 1/											N			
1 1 1 1	15						O					31 4/ 1/						

NOTES: (shaded) Not used, available for future use

1/ Control character

2/ Frame character

3/ Synchronization Character

4/ Second framing character of DACB

TABLE III. DACB acknowledgement character sequences.

SEQUENCES	CHARACTER BIT POSITION			
	b_8 b_7 b_6 b_5 b_4 b_3 b_2 b_1	b_8 b_7 b_6 b_5 b_4 b_3 b_2 b_1	b_8 b_7 b_6 b_5 b_4 b_3 b_2 b_1	b_8 b_7 b_6 b_5 b_4 b_3 b_2 b_1
ACK 31	31 1 0 0 1 1 1 1 1	31 1 0 0 1 1 1 1 1	ACK 0 0 0 0 0 1 1 0	ACK 0 0 0 0 0 1 1 0
WBT 31	31 1 0 0 1 1 1 1 1	31 1 0 0 1 1 1 1 1	WBT 0 0 0 1 1 1 1 0	WBT 0 0 0 1 1 1 1 0

Notes: b_1 is LSB
LSB transmitted first
Characters transmitted from right to left.
b_8 is MSB.
Right most character (ACK/wBT) transmitted first

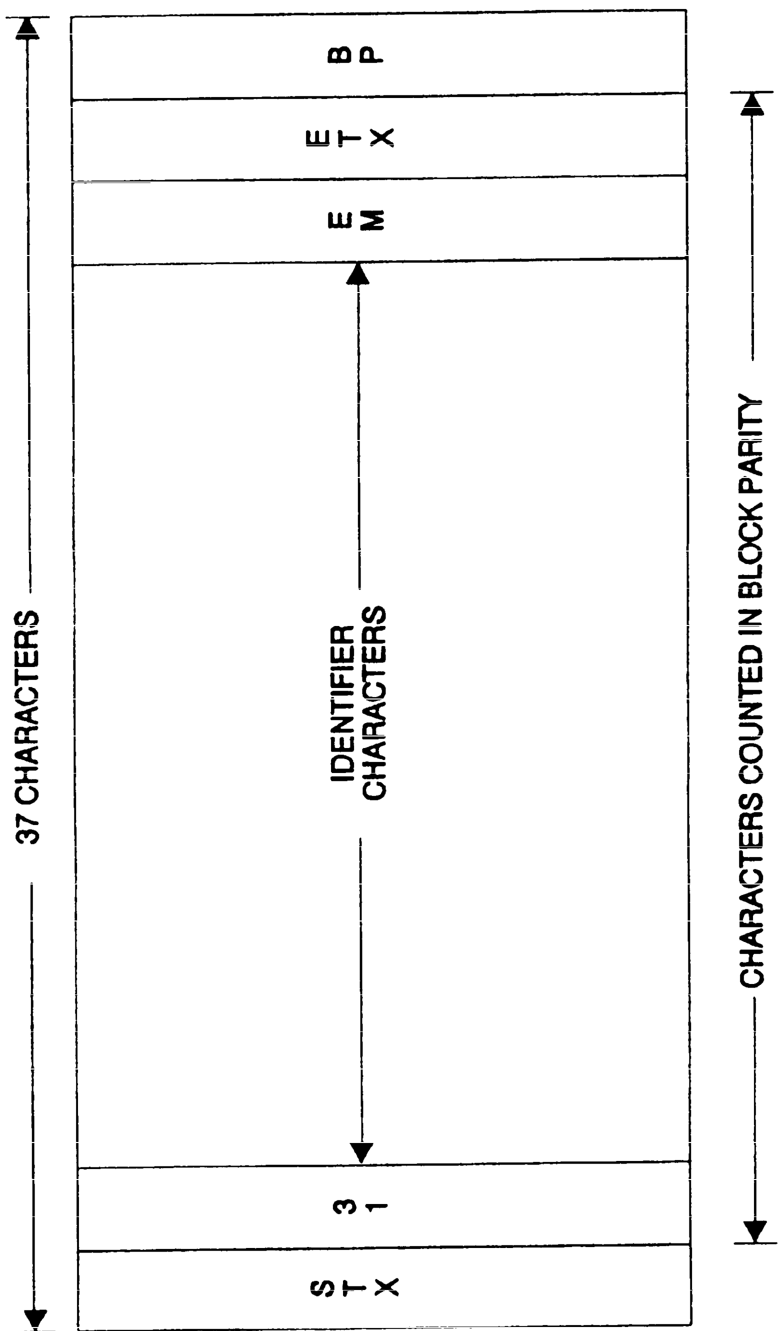


FIGURE 2. Data adapter control block.

4.2.3 Data Adapter Control Block (DACB). The DACB consists of 37 characters (see figure 2). The DACB is composed of 5 framing and 32 identifier positions.

4.2.3.1 Framing characters. The five framing characters of the DACB are (see table II):

a. Start of Text (STX).
b. 31.
c. End of Medium (EM).
d. End of Text (ETX).
e. Block parity (BP).

With the exception of BP, all framing characters shall contain an even number of logical 1 bits. Because of the manner that BP is generated, BP may be any character composed of eight bits.

4.2.3.2 Identifier position. The identifier characters are shown in table VII and are used in the 32 identifier character positions. Not all identifier characters are used in all positions. All identifier characters shall contain an odd number of logical 1 bits. Identifier characters which are not recognized as one of the assigned characters shall be treated as errors.

4.2.4 Rate change MARK. The DA places the loop in the MARK state whenever the information rate of the DACB changes.

(This page intentionally left blank.)

5. DETAILED REQUIREMENTS

5.1 Data adapter protocol. The DA may be a separate device or part of a Data Terminal Equipment (DTE), Message Switch (MS), or communications center. Figures 1A and 1B show a typical system that may be used to interconnect DA devices to each other and to an MS. This standard defines protocols exchanged and actions taken between DAs or between DAs and MSs. Two levels of interfaces shall exist for circuit switched connections between DAs or between DAs and MSs.

a. Signaling and supervision information exchanged between the telephone and various Circuit Switches (CS) to establish a data circuit path.

b. After the data circuit path is set up, the DACM coordination between DAs or between DAs and MSs shall take place. All the forms of this coordination are described herein. This coordination also applies to dedicated circuits between DAs or between DAs and MSs.

5.1.1 Protocol control. Circuit switched DA access shall require a control message exchange between DAs. This control message is known as a DACB. The state which DACBs may be transferred is known as the DACM. Prior to initiation of transmission of one or more traffic messages for either circuit switched calls or dedicated loops, the initiator shall send a DACB which shall be used to establish the parameters for the ensuing data transmission. Any change in DACB characteristics shall cause a new DACB to be transmitted. The message traffic shall be transmitted following acknowledgement of the DACB and synchronization at the DTE information rate. After completion of the message traffic transmission, a DACB may be transmitted (normally by the originating unit) to initiate the call termination sequence. A detailed description of the operation of the DACM protocol is given in Appendix C.

5.1.2 Protocol rates

5.1.2.1 DACB rate. DACBs should be sent at idle rate or information rate as defined in table I.

5.1.2.1.1 Idle rate. Idle rate shall be defined as an information rate of 2400 bps. If the loop rate is higher than 2400 bps, the bits shall be transmitted using multisampling techniques (see 5.3.1.1).

5.1.2.1.2 Information rate. Information rate is the rate that message traffic shall be exchanged (see 5.2.1.2).

5.2 DACM. The DACM shall consist of the methods and procedures required to establish, and control a tactical data communication channel between DTEs, DTE/MS, or MSs. The DACM shall be transparent to the information flow through the channel. The DACM includes the description of the following:

a. DACB types,
b. DACB format,
c. DACB acknowledgement,
d. DACB framing characters,
e. DACB signaling procedures,
f. Synchronization characters,
g. Handback request detection,
h. Break sequence,
i. MARK detection criteria,
j. Error control,
k. Message to loop rate transformation, and
l. COMmunication SECurity (COMSEC) control.

5.2.1 DACB format. A DACB shall consist of 37 8-bit characters (see tables II, IV, V, VIA, VIB and figures 2 and 3). Framing of a DACB shall be accomplished by a Start of TeXt (STX) character in position 1,followed by the framing character 31 in position 2 (see tables II, VIA, and VIB) and End of Medium (EM), End of Text (ETX), and Block Parity (BP) in positions 35,36,and 37 respectively. All framing characters, with the exception of BP, shall have an even number of logical 1 bits per character (see figure 3). BP may have an odd or an even number of logical 1 bits. All identifier characters shall have an odd number of logical 1's. Valid contents of DACBs shall be as defined in the following subsections. The minimum valid contents of each DACB generated shall be allowed as summarized in table VII.

Note: The character "31" of the DACB, identified by Column 9, row 15 of table II, is the label for the second framing character of the DACB and not a number.

5.2.1.1 Security classification and handling procedures. These two identifier characters (positions 3 and 4 of DACB) shall identify the classification parameter of the channel. These characters shall be NUL except when the transmission status control character (position 13) is NUL, B, or E. These allowable security classification indicators shall be in accordance with table VIII.

NOTE: ADP Security Directives, and Standards Operating Procedures may effect the implementation concerning these security identifiers codes. Performance requirements for each implementation should include the use of the security identification of the channel.

TABLE IV. Data adapter control block format.

Character Position	Character Description	Function	Reference Table
1	Framing	Start of Text Character - STX	N/A
2	Framing	Framing Character - 31	N/A
3-4	Security	Security of Channel Repeated Identifier (2 character)	VIII
5	Information Rate	Identifies the Information Rate	IX
6	Spare	Available for Future Use - NUL	N/A
7	Codes	Message Code	X
8	DTE Select	Identifies the DTE Channel Selected or Identified	XI
9	Message Format	Identifies Message Format Utilized	XII
10	Channel Control Procedures	Identifies Channel Control Procedures Utilized	XIII
11	Error Control	Identification of Error Control Technique Utilized	XIV
12	Precedence	Identifies Precedence of Message	XV
13	DACB Types	Identifies Purpose for Transmission of DACB	XVI
14	Mode VI Group Size	Defines Number of Blocks Per Group	XVII
15	Data Mode Control	Identifies Whether Data Mode Control Shall be Inhibited	XVIII

TABLE IV. Data adapter control block format - Continued.

Character Position	Character Description			Function	Reference Table
16	Address	Telephone Number	Area Code	First Digit of Area Code	N/A
17				Second Digit of Area Code	N/A
18				Third Digit of Area Code	N/A
19			Switch Code	First Digit of Switch Code	N/A
20				Second Digit of Switch Code	N/A
21				Third Digit of Switch Code	N/A
22			Subscriber Address	First Digit of Subscriber Address	N/A
23				Second Digit of Subscriber Address	N/A
24				Third Digit of Subscriber Address	N/A
25				Fourth Digit of Subscriber Address	N/A
26		Routing Indicator (RI)		First Character of RI	N/A
27				Second Character of RI	N/A
28				Third Character of RI	N/A
29				Fourth Character of RI	N/A
30				Fifth Character of RI	N/A
31				Sixth Character of RI	N/A
32				Seventh Character of RI	N/A

MIL-STD-188-216A

TABLE IV. Data adapter control block format - Concluded.

Character Position	Character Description	Function	Reference Table
33	DTE Type	Identification of DA Capabilities or Request for Specified DTE Capabilities (see 5.2.1.14)	N/A
34	DACB change	Identification of DACB (same as previous or changed)	XIX
35	Framing	EM - End of Medium	N/A
36	Framing	ETX - End of Text	N/A
37	Framing	BP - Block Parity	N/A

TABLE V. DACB character generation.

DACM Identifier Character Position(s)	Description	Character Setting by DACB Type										
		NUL *	DC2 *	ENQ *	INV *	A*	B*	C*	D*	E*	F*	G*
1	Framing	STX	STX	STX	STX	STX	STX	STX	STX	STX	STX	STX
2	Framing	31	31	31	31	31	31	31	31	31	31	31
3 & 4	Security	4/	NUL	NUL	NUL	NUL	4/	NUL	NUL	4/	NUL	NUL
5	Info Rate	4/	Z	H	2/	H	4/	H	H	4/	H	NUL
6	Spare	NUL	NUL	NUL	NUL	NUL	NUL	NUL	NUL	NUL	NUL	NUL
7	Codes	4/	4/	NUL	2/	NUL	4/	NUL	NUL	4/	NUL	NUL
8	DTE Select	5/	5/	5/	2/	NUL	5/	NUL	NUL	5/	5/	NUL
9	Format	4/	4/	NUL	2/	NUL	4/	NUL	NUL	4/	NUL	NUL
10	Channel Control	4/	4/	NUL	2/	NUL	4/	NUL	NUL	4/	NUL	NUL
11	Error Control	4/	4/	NUL	2/	NUL	4/	NUL	NUL	4/	NUL	NUL
12	Precedence	4/	4/	NUL	NUL	NUL	4/	NUL	NUL	4/	NUL	NUL
13	DACB Types	NUL	DC2	ENQ	INV	A	B	C	D	E	F	[illegible]
14	Mode VI Group Size	4/	NUL	NUL	2/	NUL	4/	NUL	NUL	NUL	NUL	NUL
15	Data Mode Control	4/	Z	Z	2/	Z	Z	Z	Z	Z	Z	Z
16-32	Address & RI	3/	3/	3/	3/	3/	3/	3/	3/	3/	3/	3/
$33b_1$	Page Printer	4/	4/	0	2/	0	4/	0	0	4/	4/	0
$33b_2$	Paper Tape	4/	4/	0	2/	0	4/	0	0	4/	4/	0
$33b_3$	Card Unit	4/	4/	0	2/	0	4/	0	0	4/	4/	0
$33b_4$	Terminal Display/ Storage	4/	4/	0	2/	0	4/	0	0	4/	4/	0
$33b_5$	Terminal Display/ Storage	4/	4/	0	2/	0	4/	0	0	4/	4/	0
$33b_6$	Terminal Display/ Storage	4/	4/	0	2/	0	4/	0	0	4/	4/	0

TABLE V. DACB character generation - Continued.

DACM Identifier Character Position(s)	Description	Character Setting by DACB Type										
		NUL *	DC2 *	ENQ *	INV *	A*	B*	C*	D*	E*	F*	G*
$33b_7$ 1/	SPARE	0	0	0	0	0	0	0	0	0	0	0
$33b_8$	Parity	7/	7/	7/	7/	7/	7/	7/	7/	7/	7/	7/
34	DACB Change	4/	NUL	NUL	4/	NUL	4/	NUL	NUL	4/	NUL	NUL
35	Framing	EM	EM	EM	EM	EM	EM	EM	EM	EM	EM	EM
36	Framing	ETX	ETX	ETX	ETX	ETX	ETX	ETX	ETX	ETX	ETX	ETX
37	Framing	6/	6/	6/	6/	6/	6/	6/	6/	6/	6/	6/

NOTES:

1/ - This bit position is a spare and shall be set to logical 0.

2/ - If a DACB (INV) is sent because:

a. the received DACB characteristics cannot be accommodated or
b. the received DACB characters are inconsistent with the stored classmarks associated with the RI in the received DACB.

Then each character position shall contain a valid character. The DACB (INV) character positions, except 3, 4, and 12, shall specify the characteristics acceptable to the MS/DA sending the DACB (INV).

3/ - The Message Switch/Data Adapter shall have the option of placing NUL characters in positions 16 through 25, inclusive where appropriate (i.e., dedicated circuits). Valid RI characters shall always be inserted in positions 26 through 32 inclusive.

4/ - The Message Switch/Data Adapter transmitting this DACB must place one of the valid characters or bits in this position. The characters or bits to be used are those specified in 5.2.1.1 through 5.2.1.15.

5/ - Multiple DTE Data Adapters and Message Switches shall place an appropriate valid character in this position. Single DTE Data Adapters shall place NUL in this position.

6/ - This position is a block parity character and is defined in paragraph 5.2.3.1.

7/ - This position is a parity bit and is the logical sum of all the bits of the character such that the number of logical 1's is odd.

* - DACB types (see 5.2.1.10), position 13 of DACB.

TABLE VIA. DACM characters - numerically.

DACM Characters	DACM Characters Bit Positions							
	b_8	b_7	b_6	b_5	b_4	b_3	b_2	b_1
ETX	0	0	0	0	0	0	1	1
ACK	0	0	0	0	0	1	1	0
INV	0	0	0	0	0	1	1	1
DC3	0	0	0	1	0	0	1	1
DC4	0	0	0	1	0	1	0	0
ESC	0	0	0	1	1	0	1	1
WRT	0	0	0	1	1	1	1	0
SP	0	0	1	0	0	0	0	0
1	0	0	1	1	0	0	0	1
4	0	0	1	1	0	1	0	0
7	0	0	1	1	0	1	1	1
8	0	0	1	1	1	0	0	0
C	0	1	0	0	0	0	1	1
E	0	1	0	0	0	1	0	1
F	0	1	0	0	0	1	1	0
I	0	1	0	0	1	0	0	1
J	0	1	0	0	1	0	1	0
L	0	1	0	0	1	1	0	0
O	0	1	0	0	1	1	1	1
Q	0	1	0	1	0	0	0	1
R	0	1	1	1	0	0	1	0
T	0	1	0	1	0	1	0	0
W	0	1	0	1	0	1	1	1
X	0	1	0	1	1	0	0	0
NUL	1	0	0	0	0	0	0	0
STX	1	0	0	0	0	0	1	0
ENQ	1	0	0	1	0	0	0	1
DC1	1	0	0	1	0	0	0	1
DC2	1	0	0	1	0	0	1	0

DACM Characters	DACM Characters Bit Positions							
	b_8	b_7	b_6	b_5	b_4	b_3	b_2	b_1
EM	1	0	0	1	1	0	0	1
31	1	0	0	1	1	1	1	1
0	1	0	1	1	0	0	0	0
2	1	0	1	1	0	0	1	0
3	1	0	1	1	0	0	1	1
5	1	0	1	1	0	1	0	1
6	1	0	1	1	0	1	1	0
9	1	0	1	1	1	0	0	1
A	1	1	0	0	0	0	0	1
B	1	1	0	0	0	1	0	0
C	1	1	0	0	0	1	0	0
G	1	1	0	0	0	1	1	1
H	1	1	0	0	1	0	0	0
K	1	1	0	0	1	0	1	1
M	1	1	0	0	1	1	0	1
N	1	1	0	0	1	1	1	0
P	1	1	0	1	0	0	0	0
S	1	1	0	1	0	0	1	1
U	1	1	0	1	0	1	0	1
V	1	1	0	1	0	1	1	0
Y	1	1	0	1	1	0	0	1
Z	0	1	0	1	1	0	1	0

NOTES:

a) b_1 is least significant bit (LSB)
b) LSB is first bit of a character transmitted
c) b_8 is most significant bit (MSB)
d) MSB is last bit of a character transmitted
e) Bits are transmitted from right to left (b_1 first and b_8 last).

TABLE VIB. DACM characters - alphabetically.

DACM Characters	DACM Characters Bit Positions							
	b_8	b_7	b_6	b_5	b_4	b_3	b_2	b_1
A	1	1	0	0	0	0	0	1
ACK	0	0	0	0	0	1	1	0
B	1	1	0	0	0	0	1	0
C	0	1	0	0	0	0	1	1
D	1	1	0	0	0	1	0	0
DC1	1	0	0	1	0	0	0	1
DC2	1	0	0	1	0	0	1	0
DC3	0	0	0	1	0	0	1	1
DC4	0	0	0	1	0	1	0	0
E	0	1	0	0	0	1	0	1
EM	1	0	0	1	1	0	0	1
ENQ	1	0	0	0	0	1	0	1
ETX	0	0	0	0	0	0	1	1
ESC	0	0	0	1	1	0	1	1
F	0	1	0	0	0	1	1	0
G	1	1	0	0	0	1	1	1
H	1	1	0	0	1	0	0	0
I	0	1	0	0	1	0	0	1
INV	0	0	0	0	0	1	1	1
J	0	1	0	0	1	0	1	0
K	1	1	0	0	1	0	1	1
L	0	1	0	0	1	1	0	0
M	1	1	0	0	1	1	1	0
NUL	1	0	0	0	0	0	0	0
O	0	1	0	0	1	1	1	1
P	1	1	0	1	0	0	0	0
Q	0	1	0	1	0	0	0	1
DC2	1	0	0	1	0	0	1	0

DACM Characters	DACM Characters Bit Positions							
	b_8	b_7	b_6	b_5	b_4	b_3	b_2	b_1
R	0	1	0	1	0	0	1	0
S	1	1	0	1	0	0	1	1
SP	0	0	1	0	0	0	0	0
STX	1	0	0	0	0	0	1	0
T	0	1	0	1	0	1	0	0
U	1	1	0	0	0	1	0	1
V	1	1	0	1	0	1	1	0
W	0	1	0	1	0	1	1	1
WBT	0	0	0	1	1	1	1	0
X	0	1	0	1	1	0	0	0
Y	1	1	0	1	1	0	0	1
Z	1	1	0	1	1	0	1	0
0	1	0	1	1	0	0	0	0
1	0	0	1	1	0	0	1	0
2	1	0	1	1	0	0	1	0
3	0	0	1	1	0	0	1	1
4	0	0	1	1	0	1	0	0
5	1	0	1	1	0	1	0	1
6	1	0	1	1	0	1	1	0
7	0	0	1	1	0	1	1	1
8	0	0	1	1	1	0	0	0
9	1	0	1	1	1	0	0	1
31	1	0	0	1	1	1	1	1

NOTES:

a) b_1 is least significant bit (LSB)
b) LSB is first bit of a character transmitted
c) b_8 is most significant bit (MSB)
d) MSB is last bit of a character transmitted
e) Bits are transmitted from right to left (b_1 first and b_8 last).

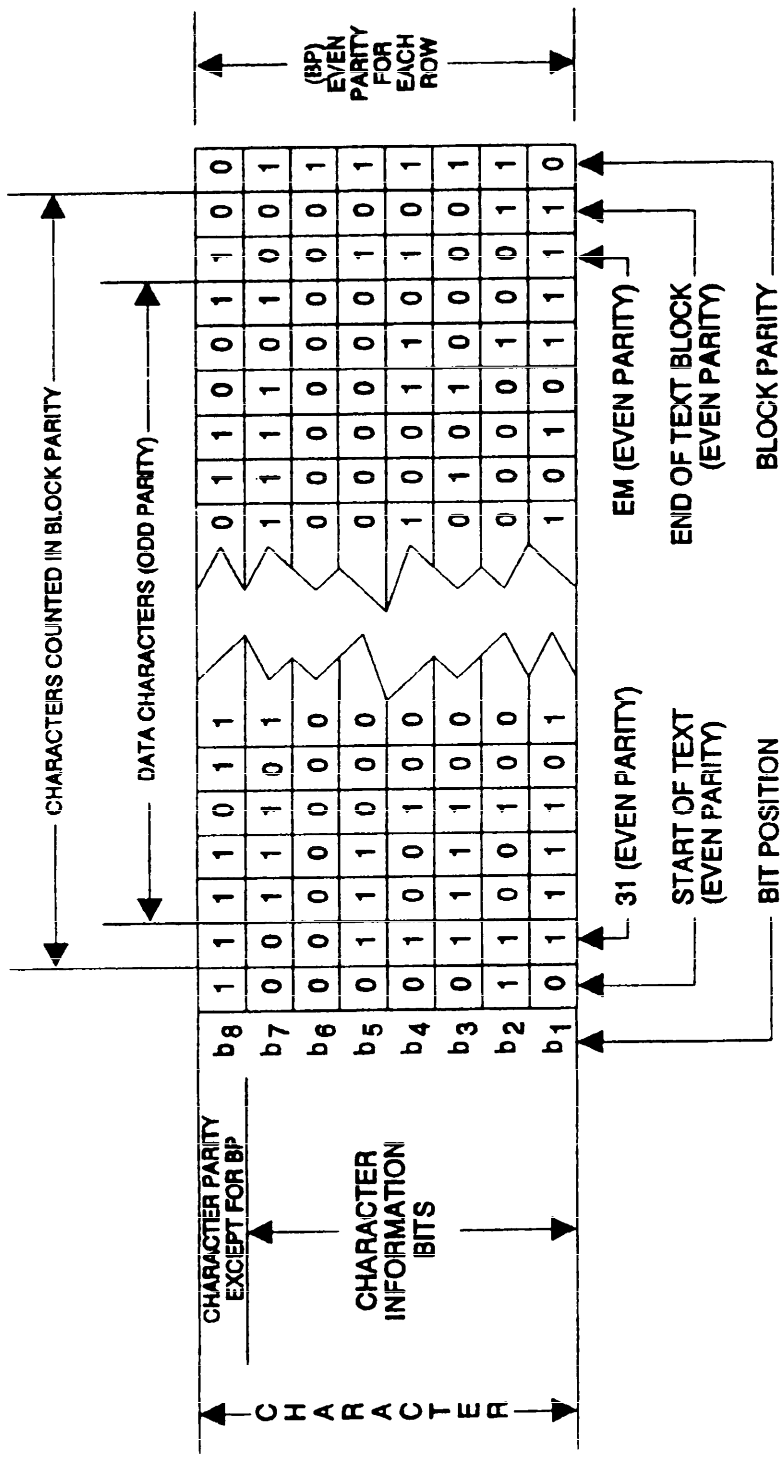


FIGURE 3. Parity checking rules for DACB.

TABLE VII. DACB identifier characters.

IDENTIFIER CHARACTERS	8 BIT CODE							
	b_8	b_7	b_6	b_5	b_4	b_3	b_2	b_1
NUL	1	0	0	0	0	0	0	0
ENQ	1	0	0	0	0	1	0	1
INV	0	0	0	0	0	1	1	1
DC1	1	0	0	1	0	0	0	1
DC2	1	0	0	1	0	0	1	0
DC3	0	0	0	1	0	0	1	1
SP	0	0	1	0	0	0	0	0
0	1	0	1	1	0	0	0	0
1	0	0	1	1	0	0	0	1
2	0	0	1	1	0	0	1	0
3	1	0	1	1	0	0	1	1
4	0	0	1	1	0	1	0	0
5	1	0	1	1	0	1	0	1
6	1	0	1	1	0	1	1	0
7	0	0	1	1	0	1	1	1
8	0	0	1	1	1	0	0	0
9	1	0	1	1	1	0	0	1
A	1	1	0	0	0	0	0	1
B	1	1	0	0	0	0	1	0
C	0	1	0	0	0	0	1	1
D	1	1	0	0	0	1	0	0
E	0	1	0	0	0	1	0	1
F	0	1	0	0	0	1	1	0
G	1	1	0	0	0	1	1	1
H	1	1	0	0	1	0	0	0
I	0	1	0	0	1	0	0	1
J	0	1	0	0	1	0	1	0
K	1	1	0	0	1	0	1	1
L	1	1	0	0	1	1	0	0
M	1	1	0	0	1	1	0	1

TABLE VII. DACB identifier characters - Continued.

IDENTIFIER CHARACTERS	8 BIT CODE							
	b_8	b_7	b_6	b_5	b_4	b_3	b_2	b_1
N	1	1	0	0	1	1	1	0
O	0	1	0	0	1	1	1	1
P	1	1	0	1	0	0	0	0
Q	0	1	0	1	0	0	0	1
R	0	1	0	1	0	0	1	0
S	1	1	0	1	0	0	1	1
T	0	1	0	1	0	1	0	0
U	1	1	0	1	0	1	0	1
V	1	1	0	1	0	1	1	0
W	0	1	0	1	0	1	1	1
X	0	1	0	1	1	0	0	0
Y	1	1	0	1	1	0	0	1
Z	1	1	0	1	1	0	1	0

Notes:

a) b_1 is least significant bit (LSB)
b) LSB is first bit of a character transmitted
c) b_8 is most significant bit (MSB)
d) MSB is last bit of a character transmitted

TABLE VIII. Security classification and handling procedures.

Identifier Characters	Identification
MM	"Y" RI Community
TT	Top Secret
SS	Secret
CC	Confidential
EE	EFTO (Encrypted for Transmission only)
UU	Unclassified
NUL NUL	No message associated with this DACB

NOTE: ADP Security Directives and Standard Operating Procedures may effect the implementation of these security identifier codes. Performance requirements for each implementation should include the use of the security classification of the channel.

5.2.1.2 Information rate. This identifier character (position 5 of DACB) shall identify the information rate of the channel (see table I). The information rate indicators shall be in accordance with table IX.

5.2.1.3 Character 6 of DACB. This identifier character (position 6 of DACB) shall be a NUL, and is a spare.

5.2.1.4 Codes. This identifier character (position 7 of DACB) shall identify the DTE message code. The indicators shall be in accordance with table X.

5.2.1.5 DTE select. This identifier character (position 8 of DACB) shall identify the DTE terminal requested within the DACB. For DACB (F) see 5.2.2.4. MSs and DAs with a single DTE channel shall not transmit DACB (INV) due solely to receipt of DC1, DC2, or DC3 in this character position. A multiple DTE DA shall transmit a DACB (INV) if an incompatible identifier character is received in a DACB. The indicators shall be in accordance with table XI.

5.2.1.6 Message format. This identifier character (position 9 of DACB) shall identify the format of the message(s) to be transmitted. The indicators shall be in accordance with table XII.

TABLE IX. Information rate.

Identifier Characters	Identification
A	45.45 baud
B	50 bps
C	75 bps
D	150 bps
E	300 bps
F	600 bps
G	1200 bps
H	2400 bps
I	4800 bps
J	9600 bps
K	16000 bps
L	32000 bps
M	2000 bps
N	4000 bps
O	8000 bps
Z	Remain at current information rate
NUL	No information rate associated with this DACB

TABLE X. Codes.

Identifier Characters	Identification
A	ASCII odd parity
B	IA No. 2
C	Continuous random bit stream and facsimile
D	4 out of 8 (IBM) code 10 unit start-stop
E	EBCDIC. (Extended Binary Coded Decimal Interchange Code)
F	Field data
G	ASCII even parity (data)
N	Nonstructured format magnetic tape
O	Structured format magnetic tape
NUL	No code identified by this DACB

NOTE: The equipment designer shall guard against the generation of false handback request.

TABLE XI. DTE select.

Identifier Characters	Identification
DC1	DTE-1
DC2	DTE-2
DC3	DTE-3
NUL	Only one DTE or selection based on character 33 of DACB

TABLE XII. Message format.

Identifier Characters	Identification
A	ACP-127
B	JANAP-128, Data
C	ACP-127 modified (DOI-103 Special)
D	JANAP-128, Teletypewriter
E	Special Format 1
F	Special Format 2
G	JANAP-128 modified (DOI-103 Standard
H	ACP-127 NATO SUPP 3
I	DOI-103 (CRITIC)
SP	RESERVED for MS trunk coordination
NUL	No special format (a valid format coordinated by means other than by DACBs)

5.2.1.7 Channel control procedures. This identifier character (position 10 of DACB) shall identify the operational mode of the DA (or the DTE connected to the DA) or the operational mode of the MS during message transmission. Modes I, II, V, and VI are defined in MIL-STD-188-171, 172, 173, and 174. Mode VII is defined in TT-B1-1205-0085. The indicators shall be in accordance with table XIII.

TABLE XIII. Channel control procedures.

Identifier Characters	Identification
A	Mode I - Continuous (MIL-STD-188-171)
B	Mode II (MIL-STD-188-172)
E	Mode V (MIL-STD-188-173)
F	Mode VI (MIL-STD-188-174)
G	Mode I - Block-by-Block (MIL-STD-188-171)
H	Mode VII (TT-B1-1205-0085)
J	Duplex Message Protocol 1/
NUL	Unspecified - utilized between DAs for facsimile and special DTE

NOTE: 1/ Duplex Protocol (Generic Gateway) - A Channel Control Procedure used by Special Community Message Switches (see Appendix A)

5.2.1.8 Error control. This identifier character (position 11 of DACB) shall identify the error control technique to be used in transmitting or receiving a message. The indicators shall be in accordance with table XIV.

TABLE XIV. Error control.

Identifier Characters	Identification
A	Multisampling - non bit framing (see 5.2.9.1.2)
D	1/2 rate Golay without multi-sampling (see Appendix D)
E	1/4 rate Golay (1/2 rate Golay without multisampling with double codeword transmission, see Appendix D)
F	1/8 rate Golay (1/2 rate Golay without multisampling with quadruple codeword transmission, see Appendix D)
NUL	Multisampling - bit framing (see 5.2.9.1.1)

5.2.1.9 Precedence. This identifier character (position 12 of DACB) shall identify the precedence of the channel. The indicators shall be in accordance with table XV.

TABLE XV. Precedence.

Identifier Characters	Identification
Y	Flash override (CRITIC, ECP)
Z	Flash
O	Immediate
P	Priority
NUL	Routine or precedence stated only in message header(s)

NOTE: Standard Operating Procedures may effect the implementation of these precedence identifier codes. Performance requirements for each implementation shall include the use of the precedence of the channel.

5.2.1.10 DACB types. This identifier character (position 13 of DACB) shall identify the reason for transmission of the DACB, or to request action(s) to be taken by the receiving DA/MS. There are 12 types of DACBs. The type of DACB is determined by the character in position 13. DACBs may be used to inquire and verify the identity of the distant end, to establish or change parameters, to terminate a call or return to idle, or to respond to an invalid DACB. The indicators and acceptable transmission rates shall be in accordance with table XVI (explained in Appendix C).

TABLE XVI. DACB types.

Rate	Characters Identifier	Identification
Information (Info)	DC2	DC2 character is sent in a DACB to reject an incoming message (non-ARQ modes only, see note 1)
Idle (circuit establishment)	ENQ	ENQ is sent in a DACB to request a DACB (F) response to verify the identity of the responding DA/MS
Idle/Info	INV	INV is sent in a DACB to indicate a received DACB cannot be accommodated by the responding DA/MS as specified in 5.2.2.3
Idle/Info	A	A is sent in a DACB to indicate present transmission has been completed, no further transmission is intended and to terminate the connection or go back to idle if dedicated
Info	B	B is sent in a DACB to indicate the received DTE to read the contents of this DACB to determine characteristics specified for continued transmission
Info	C	C is sent in a DACB to indicate transmission of message(s) is complete, hold connection in idle state. Further message transmission will be preceded by another DACB.

TABLE XVI. DACB types - (Continued).

Rate	Characters Identifier	Identification
Info	D	D is sent in a DACB to indicate cancellation of all transmission since the last start of message sequence, and to terminate the connection or go back to idle if dedicated (non-ARQ modes only) (see Note)
Info	E	E is sent in a DACB to indicate cancellation of all transmission since previous start of message sequence and to specify the characteristics for continued transmission (non-ARQ modes only) (see Note)
Idle	F	F is sent in a DACB to indicate the DACB is being sent in response to a DACB (ENQ)
Idle/Info	G	G is sent in a DACB to indicate "Go-to-Voice"
Idle/Info	NUL	NUL character is sent in a DACB during call initiation to specify and validate characteristics for subsequent data transmission
Idle/Info	K	K is reserved for future use of cryptokey exchange.

NOTE: The provision of special DACB signaling for non-ARQ modes does not imply a requirement to use this signaling. Individual DA/MS specifications defines when this signaling is required.

5.2.1.11 Mode VI group size. This identifier character (position 14 of DACB) shall identify the group size in terms of line blocks to be utilized in the ensueing Mode VI transmission when a DACB (NUL) or DACB (B) is sent. A responder shall accept a smaller group size capability when requested by the initiator. For all modes, except for Mode VI, the DA/MS shall place a NUL in this position. The indicators shall be in accordance with table XVII.

TABLE XVII. Mode VI group size.

Identifier Characters	Identification
A	32
B	64
C	96
D	16
NUL	Not applicable

5.2.1.12 Data mode control. This identifier character (position 15 of DACB) shall identify whether Data Mode Control (DMC) mode of operation shall be used (see 5.5.2) or inhibited. Upon initial establishment of a call (circuit), the DMC shall be enabled. The indicators shall be in accordance with table XVIII.

TABLE XVIII. Data mode control.

Identifier Characters	Identification
A	Data mode control inhibited
Z	Remains in present state
NUL	Data mode control employed

5.2.1.13 Address. The address (positions 16 through 32 of the DACB) shall contain addressing information of the DA/MS originating the DACB and shall consist of two fields; the telephone number of the station and the Routing Indicator (RI) of the station. The station telephone number shall be constructed in accordance with the associated digital circuit switch numbering plan. The 10-digit number (area code, switch code and subscriber address) shall be used. The telephone number shall be left justified. Unused portions of the telephone number shall be set to "NULs". The RI field shall be constructed in accordance with the applicable community RI directory (see ACP-117). The RI shall be left-justified in the field. Unused portions in the RI field shall be filled with NUL characters. For DA/MSs with multiple channel capability, the RI, for the specific DTE channel in character position 8 of the DACB, shall be inserted in characters 26-32 of DACB. If no DTE is connected to a specific channel, positions 26-32 of DACB shall be filled with "NULs".

5.2.1.14 DTE type. This identifier character (position 33 of the DACB) shall identify specific terminal equipment.

a. A logical 1 in bit position 1 shall indicate page printer.

b. A logical 1 in bit position 2 shall indicate a paper tape unit.

c. A logical 1 in bit position 3 shall indicate a card unit.

d. A logical 1 in bit position 4 shall indicate a terminal acting as a display or storage device.

e. A logical 1 in bit position 5 shall indicate a magnetic tape unit.

f. A logical 1 in bit position 6 shall indicate a facsimile unit.

g. Bit position 7 shall be a spare and shall be set to logical 0.

h. A logical 1 in more than one position shall indicate a combination of the above devices and capabilities.

i. Bit position 8: sum of logical 1s, such that the number of logical 1s are odd.

A DA/MS sending a DACB (F) or DACB (INV) shall set the appropriate bit(s) for the DTE(s) attached to the specific DTE channel when position 8 of the DACB being responded to is DC1, DC2, or DC3; or set the "logical 1" of all the DTE types on all channels when position 8 of the DACB is NUL. In DACB (NUL), DACB (B), and DACB (E) a specific bit shall be set for the type of terminal equipment requested. If a specified DTE channel (DC1, DC2, DC3, or NUL in position 8) does not have specified terminal type, a DACB (INV) shall be sent indicating the terminal types available on the specified DTE channel.

5.2.1.15 DACB change. This identifier character (position 34 of the DACB) shall identify whether the DA/MS transmitting a DACB is capable of changing its characteristics or has changed any of its characteristics from the previously transmitted DACB (provided position 13, DACB type, has not changed). Whenever DACB (DC2), DACB (ENQ), DACB (A), DACB (C), DACB (D), DACB (F), or DACB (G) is transmitted, character position 34 shall always be a NUL character. Whenever a DACB (INV) is transmitted, character position 34 of the DACB (INV) shall be the same as that of the received DACB to which the DACB (INV) responds. Whenever DACB (NUL), DACB (B), or DACB (E) is transmitted, character position 34 shall be in accordance with table XIX.

TABLE XIX. DACB change.

Identifier Characters	Identification
A	DA/MS is capable of changing its characteristics. This ASCII character (A) shall be used with first DACB transmission. It shall also be transmitted with each changed DACB when previously transmitted DACB had a "B" in position 34
B	DA/MS is capable of changing its characteristics. Transmitted with each changed DACB when previously transmitted DACB had an "A" in position 34
NUL	DA/MS not capable of changing its DACB characteristics

5.2.2 DACB acknowledgement. Upon reception of a correctly framed DACB with correct parity, the receiver shall send one of the following.

a. Positive acknowledgement.

b. Interim acknowledgement.

c. Invalid response.

d. Enquiry response.

5.2.2.1 Positive acknowledgement. The positive acknowledgement sequence shall be sent by the receiver in response to a DACB with correct parity and compatible identifiers specifying parameters acceptable to the receiver. The acknowledgement sequence shall consist of ACK ACK 31 31 (see table III). During the transmission of the positive acknowledgement sequence, no other character (data, framing, or control) shall interrupt this four character sequence.

5.2.2.2 Interim acknowledgement. The Wait Before Transmit (WBT) sequence shall consist of WBT WBT 31 31 (see table III and 5.2.4.2). The WBT sequence shall be sent to acknowledge receipt of a properly framed correct parity DACB and to request the transmitter to stop further transmission of DACBs. During the transmission of this sequence, no other characters (data, framing, or control) shall interrupt this four character sequence. The receiver shall transmit the WBT WBT 31 31 sequence at 3 second intervals until the DACB is validated by the receiver.

5.2.2.3 Invalid response. The invalid reply shall consist of a DACB with INV in position 13. DACB (INV) shall be sent only in response to a DACB (NUL), DACB (B), DACB (E), or not implemented DACB type, which is received correctly (no parity errors) and at a logical time (see table XVI), but that is received with contents specifying parameters unacceptable to the receiver. In all cases, the DACB (INV) shall contain the proper identifiers except security and precedence. NUL characters shall be inserted for security and precedence.

5.2.2.4 Enquiry response. The response to a DACB (ENQ) shall be a DACB (F). If the DACB (ENQ) contains DC1, DC2, or DC3 in character position 8, a DA with only one DTE shall respond with a DACB (F) with NUL in character position 8. A DA with more than one DTE shall respond with the same DC1, DC2, or DC3 received in character position 8.

5.2.3 DACB framing characters. The DACB shall consist of 5 framing characters and 32 identifier characters (see 5.2.1.1 through 5.2.1.15) for a total of 37 characters (see figure 2 and tables II, IV, and VI). The DACB framing characters shall serve to delineate the beginning and end of the DACB. Two of these characters (STX and 31) shall precede the identifier characters and three of these characters (EM, ETX, and BP) shall succeed the identifier characters. The transmission of a DACB shall never be interrupted by the transmission of any other characters except at termination of DACB transmission. The DACB framing characters are described in 5.2.3.1 through 5.2.3.5 and are listed in table XX.

5.2.3.1 Start of text (STX). STX shall be the first framing character of the DACB. STX shall not be included in the BP check.

5.2.3.2 Data adapter character 31. Character 31 shall be the second framing character of the DACB. Character 31 shall be included in the BP check. Character 31 shall be followed by 32 identifier characters (see table VII).

5.2.3.3 End of medium (EM). EM shall be the third FRAMING character of the DACB and shall be the 35th character of the DACB. EM shall be included in the BP check. EM shall be followed by the framing character sequence ETX BP.

5.2.3.4 End of text (ETX). ETX shall be the fourth framing character of the DACB and shall be the 36th character of the DACB. ETX shall be included in the BP check. ETX shall always be preceded by EM and followed by BP.

TABLE XX. DACM framing and control characters.

FRAMING, IDLE AND CONTROL CHARACTERS	8 BIT CODE							
	b_8	b_7	b_6	b_5	b_4	b_3	b_2	b_1
STX	1	0	0	0	0	0	1	0
ETX	0	0	0	0	0	0	1	1
ACK	0	0	0	0	0	1	1	0
EM	1	0	0	1	1	0	0	1
ESC	0	0	0	1	1	0	1	1
DC4	0	0	0	1	0	1	0	0
WBT	0	0	0	1	1	1	1	0
31	1	0	0	1	1	1	1	1

Notes:

a) b_1 is least significant bit (LSB)
b) LSB is first bit of a character transmitted
c) b_8 is most significant bit (MSB)
d) MSB is last bit of a character transmitted

5.2.3.5 Block parity (BP). BP shall be the last framing character of the DACB. BP shall always follow ETX. BP shall be formed by the binary addition without carry of each of the bits in each row of a block starting with the second framing character (31), including all identifier characters, the EM character, and ETX character. When ETX is detected, the next character should be compared bit for bit with the receiver generated BP character. These two characters should be identical. If they are not, the block shall be considered to have a parity error (see figure 3).

5.2.4 DACB signaling procedures. Each DACB transmitted and each acknowledgement sequence shall be sent with contiguous characters. No idle characters or other characters shall be sent between the defined DACB or acknowledgement sequence character positions.

5.2.4.1 DACB transmission. A DACB shall be sent continuously until receipt of an ACK 31 or until another appropriate response. Transmission of continuous DACBs shall be terminated upon receipt of an acknowledgement (ACK, WBT, DACB (INV), or DACB (F)) for the DACB. After receipt of a WBT sequence, no new DACB shall be initiated until after receipt of acknowledgement sequence or DACB (INV) or a time-out has occurred. The termination shall occur at any character boundary during the transmission of a DACB. Once a

WBT has been sent, any incoming DACBs shall be ignored until an ACK sequence, DACB (F), or DACB (INV) has been transmitted.

5.2.4.2 DACB acknowledgement transmission. An acknowledgement sequence (ACK ACK 31 31 or WBT WBT 31 31) shall be sent 10 times in response to a DACB. DC4 idle characters (see 5.2.5.1) shall be allowed between acknowledgement sequences. The receipt of a complete ACK ACK 31 31 or WBT WBT 31 31 sequence by a receiver shall be required for validation of these control character sequences. Termination of an acknowledgement sequence shall occur on any character boundary following the detection, by the responder, of the advancement of the initiator to the next signaling state.

5.2.4.3 DACB response transmission. If the responder continues to receive the same DACB after having sent a response other than WBT - i.e., ACK, DACB (F) or DACB (INV), it shall be assumed that the response sequence has been lost or not yet received and/or acted upon by the initiator. The duplicate block(s) shall be disregarded; however, the response to the previously answered DACB shall be retransmitted. In the case of duplicate block(s) received after the transmission of WBT, those blocks shall be disregarded an no response shall be sent.

5.2.4.4 Multiple DTE channel usage arbitration. In case of channel use "contention' with DTEs of a multiple DTE DA, the precedence of DTE message shall be utilized to determine the order in which the messages shall be transmitted.

5.2.5 Synchronization characters. The synchronization characters shall be DC4 and ESC and are listed in table XX.

5.2.5.1 Idle character (DC4). The DC4 character shall be the idle character used to establish and maintain DACM character synchronization. It shall also be used to signal handback. DC4 shall be transmitted at idle rate or at information rate. At least 10 contiguous DC4 characters shall be transmitted between each DACB.

5.2.5.2 Escape character (ESC). The ESC character is the transition synchronization character that shall be used during the transition between two lines states; e.g., idle rate to information rate or old information rate to new information rate. The ESC shall be sent as a synchronous character with the necessary encoding. When a transition is being made to a new information rate, the Forward Error Correction (FEC), bit stuffing, or multisampling that is specified for the new information rate shall be used to encode the ESC. When a transition is being made to idle rate, multisampling to 2400 bps information rate shall be used if the loop rate is greater than 2400 bps.

5.2.6 Handback request detection. While in the traffic state, the decoded information rate bit stream shall be constantly examined for synchronous DC4 characters. A DC4 character boundary may be different than the character boundary of the traffic mode. The detection of the DC4 stream shall indicate that the distant end is requesting a handback to DACM. Appendix C gives details of handback synchronization.

NOTE: For Modes that are capable of detecting excessive unexpected characters (Modes I, VI,etc), a handback request shall not be treated as excessive unexpected characters.

5.2.7 Break sequence. A break sequence shall be sent to "wake up" a distant end and shall force a return to the idle line state (see table XXI and Appendix C).

5.2.7.1 Break generation. A generated break sequence shall consist of one second of continuous "space" (logic zero) loop bits. After having sent a break sequence, the sender shall go to idle line state (see table XXI and Appendix C (50.2.1)).

5.2.7.2 Break detection. A break shall be recognized when 750 milliseconds of spacing line are detected. The break detector shall be implemented using a loop bit error filtering algorithm to ensure that a break, in a worst case noise environment,shall be detected. False detection shall also be guarded against by use of a filtering algorithm. To protect against false detection of break during idle-to-information and information-to-idle rate transitions, MARK shall be sent (see tables XXII and XXIII). The break detector shall be active at all times.

5.2.8 MARK detection criteria. MARK is sent in order to synchronize DA/MS. It is used after a break sequence by the slave who becomes the responder in the idle sync process and to initialize DA/MS.

5.2.8.1 MARK sequence. A detection of 32 contiguous logical 1 bits at information rate shall be considered as "detecting MARK."

5.2.8.2 Detection of loss of MARK sequence. When in the MARK detection sequence state, the DA/MS shall declare itself out of MARK sequence state if any 720 bit sample contains less than 32 contiguous mark bits.

5.2.9 Error control/message to loop rate transformation. The DA/MS may implement bit stuffing, multisampling, FEC (see Appendix D), and Automatic Repeat-reQuest (ARQ) error control techniques. Depending on the DA/MS capabilities, various combinations of these may be used. Error control and information to loop rate transformation shall be coordinated through the DACB.

TABLE XXIA. Example of generation of break (break by Master) - return to idle.

MASTER		SLAVE		DESCRIPTION
STATE	ACTION	ACTION	STATE	
IDLE LINE	Break (Loop Rate) →		IDLE LINE	Master recognizes loss of SYNC and performs Crypto Resync then sends break (logical zero (0) for one second) at loop rate. FEC and bit stuffing are inhibited as required.
		← Mark (Loop Rate)		Slave recognizes break and sends Mark. FEC and bit stuffing inhibited as required.
IDLE SYNC	ESC (2400) →		IDLE SYNC	Master detects mark and sends transitional idle (ESC).
		← ESC (2400)		Slave detects ESC and sends ESC.
	DC4 (2400) →			Master syncs on ESC and sends DC4.
		← DC4 (2400)		Slave syncs on DC4 and sends DC4.
	DC4 (2400) →			Master syncs on DC4. System is ready for transmission of DACBs.

TABLE XXIB. Example of generation of break (break by slave) - return to idle.

MASTER		SLAVE		DESCRIPTION
STATE	ACTION	ACTION	STATE	
IDLE LINE		← Break / (Loop Rate)	IDLE LINE	Slave recognizes loss of SYNC and performs Crypto Resync then sends break (logical zero (0) for one second) at loop rate. FEC and bit stuffing are inhibited as required.
IDLE SYNC	ESC / (2400) →		IDLE SYNC	Master break and sends transitional idle (ESC).
		← ESC / (2400)		Slave detects ESC and sends ESC.
	DC4 / (2400) →			Master syncs on ESC and sends DC4.
		← DC4 / (2400)		Slave syncs on DC4 and sends DC4.
	DC4 / (2400) →			Master syncs on DC4. System is ready for transmission of DACBs.

TABLE XXII. Example of call termination.

INITIATOR STATE	INITIATOR ACTION	RESPONDER ACTION	RESPONDER STATE	DESCRIPTION
TRAFFIC	SYN/MARK/DATA (Encoded)** (Msg Rate) →	← SYN/MARK/DATA (Encoded)** (Msg Rate) •	TRAFFIC	Initiator completes message transmission and sends encoded idle.
HANDBACK SYNC	DC4 (Encoded)** (Msg Rate) →	← SYN/MARK/DATA (Encoded)** (Msg Rate)	TRAFFIC	Initiator desires termination and signals hand-back by sending DC4s.
HANDBACK SYNC	DC4 (Encoded)** (Msg Rate) →	← DC4 (Encoded)** (Msg Rate)	HANDBACK SYNC	Responder detects and syncs on DC4 and sends DC4 and waits for DACB.
MSG RATE DACM	DACB (A/D) (Encoded)** (Msg Rate) →	← DC4 (Encoded)** (Msg Rate)	MSG RATE DACM	The Initiator syncs on DC4 and sends DACB (A) or DACB (D) continuously.

TABLE XXII. Example of call termination - continued.

INITIATOR		RESPONDER		DESCRIPTION
STATE	ACTION	ACTION	STATE	
MSG RATE DACM	DACB (A/D) (Msg Rate)**	ACK 31 (Msg Rate)**	MSG RATE DACM	The responder acknowledges DACB. Responder sends 10 ACK 31 for each DACB received.
	MARK + (Loop Rate)	IF DEDICATED		If circuit switched call, initiator detects ACK 31 and goes on hook. Responder detects Mark and goes on hook
	MARK + (2400)			If dedicated connection, initiator detects ACK 31 sequence, inhibits FEC coding and stuffing, if applicable, and sends mark.
		MARK + (2400)		Responder detects loss of DACB/DC4 and inhibit FEC coding and stuffing, if applicable, and sends Mark.
				Responder detects Mark and sends Mark.

TABLE XXII. Example of call termination - concluded.

INITIATOR		RESPONDER		DESCRIPTION
STATE	ACTION	ACTION	STATE	
IDLE SYNC	ESC (2400)** →		IDLE SYNC	Initiator detects Mark and sends ESC.
		← ESC (2400)**		Responder detects ESC and sends ESC.
	DC4 (2400)* →			Initiator detects ESC and sends DC4.
		← DC4 (2400)*		Responder detects DC4 and sends DC4.
	DC4 (2400)* →	← DC4 (2400)*		Both initiator and responder send DC4. System is ready for DACB transmission.

\+ MARK always sent at loop rate and unencoded. The ( ) associated rate indicates MIS/DA transmit/ receive baud rate clock during MARK transmission.

* Information rate. If loop rate is greater, multisampling, and bit stuffing are used as appropriate.

** Encoded - Multisampled - FEC Coded - Bit Stuffed

TABLE XXIII. Example of change of call characteristics.

INITIATOR STATE	INITIATOR ACTION	RESPONDER ACTION	RESPONDER STATE	DESCRIPTION
TRAFFIC MODE	SYN/MARK/DATA (Msg Rate)** →	← SYN/MARK/DATA (Msg Rate)**	TRAFFIC MODE	Traffic mode
HAND-BACK SYNC	DC4 (Msg Rate)** →	← SYN/MARK/DATA (Msg Rate)**	TRAFFIC MODE	Initiator signals for handback
HAND-BACK SYNC	DC4 (Msg Rate)** →	← DC4 (Msg Rate)**	HAND-BACK SYNC	Responder detects and syncs on DC4 and then sends DC4.
MSG RATE DACM	DACB (B/E) (Msg Rate)** →	← DC4 (Msg Rate)**	MSG RATE DACM	Initiator syncs on DC4 and sends DACB to request handover with new characteristics.
MSG RATE DACM	DACB (B/E) (Msg Rate)** →	← ACK 31 (Msg Rate)**	MSG RATE DACM	Responder acknowledges DACB. Responder sends 10 ACK 31 for each DACB received.
MSG RATE DACM	DC4 (Msg Rate)** →	← DC4 (Msg Rate)**	MSG RATE DACM	

TABLE XXIII. Example of change of call characteristics - continued.

INITIATOR		RESPONDER		DESCRIPTION
STATE	ACTION	ACTION	STATE	
HAND-OVER SYNC	MARK + (Loop Rate) →		HAND-OVER SYNC	Initiator detects ACK 31, stops DACB (B/E) transmission, and sends Mark sequence to indicate reception of ACK 31, inhibits FEC coding and stuffing, if applicable.
		← MARK + (Loop Rate)		Responder detects loss of DACB (B/E) and DC4. Searches for Mark. Inhibits FEC coding and stuffing, if applicable. Responder detects Mark, sends Mark and searches for transitional idle (ESC).
	ESC (Msg Rate)** →			Initiator detects Mark and sends transitional idle (ESC) with FEC, bit stuffing, multisampling as required.
		← ESC (Msg Rate)**		Responder does all levels of sync to encoded ESC and sends encoded ESC.
	SYN/MARK (Msg Rate)** →			Initiator does all sync to encoded ESC and hands over to the traffic mode idle pattern.

TABLE XXIII. Example of change of call characteristics - concluded.

INITIATOR		RESPONDER		DESCRIPTION
STATE	ACTION	ACTION	STATE	
HAND-OVER SYNC		← SYN/MARK (Msg Rate)**	HAND-OVER SYNC	Responder detects SYN/MARK and sends SYN/MARK. Initiator detects encoded SYN/MARK (traffic idle character) and prepares for traffic.
TRAFFIC	SYN/MARK/DATA (Msg Rate)** →	← SYN/MARK/DATA (Msg Rate)**	TRAFFIC	Traffic mode.

\+ MARK always sent at loop rate and unencoded. The ( ) associated rate indicates MS/DA transmit/receive baud rate clock during MARK transmission.

** Encoded - Multisampled - FEC Coded - Bit stuffed

5.2.9.1 Multisampling. The multisampling technique shall be used with information rates specified in table XXIV. Multisampling shall not be used in conjunction with bit stuffing or FEC.

5.2.9.1.1 Bit framing. In this mode of operation, all bits (data and idle) shall be transmitted using the information rate clock, that shall be derived from the loop rate clock according to the sampling sequences shown in table XXIV. This shall ensure that information bits contained in the loop rate data stream between the transmitter and receiver have a fixed and known relationship to the loop bits.

5.2.9.1.1.1 Start-stop data. The DA and MS shall only transmit an integral number of stop bits. For International Alphabet No. 2 (IA No. 2) start-stop code, one start, five data, and at least two stop bits (eight unit IA No. 2 code) shall be transmitted. In all cases, if there are no characters available for transmission, an integral number of information bit times of marks shall be generated before starting the next character.

5.2.9.1.1.2 Quantizing information bits. When the message rate to loop rate transformation results in a fractional number of loop samples per information bit, the fractional loop bit shall be rounded to an integral number by addition or subtraction of the fractional unit in a manner such that the average information rate is maintained (see figure 4 and table XXIV).

5.2.9.1.2 Non-bit framing. In this mode of operation, all information (data and idle) transmitted shall be multisampled at the loop clock rate i.e., bit framing (5.2.9.1.1) and bit quantization (5.2.9.1.1.1) need not be performed.

5.2.9.1.3 Reconstruction of multisampled data. The receiver shall reconstruct the data that has been transmitted by means of multisampling.

5.2.9.2 Bit stuffing. Bit stuffing shall be utilized to adjust certain information rates to loop rates (see table XXIV and Appendix D, table XXVIII). Bit stuffing shall be accomplished by transmitting three data bits followed by two stuff bits. If FEC is used, bit stuffing shall be accomplished subsequent to FEC.

NOTE: The receiver must be aware that the relationship of stuff bits to the FEC code word may not have a fixed relationship.

5.2.9.3 Automatic Repeat-Request (ARQ). ARQ is an error detecting scheme used by Mode I, Mode V, Mode VI, and Mode VII. ARQ may be used in conjunction with FEC and multisampling.

TABLE XXIV. Conversion tables from loop rates to information rates.

Loop Transmission Rate (bps)	Information Rate (bps)	Sampling Rate	Sampling Sequence 2/
2400	45.45 bauds	52.8	52, 53, 53, 53, 53 . . .
	50	48	48, 48, 48, 48, . . .
	75	32	32, 32, 32, 32, . . .
	150	16	16, 16, 16, 16, 16, . . .
	300	8	8, 8, 8, 8, 8, . . .
	600	4	4, 4, 4, 4, 4, . . .
	1200	2	2, 2, 2, 2, 2, . . .
	2400	1	1, 1, 1, 1, 1, . . .
4800	45.45 bauds	105.6	105, 106, 105, 106, 106, . . .
	50	96	96, 96, 96, 96, . . .
	75	64	64, 64, 64, 64, . . .
	150	32	32, 32, 32, 32, . . .
	300	16	16, 16, 16, 16, . . .
	600	8	8, 8, 8, 8, 8, . . .
	1200	4	4, 4, 4, 4, 4, . . .
	2400	2	2, 2, 2, 2, 2, . . .
	4800	1	1, 1, 1, 1, 1, . . .
9600	45.45 bauds	211.2	211, 211, 211, 211, 212, . . .
	50	192	192, 192, 192, . . .
	75	128	128, 128, 128, . . .
	150	64	64, 64, 64, 64, . . .
	300	32	32, 32, 32, 32, . . .
	600	16	16, 16, 16, 16, . . .
	1200	8	8, 8, 8, 8, 8, . . .
	2000	4.8	4, 5, 5, 5, 5, . . .
	2400	4	4, 4, 4, 4, . . .
	4800	2	2, 2, 2, 2, 2, . . .
	9600	1	1, 1, 1, 1, 1, . . .

TABLE XXIV. Conversion tables from loop rates to information rates - Continued.

Loop Transmission Rate (bps)	Information Rate (bps)	Sampling Rate	Sampling Sequence 2/
16000	45.45 bauds	352.0	352, 352, 352, 352, . . .
	50	320	320, 320, 320, 320
	75	213-1/3	213, 213, 214, . . .
	150	106-2/3	106, 107, 107, . . .
	300	53-1/3	53, 53, 54, 53, 53, 54, . . .
	600	26-2/3	26, 27, 27, . . .
	1200	13-1/3	13, 13, 14, . . .
	2400	6-2/3	6, 7, 7, 6, 7, 7, . . .
	4800	3-1/3	3, 3, 4, 3, 3, 4, . . .
	9600	Stuffed to 16000	3+2, 3+2, 3+2, . . . 1/
	2000	8	8, 8, 8, 8, 8, . . .
	4000	4	4, 4, 4, 4, 4, . . .
	8000	2	2, 2, 2, 2, 2, . . .
	16000	1	1, 1, 1, 1, 1, . . .
32000	45.45 bauds	704.1	704, 704, 704, 704, 704, 704, 704, 704, 704, 705, . . .
	50	640	640, 640, 640, . . .
	75	426-2/3	426, 427, 427, . . .
	150	213-1/3	213, 213, 214, . . .
	300	106-2/3	106, 107, 107, . . .
	600	53-1/3	53, 53, 54, . . .
	1200	26-2/3	26, 27, 27, . . .
	2400	13-1/3	13, 13, 14, . . .
	4800	6-2/3	6, 7, 7, 6, 7, 7, . . .
	9600	3-1/3	3, 3, 4, 3, 3, 4, . . .
	2000	16	16, 16, 16, . . .
	4000	8	8, 8, 8, 8, . . .
	8000	4	4, 4, 4, 4, 4, . . .
	16000	2	2, 2, 2, 2, 2, . . .
	32000	1	1, 1, 1, 1, 1, . . .

NOTES:
1/ 3+2 = 3 data bits plus 2 stuff bits   2/. . .; repeat previous sequences

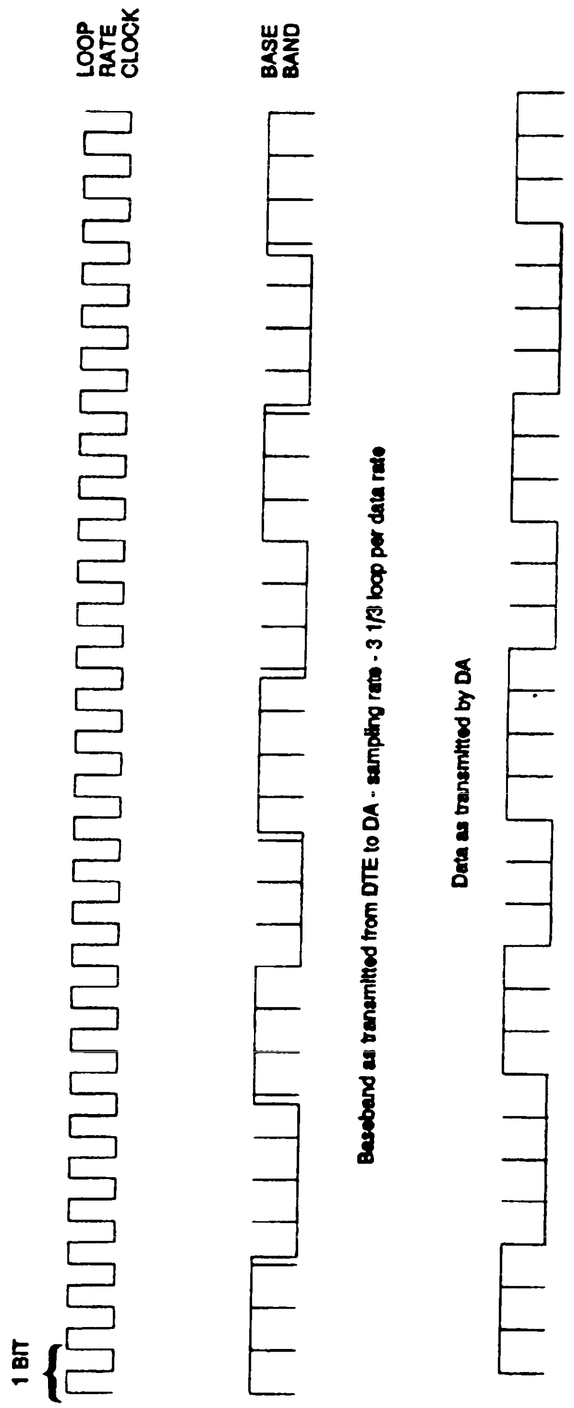


FIGURE 4. Example of quantizing information bits.
Data rate = 4800 bps, loop rate = 16000 bps.

5.2.9.4 Forward Error Correcting (FEC). FEC specified in this standard is 1/2, 1/4, and 1/8 rate Golay (see Appendix D).

5.3 Synchronization, resynchronization, and time-out

5.3.1 Synchronization sequences. Synchronization is the process whereby a transmitter/receiver sharing a connection, cooperatively progresses from a common starting point to a commonly desired end state. During the stages of synchronization, a receiver shall utilize the incoming encoded characters (e.g., DC4, ESC, and SYN) to achieve synchronization (encoded by multisampling, bit stuffing, and FEC encoding as applicable). During the various synchronization processes (see Appendix C), an initiator/responder relationship shall be used to determine the synchronization leader/follower respectively. The types of synchronization are multisampling, bit stuffing without FEC encoding, bit stuffing with FEC encoding, FEC without bit stuffing, and character synchronization. Examples of some typical character synchronization sequences are contained in the tables listed below.

Generation of break, return to idle - table XXI.
Normal call termination - table XXII.
Change of call characteristics - table XXIII.
Call initiation - table XXV.
Reject message - table XXVI.
Transmission complete, return to idle - table XXVII.
Invalid characteristics - table XXVIII.

5.3.1.1 Multisampling. When multisampling is employed, the transmitter shall send the current SYN character encoded with multisampling. The receiver shall establish bit synchronization on the information rate bits of the SYN pattern. The responder shall declare itself "in sync" upon detection of four contiguous decoded sync characters.

5.3.1.2 Bit stuffing without FEC encoding. The initiator, having attained synchronization, shall send ESC characters with stuff bits and data bits positioned as shown in figure 5. The responder shall strip stuff bits from the incoming bit stream using the previously acquired frame synchronization. The responder shall declare itself "in sync" upon detection of four contiguous decoded ESC characters.

5.3.1.3 Bit stuffing with FEC encoding. The initiator, having attained synchronization, shall send FEC encoded ESC characters with stuff bits, data bits, and FEC code bits positioned as required by Appendix D for Golay coding. The responder shall declare itself "in sync" upon detection of four contiguous decoded ESC characters.

NOTE: The receiver must be aware that a fixed relationship may not exist between stuff bits and the FEC code word.

TABLE XXV. Example of call initiation with ID establishment.

INITIATOR		RESPONDER		DESCRIPTION
STATE	ACTION	ACTION	STATE	
IDLE LINE	MARK + (Loop Rate)**	MARK + (Loop Rate)**	IDLE LINE	No connection between devices (on-hook/channel out of service). Dedicated or switched Initiator and responder in Mark state.
IDLE SYNC	ESC (2400)*	MARK + (Loop Rate)**	IDLE LINE	Initiator sends ESC while searching for ESC. Responder sends Marks while searching for ESC.
IDLE SYNC	ESC (2400)*	ESC (2400)*	IDLE SYNC	Initiator sends ESC while searching for ESC. Responder syncs on ESC and sends ESC.
IDLE SYNC	DC4 (2400)*	ESC (2400)*	IDLE SYNC	Initiator syncs on ESC and sends DC4.
IDLE SYNC	DC4 (2400)*	DC4 (2400)*	IDLE SYNC	Responder syncs on DC4 and sends DC4.
IDLE RATE DACM	DACB (ENQ) (2400)*	DC4 (2400)*	IDLE RATE DACM	Initiator syncs on DC4 and sends DACB (ENQ) to request Identification.

TABLE XXV. Example of call initiation with ID establishment - continued.

INITIATOR		RESPONDER		DESCRIPTION
STATE	ACTION	ACTION	STATE	
IDLE RATE DACM	DACB (ENQ) (2400)* →	← DACB (F) (2400)*	IDLE RATE DACM	Responder recognizes DACB (ENQ) and responds with DACB (F). Responder sends DACB (F) for each DACB (ENQ) received.
	DC4 (2400)* →	← DC4 (2400)*		Initiator recognizes DACB (F) and stops sending DACB (ENQ).
	DACB (NUL) (2400)* →	← DC4 (2400)*		Initiator sends a DACB (NUL) to initiate a DTE handover.
	DACB (NUL) (2400)* →	← ACK 31 (2400)*		Responder answers.
	DACB (NUL) (2400)* →	← ACK 31 (2400)*		Responder sends 10 ACK 31 for each DACB (NUL) received and waits for DACB (NUL) transmission to stop.
HAND-OVER SYNC	MARK + (Loop Rate) →		HAND-OVER SYNC	Initiator detects ACK 31 and sends Mark.
		← MARK + (Loop Rate)		Responder detects loss of DACB/DC4 and searches for MARK. Responder detects Mark and sends Mark.
	ESC (Info Rate)** →			Initiator detects Mark and changes DMC, if required, and sends transitional idle (ESC) with FEC, bit stuffing, multisampling as required. Initiator searches for ESC.

TABLE XXV. Example of call initiation with ID establishment - concluded.

INITIATOR STATE	INITIATOR ACTION	RESPONDER ACTION	RESPONDER STATE	DESCRIPTION
HAND-OVER SYNC		← MARK + (Loop Rate)	HAND-OVER SYNC	Responder, if DMC is changed, searches for loss of Mark, while sending Mark.
				Responder, if DMC is changed by initiator, detects loss of Mark, and changes DMC while continuing Mark transmission. Responder searches for encoded ESC at information rate (Info Rate).
	ESC (Info Rate)** →			Responder detects ESC, does all level of SYNC on encoded ESC.
		← ESC (Info Rate)**		Responder does all levels of sync to the encoded ESC and sends encoded ESC.
	SYN/MARK (Info Rate)** →			Initiator does all levels of sync to encoded ESC and hands over to the traffic mode idle pattern.
		← SYN/MARK (Info Rate)**		Responder detects SYN/MARK and transmits SYN/MARK. Initiator detects encoded SYN/MARK (traffic idle character) and prepares for traffic.
TRAFFIC	SYN/MARK/DATA (Info Rate)** →	← SYN/MARK/DATA (Info Rate)	TRAFFIC	Traffic mode.

+ MARK always sent at loop rate and unencoded.
* Information rate. If loop rate is greater than information rate, multisampling or bit stuffing are used as appropriate.
** Multisampled, FEC Coded or Bit stuffed as appropriate.
( ) Indicates MS/DA info rate.

TABLE XXVI. Example of reject message.

INITIATOR		RESPONDER		DESCRIPTION
STATE	ACTION	ACTION	STATE	
TRAFFIC	MARK/DATA/SYN (Info Rate) →	← MARK/DATA/SYN (Info Rate)**	TRAFFIC	Traffic mode
HAND-BACK SYNC	DC4 (Info Rate)** →	← MARK/DATA (Info Rate)**	TRAFFIC	Initiator signals for "Handback."
HAND-BACK SYNC	DC4 (Info Rate)** →	← DC4 (Info Rate)**	HAND-BACK SYNC	Responder detects and syncs on DC4 and then sends DC4.
MSG RATE DACM	DACB (DC2) (Info Rate)** →	← DC4 (Info Rate)**	MSG RATE DACM	Initiator syncs on DC4 and sends DACB (DC2).
MSG RATE DACM	DACB (DC2) (Info Rate)** →	← ACK 31 (Info Rate)**	MSG RATE DACM	Responder sends 10 ACK 31 for each DACB (DC2) received.
MSG RATE DACM	DC4 (Info Rate)** →	← DC4 (Info Rate)**	MSG RATE DACM	

TABLE XXVI. Example of reject message - concluded.

INITIATOR STATE	INITIATOR ACTION	RESPONDER ACTION	RESPONDER STATE	DESCRIPTION
HAND-OVER SYNC	MARK (Info Rate)** →		HAND-OVER SYNC	Initiator detects ACK 31 sequence, stops transmission of DACB (DC2) and DC4 and sends Mark.
HAND-OVER SYNC		← MARK (Info Rate)**	HAND-OVER SYNC	Responder detects Mark and sends Mark. Responder searches for ESC.
HAND-OVER SYNC	ESC (Info Rate)** →		HAND-OVER SYNC	Initiator detects Mark and sends ESC.
HAND-OVER SYNC		← ESC (Info Rate)**	HAND-OVER SYNC	Responder detects ESC and sends ESC.
TRAFFIC	SYN/MARK (Info Rate)** →		TRAFFIC	Initiator does all sync on encoded ESC and hands over to traffic code idle pattern.
TRAFFIC		← SYN/MARK (Info Rate)**	TRAFFIC	Responder detects loss of ESC, searches for traffic code idle pattern. When idle pattern is detected, responder hands over to traffic code idle pattern. Responder searches for traffic.
TRAFFIC	SYN/MARK/DATA (Info Rate)** →	← SYN/MARK/DATA (Info Rate)**	TRAFFIC	Traffic mode.

** Encoded - Multisampled, FEC Coded, or Bit stuffed as appropriate

TABLE XXVII. Example of transmission complete return to idle.

INITIATOR		RESPONDER		DESCRIPTION
STATE	ACTION	ACTION	STATE	
TRAFFIC	SYN/MARK/DATA → (Info Rate)**	← SYN/MARK/DATA (Info Rate)**	TRAFFIC	Traffic mode
HAND-BACK SYNC	DC4 → (Info Rate)**	← SYN/MARK/DATA (Info Rate)**	TRAFFIC	Initiator signals for "Handback."
HAND-BACK SYNC	DC4 → (Info Rate)**	← DC4 * (Info Rate)**	HAND-BACK SYNC	Responder detects and syncs on DC4 and then sends DC4.
MSG RATE DAGM	DACB (C) → (Info Rate)**	← DC4 * (Info Rate)**	MSG RATE DAGM	Initiator syncs on DC4 and sends DACB (C).
MSG RATE DAGM	DACB (C) → (Info Rate)**	← ACK 31 * (Info Rate)**	MSG RATE DAGM	Responder sends 10 ACK 31 for each DACB received.

TABLE XXVII. Example of transmission complete return to idle - concluded.

INITIATOR STATE	INITIATOR ACTION	RESPONDER ACTION	RESPONDER STATE	DESCRIPTION
MSG RATE DACM	MARK (Loop Rate) →		MSG RATE DACM	Initiator detects ACK 31, stops DACB (C) transmission and sends Mark to indicate reception of ACK 31, inhibits FEC coding and stuffing, if applicable.
		← DC 4 (Info Rate)+**		Responder detects loss of DACB (C) and DC4 and searches for Mark. Inhibits FEC coding and stuffing, if applicable.
	MARK (Loop Rate) →	← MARK (Loop Rate)		Responder detects Mark and sends Mark.
IDLE SYNC	ESC (2400) * →		IDLE SYNC	Initiator detects Mark and sends transitional sync (ESC).
		← ESC (2400) *		Responder syncs on ESC and sends ESC.
	DC4 (2400) * →	← ESC (2400) *		Initiator syncs on ESC and sends DC4.
	DC4 (2400) * →	← DC4 (2400) *		Responder syncs on DC4 and sends DC4.
	DC4 (2400) * →	← DC4 (2400) *		System ready for transmission of DACBs.

\+ MARK always sent at loop rate and unencode.
* Information rate. If loop rate is greater than information rate, multisampling, or bit stuffing are used as appropriate.
** Encoded - Multisampled, FEC coded or Bit stuffed as appropriate.
( ) Indicates MS/DA Info rate.

TABLE XXVIII. Example of invalid characteristics.

INITIATOR STATE	INITIATOR ACTION	RESPONDER ACTION	RESPONDER STATE	DESCRIPTION
IDLE LINE	MARK + (Loop Rate) →	← MARK + (Loop Rate)**	IDLE LINE	No connection between devices (on-hook/channel out of service). Dedicated or switched initiator and responder in Mark state.
IDLE SYNC	ESC (2400)* →	← MARK + (Loop Rate)	IDLE LINE	Initiator sends ESC while searching for ESC. Responder sends Marks while searching for ESC.
IDLE SYNC	ESC (2400)* →	← ESC (2400)*	IDLE SYNC	Responder syncs on ESC and sends ESC.
IDLE SYNC	DC4 (2400)* →	← ESC (2400)*	IDLE SYNC	Initiator syncs on ESC and sends DC4.
IDLE SYNC	DC4 (2400)* →	← DC4 (2400)*	IDLE SYNC	Responder syncs on DC4 and sends DC4.
IDLE RATE DACM	DACB (ENQ) (2400)* →	← DC4 (2400)*	IDLE RATE DACM	Initiator syncs on DC4 and sends DACB (ENQ) to request identification.

TABLE XXVIII. Example of invalid characteristics - continued.

INITIATOR STATE	INITIATOR ACTION		RESPONDER ACTION	RESPONDER STATE	DESCRIPTION
IDLE RATE DACM	DACB (ENQ) (2400)*	→		IDLE RATE DACM	Responder recognizes DACB (ENQ) and responds with DACB (F). Responder sends DACB (F) for each DACB (ENQ) received.
		←	DACB (F) (2400)*		
	DC4 (2400)*	→			Initiator recognizes DACB (F) and stops sending DACB (ENQ). Initiator send DC4.
		←	DC4 (2400)*		
	DACB (NUL) (2400)*	→			Initiator sends a DACB (NUL), with character 'A' in position 34 to initiate a DTE handover.
		←	DC4 (2400)*		
	DACB (NUL) (2400)*	→			Responder detects DACB (NUL); cannot validate the characteristics. Responder sends DACB (INV).
		←	DACB (INV) (2400)*		Initiator detects DACB (INV) changes the characteristics of the DACB; Initiator send a new DACB (NUL) Responder validates new DACB (NUL).
	DACB (NUL) (2400)*	→			Responder sends 10 ACK 31 for each DACB (NUL), with character 'B' in position 34 received and waits for DACB (NUL) transmission to stop.
		←	ACK 31 (2400)*		
HAND-OVER SYNC	MARK + (Loop Rate)	→		HAND-OVER SYNC	Initiator detects ACK 31 and sends Mark.
		←	MARK + (Loop Rate)		Responder detects loss of DACB/DC4 and searches for MARK. Responder detects Mark and sends Mark.
	ESC (Info Rate)**	→			Initiator detects Mark and changes DMC, if required, and sends transitional Idle (ESC) with FEC, bit stuffing, multisampling as required. Initiator searches for ESC.

TABLE XXVIII. Example of invalid characteristics - concluded.

INITIATOR		RESPONDER		DESCRIPTION
STATE	ACTION	ACTION	STATE	
HAND-OVER SYNC		← MARK + (Loop Rate)	*	Responder, if DMC is changed, searches for loss of Mark, while sending Mark.
	ESC → (Info Rate)**		HAND-OVER SYNC	Responder, if DMC is changed by initiator, detects loss of Mark, and changes DMC while continuing Mark transmission. Responder searches for encoded ESC at information rate (Info Rate).
		← ESC (Info Rate)**		Responder does all levels of sync to the encoded ESC and sends encoded ESC.
	SYN/MARK → (Info Rate)**			Initiator does all levels of sync to encoded ESC and hands over to the traffic mode idle pattern.
		← SYN/MARK (Info Rate)**		Responder detects SYN/MARK and transmits SYN/MARK. Initiator detects encoded SYN/MARK (traffic idle character) and prepares for traffic.
TRAFFIC	SYN/MARK/DATA → (Info Rate)**	← SYN/MARK/DATA (Info Rate)**	TRAFFIC	Traffic mode.

+ MARK always sent at loop rate and unencoded.
* Information rate. If loop rate is greater, than information rate, multisampling, or bit stuffing are used as appropriate.
** Multisampled, FEC Coded or Bit stuffed as appropriate.
( ) Indicates MS/DA info rate.

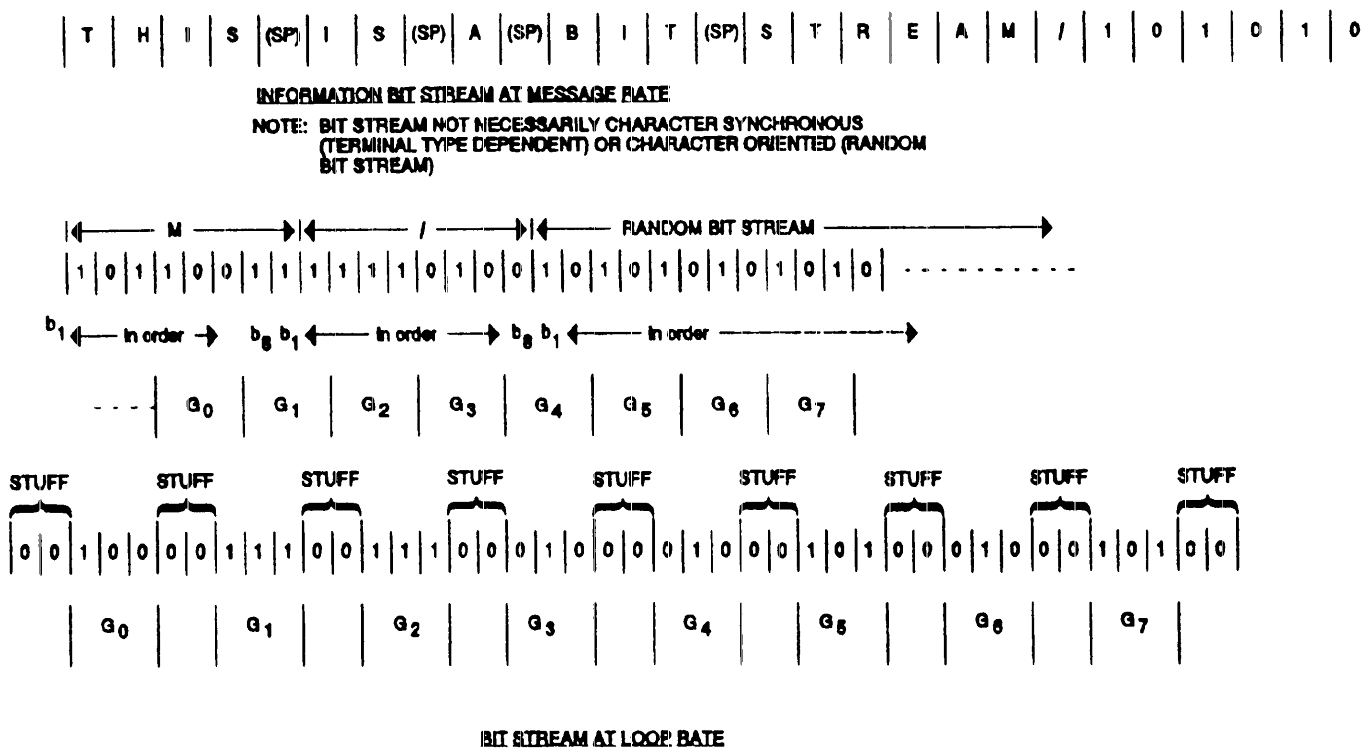


FIGURE 5. Bit stuffing without error control.

5.3.1.4 FEC encoding without bit stuffing. The initiator shall send FEC encoded ESC characters (1/2 rate, 1/4 rate, or 1/8 rate) as required by Appendix D for Golay coding. The responder shall declare itself "in sync" upon detection of four contiguous decoded ESC characters.

5.3.1.5 Character synchronization. A DA/MS shall obtain character synchronization by searching the decoded information rate bit stream, bit by bit for an eight-bit pattern that corresponds to the current SYN character. Upon finding a match, the DA/MS shall tentatively establish character boundary synchronization and then examine the next three characters and ensure that they are also the SYN character. If so, character synchronization shall be considered acquired. If any one of the three characters is not the current SYN character, the entire process shall be initiated again starting with the bit-by-bit search of the encoded information rate bit stream. The detailed synchronization requirements are given in Appendix C.

5.3.2 Loss of synchronization and resynchronization. Upon having progressed through many levels of synchronization to a desired level, it is then possible for any one of those levels of synchronization to be lost. The means for detecting loss of synchronization are described in Appendix C.

5.3.2.1 Methods for detecting loss of synchronization. The methods for detecting loss of synchronization shall be by:

a. Excessive unexpected characters (in a mode where such recognition is possible).

NOTE: A handback request shall not be treated as excessive unexpected characters.

b. Excessive start/stop bit position errors (Modes II or V).

c. Failure to progress to the next state of DACM.

d. Excessive parity errors in traffic state.

e. The operator.

5.3.2.2 Recovery procedures. Recovery procedures shall range from simple operator alarms with manual recovery to automatic link synchronization including automatic message cancellation and retransmission. The general capabilities provided by the DACM protocol are specified in Appendix C. For all recovery procedures other than a character resynchronization, the DA/MS shall verify loss of synchronization before attempting recovery procedures.

5.3.3 Time-out. The DA/MS shall time-out when synchronization, signaling and traffic procedures are not executing properly after a predetermined lapsed time. Timers shall be implemented as described in table XXIX and Appendix C.

NOTE: Timers/time-Outs tolerances are to be specified by the developer of the DA.

5.3.3.1 Circuit switched with high precedence traffic. For circuit switched high precedence traffic, the DA/MS shall return to idle rate and institute recovery procedures by sending a Break sequence (see 5.2.7 and Appendix C).

5.3.3.2 Circuit switched with low precedence traffic. For circuit switched low precedence traffic, the DA/MS shall release the connection.

5.3.3.3 Dedicated traffic. For a dedicated circuit, the DA/MS shall return to the idle rate and institute recovery procedures by sending a Break sequence (see 5.2.7 and Appendix C).

5.4 Structural validation of DACB. The DA/MS shall validate the DACB using the following rules (see figure 2).

a. The five framing characters shall be validated (STX, 31, EM, ETX, and BP).

b. Each identifier character shall be checked for parity error.

c. Position 13 of the DACB shall be validated and depending upon the character present, additional positional character content validation shall be performed.

5.5 Operation with cryptographic equipment

5.5.1 Cryptographic resynchronization. Loss of cryptographic synchronization and its recovery is a subset of overall loss of synchronization and resynchronization (see 5.3.2).

5.5.2 Data mode control (DMC). Data transmission between transmitter/receiver shall be capable of operating with or without the DMC of the associated COMSEC equipment enabled. Changing of the DMC status shall be accomplished during handover synchronization. For circuit switched data calls the DMC shall be enabled before entering the idle synchronization state.

5.5.2.1 Dedicated lines. On dedicated lines, the status of DMC during the connection shall be pre-coordinated by the operators.

TABLE XXIX. Timeouts and timeout actions.

STATE	CONDITION	ACTION TO BE TAKEN
Any synchronization character established	10 seconds no synchronization received	• Send break if dedicated • Send break if CS and high precedence • Terminate call if CS and low precedence
DACB sent	10 second no response	• Send break if dedicated • Send break if CS and high precedence • Terminate call if CS and low precedence
WBT 31 received	10 second time out	Resend DACB
	5 minute time out	Alarm
WBT 31 sent	3 seconds and not able to validate DACB	Resend WBT 31 sequence
Break sent	10 second time out	• Send break if dedicated • Send break if CS and high precedence • Terminate call if CS and low precedence
MARK sent	10 second time out	• Send break if dedicated • Send break if CS and high precedence • Terminate call if CS and low precedence

5.5.2.2 Switched lines. During call connection using DACBs, the associated COMSEC equipment of the DA/MS shall utilize the DMC feature. The successful transmission of a DACB (NUL) shall establish the state of DMC as specified by the identifier characters in position 15 of the DACB. Once the state of the DMC is determined by the first DACB (NUL), the state of the DMC shall be fixed until the call is terminated.

5.6 Glare. A glare situation arises when both parties simultaneously attempt to initiate DACB signaling. In such a case, the master's signaling shall be allowed to succeed (master wins glare) and the slave shall back down (lose glare) and shall respond to the master's signaling.

5.7 Identifier characters. Whenever the characteristics of a DACB are changed during call initiation, the DA upon completion of the call, shall reset the DACB characteristics to those identified during DA setup.

NOTE: The setup and manner of choosing the DACB characteristics shall be specified in the procurement documentation.

6. INFORMATION FOR GUIDANCE ONLY

6.1 Subject term (key word) listing

data adapter
data adapter control block
data adapter control mode
data adapter termination unit
data mode control
error detection
golay code

6.2 Special cases. The DA/MS shall not search for or act upon any of the DACM SYN characters (ESC,DC4), when the Data Adapter is not using one of the following Modes/Codes:

- a. Mode I,
- b. Mode II, IA No.2,
- c. Mode II, IA No.5, Odd Parity,
- d. Mode V, IA no.2,
- e. Mode V, IA No.5, Odd Parity,
- f. Mode VI,

6.2.1 Circuit switched connections. Upon completion of traffic transmission, the initiator/master shall terminate the call by releasing the connection (hang-up). For all other recovery situations see 5.3.3.1 and 5.3.3.2.

6.2.2 Handback. Handback shall be accomplish by the transmission of a Break sequence.

(This page intentionally left blank.)

APPENDIX A

DUPLEX MESSAGE PROTOCOL

Appendix A contains specific information in support of Duplex Message Protocol (Generic Gateway). Appendix A is not a mandatory part of this-document. Implementation of the Duplex Message Protocol is optional, but when implemented, it shall be accomplished in accordance with this appendix, (Appendix A)

APPENDIX A

10. FUNCTIONAL DESCRIPTION

The Full Duplex Message Protocol (FDMP) is used by application programs (gateway tasks) to send and receive messages between two message handling systems. An application program reads messages from a mass storage device (disk) and utilizes FDMP to transfer them to another system. FDMP passes messages it has received from another system to the application program which writes them to disk. FDMP utilizes a link level protocol to transfer messages and control information between systems. Specific features of FDMP are:

- Operates in a full duplex mode. That is, sending and receiving of messages may occur simultaneously.
- Control of the send and receive functions is independent. Message transfer in one direction may be suppressed without affecting transfer in the other direction.
- Supplemental data, such as dissemination information, may be transferred with the message text.
- FDMP is independent of the link level protocol, device interface, and physical characteristics of the link.
- Start up and shut down of either side of the link is asynchronous with respect to the other side.

To fully utilize FDMP, a link level protocol such as Digital Data Communications Message Protocol (DDCMP) or High-level Data Link Control (HDLC), which supports full duplex, variable sized blocks, and error detection and recovery, should be used. To allow for character oriented protocols such as Bisync to be used, FDMP avoids the use of binary data and communication control characters.

FDMP assumes a point-to-point communication environment and contains no provisions for use in a network or multipoint environment.

20. INTERFACES

This section describes the relationship between the user application, FDMP, and the link level protocol/device interface.

20.1 Application interface to FDMP. FDMP shall accept message segments from the application program. The application program identifies the first and last segments. FDMP is responsible for adding its control headers and breaking down and/or combining those segments into buffers of the size it uses for data transfer. FDMP shall pass segments of messages it has received, minus control headers, to the application program. The application program is responsible for combining and/or breaking down those segments into buffers of the size it uses for storage. FDMP shall identify the first and last segments to the application program. The content of the messages is transparent to FDMP.

The user notifies FDMP when it is starting up and shutting down. FDMP shall notify the user of changes in link status and link errors.

20.2 <u>FDMP interface to link/device</u>. FDMP shall select the size of buffers for data transfer within any limits allowed by the link level protocol or communication device. Depending on the actual link protocol, communication device, and software implementation, the link interface may specify how much space in those buffers must be reserved for link level headers and trailers. The link interface implements the link level protocol and interface to the communication device hardware to provide error free transfer of data buffers between FDMP modules.

Although FDMP is designed for direct point-to-point communications, it could be used in a network environment if the appropriate network protocol layers are inserted between the link interface and FDMP.

30. FORMATS

30.1 <u>General notation</u>. In the following discussions, a "buffer" refers to a unit transmitted or received via the link interface. FDMP shall produce and accept three types of buffers: control, supplemental data, and message text.

A "message" is a group of text buffers optionally preceded by supplemental data.

Each end of an FDMP link shall maintain status information on the ability to send and receive messages. When one end is ready to receive messages, it sets its status to "okay to receive,, and notifies the other end who then sets its status to "okay to send". At start up and after certain errors, status is always "not okay to send". In other words, a system is responsible for its own "receive" status. It relies on the other end to set its "send" to "okay".

Two timers are used in FDMP. One to control/measure events relating to sending a message and the other for receiving a message.

The term "bust" refers to the handling of incomplete messages. The receiver of an incomplete message "busts" it by ignoring all segments already received.

The term "re-queue" refers to the handling of incomplete messages by the sender. When the sender "re-queues" a message, he saves it for retransmission at a future time.

Two sets of message numbers are maintained by both ends of the link, one for each direction of transfer.

The term M/S refers to the sender of a message and M/R the receiver. The terms "sender" and "receiver" refer respectively to the sender and receiver of buffers.

ASCII numeric fields always have the most significant digit first and are padded with leading zeros when necessary.

30.2 Control buffers. Control buffers are used to communicate status and control the flow of messages. The format of a control buffer shall be as follows:

C	MSGNO	SUBTYP

where:

C 1 byte, ASCII 'C' (103 octal) - type identifier for control buffer.

MSGNO 4 bytes, ASCII numeric - number of the message to which the control buffer applies.

SUBTYP 3 to 6 bytes, ASCII - control subtype.

The control subtypes are the following:

REQSTS Request status. FDMP shall send REQSTS at start up and after any error indicative of loss of communications. The senders status is "not okay to send".

READY Ready to receive messages. When ready, FDMP shall send READY in response to REQSTS. The sender status is "okay to receive". The receiver status becomes "okay to send".

WBT Wait before transmitting (i.e., not ready to receive). FDMP shall send WBT in response to REQSTS when not ready, or to indicate change in ready to receive status to not ready. Senders status is "not okay to receive". Receivers status becomes "not okay to send". When sent while receiving a message, it indicates that the M/R cannot accept the complete message. The M/R "busts" the message. Upon receipt of WBT, the M/S shall stop sending and re-queue the message. The status of both sides changes as previously described.

REJECT — Negative acknowledgement. The M/R shall send REJECT to indicate sequence or format error or failure of the CRC validation on a received message. The M/R busts the message. Upon receipt of a REJECT, the M/S shall retransmit the message from the beginning.

ACK — Message acknowledgement. The M/R shall send ACK after successfully receiving and recording an entire message.

CANCEL — Cancel message. The M/S shall send CANCEL to specify that the remainder of a message will not be sent. The M/S shall re-queue the message. M/R busts the message.

30.3 Supplemental data. Supplemental data is optional but each implementation of FDMP shall accept supplemental data and pass the information to the application program. This is information apart from the text of a message which accompanies the message on transmission. To provide flexibility, supplemental data is divided into one or more items. The content of the items is transparent to FDMP. However, to provide the widest choice of link protocols and communication device, it should not contain binary data for communication control characters. Supplemental data is optional. If any is sent, it precedes the message text.

Supplemental data shall be formatted as shown below:

S	MSGNO	SEQNO	FLG	Supplemental Data

S	-	1 byte, ASCII IS' (123 octal) - type identifier for supplemental data buffer.
MSGNO	-	4 bytes, ASCII numeric - message number.
SEQNO	-	3 bytes, ASCII numeric - sequence number.
FLG	-	1 byte, ASCII flag - 'L' (114 octal) indicates the last buffer.

A data item will normally begin with a keyword followed by a variable amount of data. Because data items may be any length, and to optimize link utilization, supplemental data items have four forms.

Form 1 is used when an item fits in one buffer.

L E N	Keyword, Data	Additional Items

LEN - 3 bytes, ASCII numeric - length of the data item.

Additional items - Optional. If present, they will be Form 1 or 2.

Form 2 is used when the beginning of an item is too large to fit in the remaining buffer space.

0	0	0	Keyword, Data

000 - 3 ASCII zeros - signifies that the remainder of the buffer contains the beginning of the item.

Form 3 is used for the continuation of an item which fills the entire buffer.

0	0	0	Data

000 - 3 ASCII Zeros - signifies that the entire buffer contains the continuation of the item.

Form 4 is used for the last segment of an item which spans buffers.

L E N	Keyword, Data	Additional Items

LEN - 3 bytes ASCII - length of the last segment of the data item.

Additional items - Optional. If present, they will be Form 1 or 2.

30.4 Message text. The format of message text buffers is:

```
-------------------------------------------------------------
| T | M S G N O | S E Q N O | FLG | Message Text            |
-------------------------------------------------------------
```

where

T	-	1 byte, ASCII 'T' (124 octal) - type identifier for message text buffers.
MSGNO	-	4 bytes, ASCII numeric - message number.
SEQNO	-	3 bytes, ASCII numeric - sequence number.
FLG	-	1 byte, ASCII flag - 'L' (114 octal) indicates the last buffer.

The content of the message text is transparent to FDMP. However, it should not contain binary data nor communication control characters.

40. OPERATION

FDMP is a true full duplex protocol with respect to sending and receiving messages. Operations involving sending a message and receiving a message have no effect on each other. Therefore, control buffers have meaning only to message transfer in a given direction. REQSTS and CANCEL are always sent by the message sender (M/S) to the message receiver (M/R). READY, WBT, REJECT,and ACK are always sent by the M/R to M/S.

FDMP operation for both sending and receiving are divided into four modes: not ready, starting up (becoming ready), idle (ready but inactive), and actively sending or receiving.

40.1 Sending Messages. For each mode the following paragraphs give events that may occur and the subsequent action that is to be taken.

40.1.1 Not ready. This mode is entered if the application program is suppressing message transmission. In this mode, FDMP shall inhibit sending any buffers and shall ignore READY, WBT, ACK, and REJECT. The status remains "not okay to send".

40.1.2 Startup. When starting up, or after a link error, the status is "not okay to send". The status of the other end must be determined. FDMP shall send the REQSTS control buffer and start a timer. One of the following will then occur:

- Control READY is received. FDMP shall cancel the timer and change status to "okay to send". If messages are waiting, transmission may begin. FDMP shall enter idle or active mode.

- Control WBT is received. FDMP shall restart the timer and retain the status of "not okay to send". FDMP shall remain in startup mode.

- Timer expires. FDMP shall retransmit the REQSTS control buffer and the restart the timer. A counter is incremented. When the counter reaches its threshold value, an error message is printed and the counter reset. FDMP shall remain in startup mode.

- ACK or REJECT received. Increment appropriate error count and check error thresholds. FDMP shall remain in startup mode.

40.1.3 Idle. When no message is being sent the following may occur:

- Control WBT is received. FDMP shall start the timer and set status to "not okay to send". FDMP shall enter startup mode.

- Control READY is received. This buffer is ignored. FDMP shall remain in idle mode.

- ACK or REJECT received. Increment appropriate error count and check error thresholds. FDMP shall remain in idle mode.

- A message ready to be sent. FDMP shall enter the message active mode.

40.1.4 Message active. Sending a message consists of transmitting buffers of supplemental data and text and waiting for acknowledgement after the last buffer is sent. When sending a message, one of the following may occur:

- Control REJECT is received. After any buffers in the process of transmission are complete, FDMP shall retransmit the entire message, including supplemental data. The same message number is used. Re-sequencing begins at 001. Increment appropriate error count and check error thresholds. FDMP shall remain in message active mode.

- Control WBT is received. Further transmission of buffers for the message shall be inhibited. FDMP shall re-queue the message and change status to "not okay to send". The timer is started. FDMP shall enter the startup mode.

- Control READY or ACK is received. Increment appropriate error count and check error thresholds. FDMP shall remain in message active mode.

- Link error occurs. FDMP shall attempt to send control CANCEL and proceed as though receiving WBT.

- User message handling error occurs. FDMP shall send control CANCEL and enter idle mode. The user program determines whether message is to be retransmitted.

After sending the last text buffer, FDMP shall start a timer. At this point the following may occur:

- Control ACK is received. FDMP shall cancel the timer. If any messages are available, FDMP may begin sending. Otherwise, FDMP shall enter the idle mode.

- REJECT or WBT is received. FDMP shall cancel the timer. Further transmission of buffers for the message shall be inhibited. FDMP shall re-queue the message and change status to "not okay to send". The timer is started. FDMP shall enter the startup mode.

- Timer expires. FDMP shall send CANCEL and re-queue the message. Status becomes "not okay to send". FDMP shall enter startup mode.

- Control READY received. Increment appropriate error count and check error thresholds. FDMP shall remain in message active mode.

40.2 Receiving Messages. For each mode the following paragraphs give events that may occur and the subsequent action that is to be taken.

40.2.1 Not ready. Status is "not okay to receive". FDMP shall send a control WBT in response to supplemental data, message text, control CANCEL, or REQSTS buffers.

40.2.2 Startup. Status becomes "okay to receive". FDMP shall send a control READY and enter idle mode.

40.2.3 Idle. When "okay to receive, and no message is being received the following may occur:

- REQSTS is received. FDMP shall send a control READY and remain in idle mode.

- Data or text with sequence number 001 is received. FDMP shall enter message active mode and start a timer.

- Data or text with sequence number not 001 is received. FDMP shall send control REJECT and remain in idle mode. Increment appropriate error count and check error thresholds.

- Control CANCEL is received. Increment appropriate error count and check error thresholds. FDMP shall remain in idle mode.

40.2.4 Message active. While receiving a message the following may occur:

- Good data or text is received. Increment count of good buffers. If the last text buffer of a message is received, FDMP shall cancel the timer and enter idle mode. Otherwise, FDMP shall remain in the message active mode.
- Control CANCEL is received. Bust the message. FDMP shall send control READY and enter idle mode.
- Timer expires. If the good buffer count is non-zero, FDMP shall remain in the message active mode. Restart the timer and reset the count. If the good buffer count is zero, FDMP shall send REJECT and enter idle mode. Bust the message.
- User message handling error occurs. FDMP shall send control REJECT or WBT and enter idle or not ready mode as directed by the user program.

40.3 Shutting down or throttling. FDMP may throttle incoming messages either as a condition of available buffer space or upon direction of the application program. FDMP shall send a control WBT to stop receiving messages. If a message was being received, it is busted.

50. A TYPICAL IMPLEMENTATION

A typical environment includes the Communication Support Processor (CSP) as used by the All Source Analysis System (ASAS). The CSP provides all external interfaces including the interface to AUTODIN. The CSP uses a communications interface processor called the Communications Protocol Processor (CPP) to standardize all external interfaces. For purposes of this document, the term CSP will be used to refer to the combined CSP and CPP. The full duplex Message Protocol (FDMP) is used for message transfer between the CSP and other processors. The link level protocol used is the Digital Data Communications Message Protocol (DDCMP). The format of message text sent from the CSP and accepted by the CSP is either DOI-103 or JANAP 128.

50.1 Data Flows. Data flow between the CSP and external systems is full duplex. A typical message exchange scenario between to full-duplex FDMP/DDCMP modules is diagrammed in below:

CSP requests DDCMP synchronization with DDCMP STRT
REMOTE receives STRT and responds with DDCMP STACK
(DDCMP link between CSP to REMOTE is initialized)

REMOTE requests FDMP synchronization with FDMP REQSTS
CSP receives REQSTS and responds with FDMP READY with DDCMP ACK
REMOTE receives READY and returns DDCMP ACK
(FDMP link from REMOTE to CSP is initialized)
CSP requests FDMP synchronization with FDMP REQSTS
REMOTE receives REQSTS and responds with FDMP READY with DDCMP ACK
CSP receives READY and returns DDCMP ACK
(FDMP link from CSP to REMOTE is initialized)
CSP transmits FDMP message to REMOTE
REMOTE receives message and detects CRC error in DDCMP Header
REMOTE sends DDCMP NAK
CSP receives NAK and retransmits FDMP message
REMOTE accepts message and transmits message to CSP with DDCMP ACK
CSP receives message and returns DDCMP ACK

50.2 Protocol Formats. Link level protocol communications between the CSP and the REMOTE occurs at the DDCMP level. Two Types of DDCMP frames are used in the interface:

- Data Frames
- Control Frames

Control frames are used to communicate link control instructions, transmission status and reception status and are described in section 50.2.1. Data Frames are used to transmit and receive variable length data message and are described in section 50.2.2.

The DDCMP Data Frames that are communicated on this interface always contain an FDMP frame. The FDMP fames are extracted on reception from, and assembled on transmission to, the REMOTE.

50.2.1 DDCMP Level Control Messages. DDCMP is a protocol which carries link control information, transmission status, and initialization notification between the Transmitter and the Receiver. The following control types are used by this protocol implementation:

Start Message - STRT. The STRT message establishes initial contact and synchronization on a DDCMP link. The transmitter sends this message during link start-up or reinitialization. The start sequence resets message numbering at the transmitter and receiver.

Start Acknowledge Message - STACK. The STACK message is the response to a STRT message. It tells the receiver that the transmitter has completed initialization.

Acknowledge Message - ACK. This message acknowledges the receipt of correctly numbered data messages that have passed the CRC-16 check. This message is also used to acknowledge receipt of the DDCMP control STACK message. The ACK message is used when acknowledgments are required and when no data messages are to be sent in the reverse direction. The ACK message conveys the same information as the RESP field in numbered data messages.

Negative Acknowledge Message - NAK. The NAK message passes error information from the DDCMP data receiver to the DDCMP data sender. The NAKTYPE field indicates the cause of the error. The NAK message also includes the same information as the ACK message. Thus it serves two functions: acknowledging previously received messages and notifying the sender of some error condition. The following is a list of the possible error conditions

- BCC Header Error
- BCC Data Error
- Rep Response
- Buffer Unavailable
- Receiver Overrun
- Message Too Long
- Header Format Error

Reply to Message Number - REP. The REP message requests received message status from the data receiver. It is usually sent when the sender has transmitted a data message and has not received a reply within a timeout period. The response to a REP is an ACK or NAK depending on whether the receiver has or has not received all the messages previously sent by the sender as indicated by the message number in the REP.

50.2.2 FDMP Level Control Messages FDMP is used to send and receive messages between two formatted message handling systems. FDMP assumes a point-to-point communication environment. The protocol formats of the FDMP level use the following control types:

REQSTS Request status. Applies only to the transmit side. Sent at start-up and after any error indicative of loss of communications.

READY Ready to receive messages. Sent in response to a REQSTS.

REJECT Negative acknowledgement. Sent by the message receiver to indicate a sequence or format error.

ACK Message acknowledgement. Sent after receiption of the entire message indicating successful reception and safe store of the message.

CANCEL Cancel message. Sent by the message sender to specify that the remainder of the message will not be sent.

WBT Wait before transmitting. Sent in response to REQSTS or to indicate a change in receiver's ability to receive messages.

50.3 Format Line 15A Verification. The CSP scans DOI-103 and JANAP 128 messages identifying format lines 5, 6, and 12 and calculates a CRC-16. This value is then converted to ASCII and compared with the contents of format line 15A. A successful comparison will result in continued processing of the message. If the comparison fails, a FDMP REJECT is transmitted indicating the CRC error. The CRC-16 calculation is performed using the following polynomial:

$$X^{16} + X^{15} + X^{2} + 1$$

(This page intentionally left blank.)

APPENDIX B

LIST OF ABBREVIATIONS AND ACRONYMS USED IN MIL-STD-188-216

This appendix contains general information in support of MIL-STD-188-216. Appendix B is a nonmandatory part of this document.

APPENDIX B

ACRONYMS AND ABBREVIATIONS

This appendix provides definitions of acronyms and abbreviations used in this standard. This appendix is not a mandatory part of this standard.

31	Control or framing character
ACK	Positive acknowledgement
ACP	Allied communication publication
ARQ	Automatic repeat - request
ASCII	American Standard Code for Information Interchange
AUTODIN	Automatic digital network
BP	Block parity - framing character
bps	Bits per second
CMD	Command
COMSEC	Communications security
CS	Circuit switch
CTL	Control
DA	Data adapter
DACB	Data adapter control block
DACB (A)	DACB with identifier character A in position 13. Transmission complete - terminate call (GO-ON-HOOK if switched).
DACB (B)	DACB with identifier character B in position 13. Transmission complete - read contents of this DACB for new characteristics and continue.
DACB (C)	DACB with identifier character C in position 13. Transmission complete - return to idle rate.

DACB (D)	DACB with identifier character D in position 13. Cancel all transmission since last start of message sequence then terminate the call (GO-ON-HOOK if switched).
DACB (DC2)	DACB with identifier character 'DC2' in position 13 - reject message.
DACB (E)	DACB with identifier character E in position 13. Cancel reading of DACB contents for new characteristics and continue.
DACB (ENQ)	DACB with identifier character 'ENQ' in position 13. Request receiving DA send its DACB (F).
DACB (F)	DACB with identifier character 'F' in position 13. Positive response to received DACB 'ENQ'.
DACB (G)	DACB with identifier character G in position 13. Go to voice.
DACB (K)	DACB with identifier character K in position 13. Cryptokey exchange (Future use).
DACB (INV)	DACB with identifier character 'INV' in position 13. Response when invalid DACB is received.
DACB (NUL)	DACB with identifier character 'NUL' in position 13. Sent during call initiation.2
DACM	Data adapter control mode. This is the state between DA/MSs in which DACBs may be sent.
DA/MS	Data adapter/message switch; data adapter to message switch; between data adapter and message switch.
DCAC	Defense Communications Agency Circular
DC4	DACM idle character
DLED	Dedicated loop encryption device
DMC	Data mode control

DNVT	Digital non-secure voice terminal
DO	Design objective
DODD	Department of Defense Directive
DODISS	Department of Defense Index of Specifications and Standards
DOI	DSSCS operating instruction
DSSCS	Defense Special Security Communications System
DSVT	Digital subscriber voice terminal - secure voice/data digital terminal
DTE	Data terminal equipment
DTE-1	DTE connected to terminal 1 of DA
DTE-2	DTE connected to terminal 2 of DA
DTE-3	DTE connected to terminal 3 of DA
EBCDIC	Extended Binary Coded Decimal Interchange Code
ECP	Emergency command precedence
EFTO	Encrypted for transmission only
EM	End of Medium framing character
ENQ	Enquiry DACM character
ESC	DACM message rate idle character and/or idle synchronization character
ETX	End of text - framing character
FDMP	Full duplex message protocol
FEC	Forward error correction
FED-STD	Federal standard
INFO	information
INV	Invalid DACM character
IR	Idle rate

IA No. 2	International Alphabet No. 2
JANAP	Joint Army, Navy, Air Force Publication
LSB	Least significant bit
MIL-STD	Military standard
MS	Message switch or store and forward module
MSB	Most significant bit
MS/DA	Message switch/data adapter
MSG RATE	Information rate (Info rate)
N/A	Not applicable
SYN	character (ESC, DC4)
SYNC	synchronization
TRI-TAC	Joint Tactical Communication Office Equipment
WBT	Wait before transmitting, DACM character

(This page intentionally left blank)

APPENDIX C

STATE DIAGRAMS FOR DACM PROTOCOL

Appendix C contains specific information in support of MIL-STD-188-216. Appendix C is a nonmandatory part of this document.

APPENDIX C

10. GENERAL

10.1 Purpose. The purpose of this appendix is to define the DACM protocol as a tool with many capabilities in a manner which provides for a consistent but flexible implementation.

10.2 Scope. This appendix contains state diagrams illustrating the DACM protocol. The intent is to clearly define the normal and abnormal data and control system modes.

20. APPLICABLE DOCUMENTS

Not applicable.

30. DEFINITIONS

For purposes of this appendix, the definitions of section 3 of this document and FED-STD-1037 shall apply.

40. GENERAL REQUIREMENTS

The DACM protocol described herein is general in its nature. It describes a function which may be implemented within simple adapter boxes, intelligent terminals, or large switching centers. Each of these pieces of equipment have system-level requirements which dictate how this protocol is to be implemented. The DACM protocol function can be subdivided into a set of basic functions (tools, assets, processes) under the control of a "supervisor". This is illustrated in figure 6. In the supervisory function, the "supervisor" will decide how information flows between these functions, what task a given function performs at any given time, and what functions are active at any given time. It is also responsible for communicating with the higher-level function.

The basic functions are:

a. input bit processing.

(1) Perform serial to parallel conversion.

(2) Perform Golay decoding, bit unstuffing, demultisampling, and framing checking.

(3) Perform input synchronization.

(4) Perform break detection.

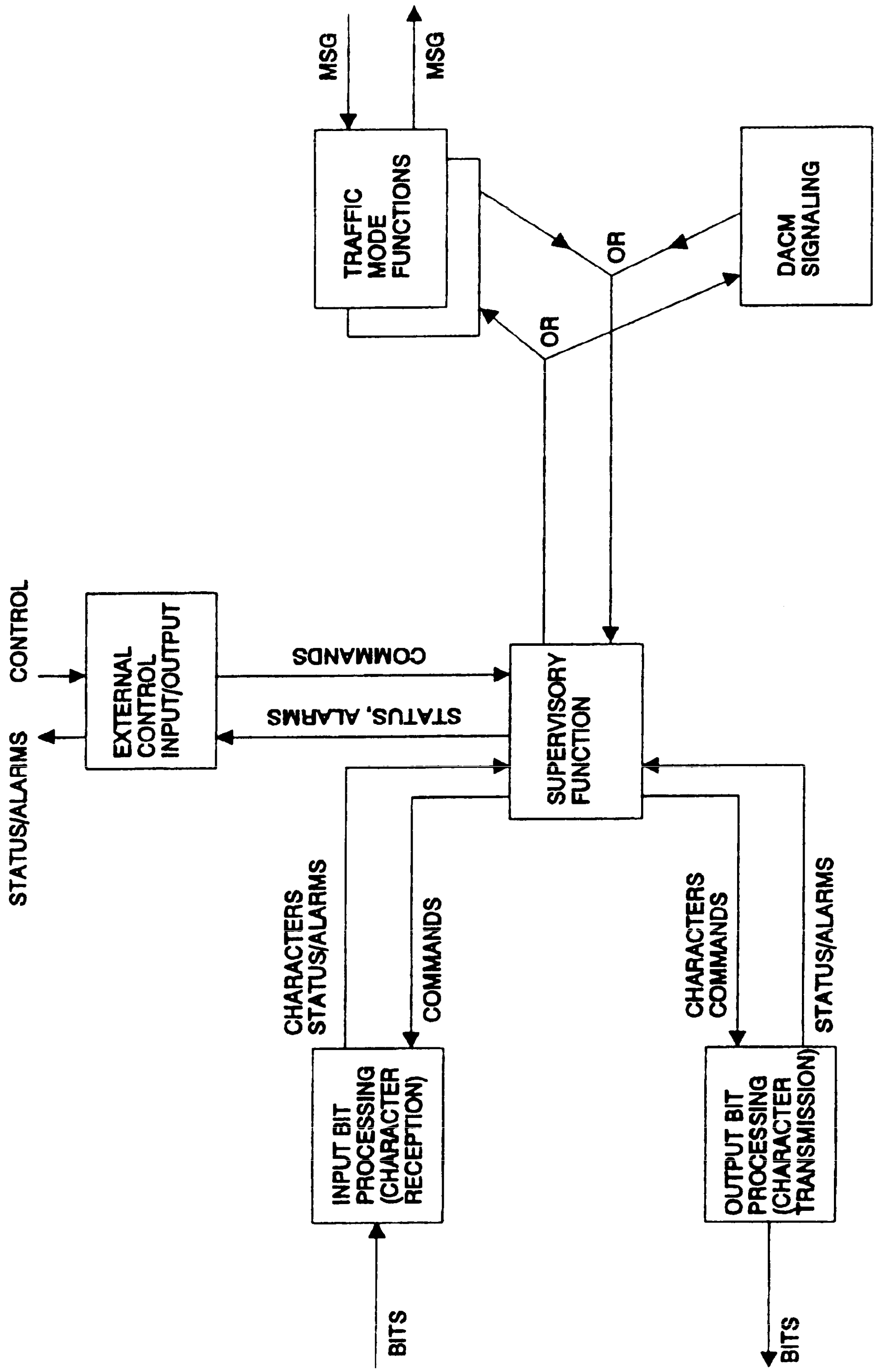


FIGURE 6. DACM protocol functional internal representation.

b. output bit processing.

(1) Perform parallel to serial conversion.

(2) Perform Golay encoding, bit stuffing, multisampling, and framing.

(3) Perform output synchronization.

(4) Perform break generation.

c. DACM signaling.

(1) Perform the mechanics of DACM signaling.

40.1 Documentation approach. A hierarchical approach is used to divide the documentation into manageable pieces. Figure 7 shows only the structure of the documentation of DACM signaling, traffic mode functions, and supervisor functions. The representation contained in figure 7 corresponds to that in figure 6. The document convention is shown in Figure 8. The top-level diagram, figure 9, shows each of the high-level processes which the DACM protocol supervisor can perform and the interrelationship with the other high-level processes. Each process is in turn defined by an individual process diagram or explanation, illustrating all possible actions, both normal operation and abnormal operation or fault conditions available to the supervisor, while performing that process. To use this appendix, one must determine the active states. At each level there will be an active state; e.g., the DA/MS is awaiting the answer to a DACB (NUL). On the top level diagram, figure 9, the call identification and call initiation signaling process, figure 10 and 11. The "supervisor" is constantly monitoring the "basic functions" of figure 6, awaiting output from them. Although output is expected from DACM signaling, a break or an external command can be received at any time. Within DACM signaling (figure 12), "waiting for response" is active. One then determines from the state diagrams the response for any given stimulus.

40.2 Introduction to top-level diagram. The top-level diagram (figure 9) divides the DACM protocol into processes and defines the relationships among these processes. These processes fall into several categories defined in the following subparagraphs.

40.2.1 Processes external to the DACM protocol

a. Connection terminated.

b. Voice state.

c. Crypto synchronization.

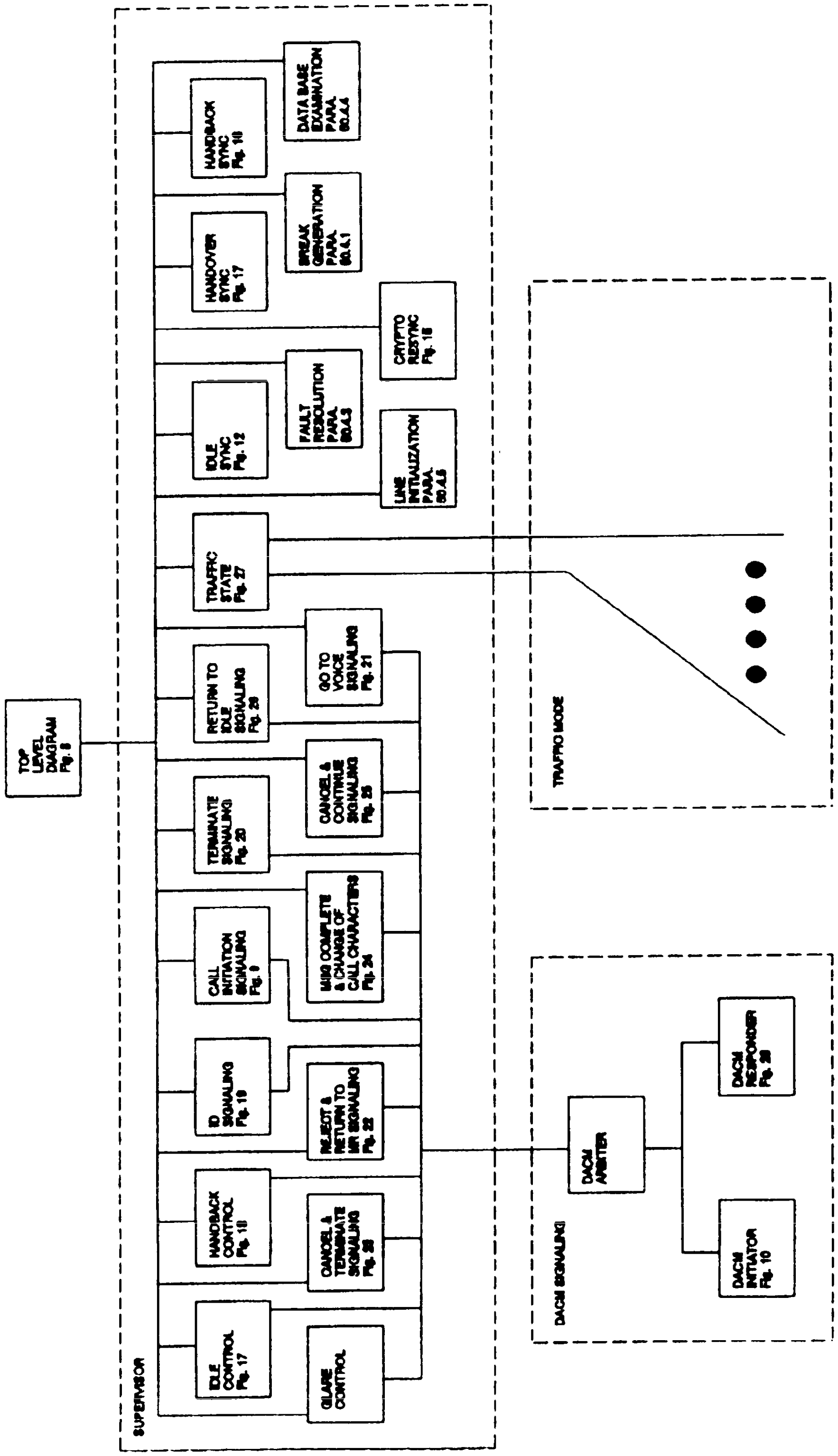


FIGURE 7. Documentation structure.

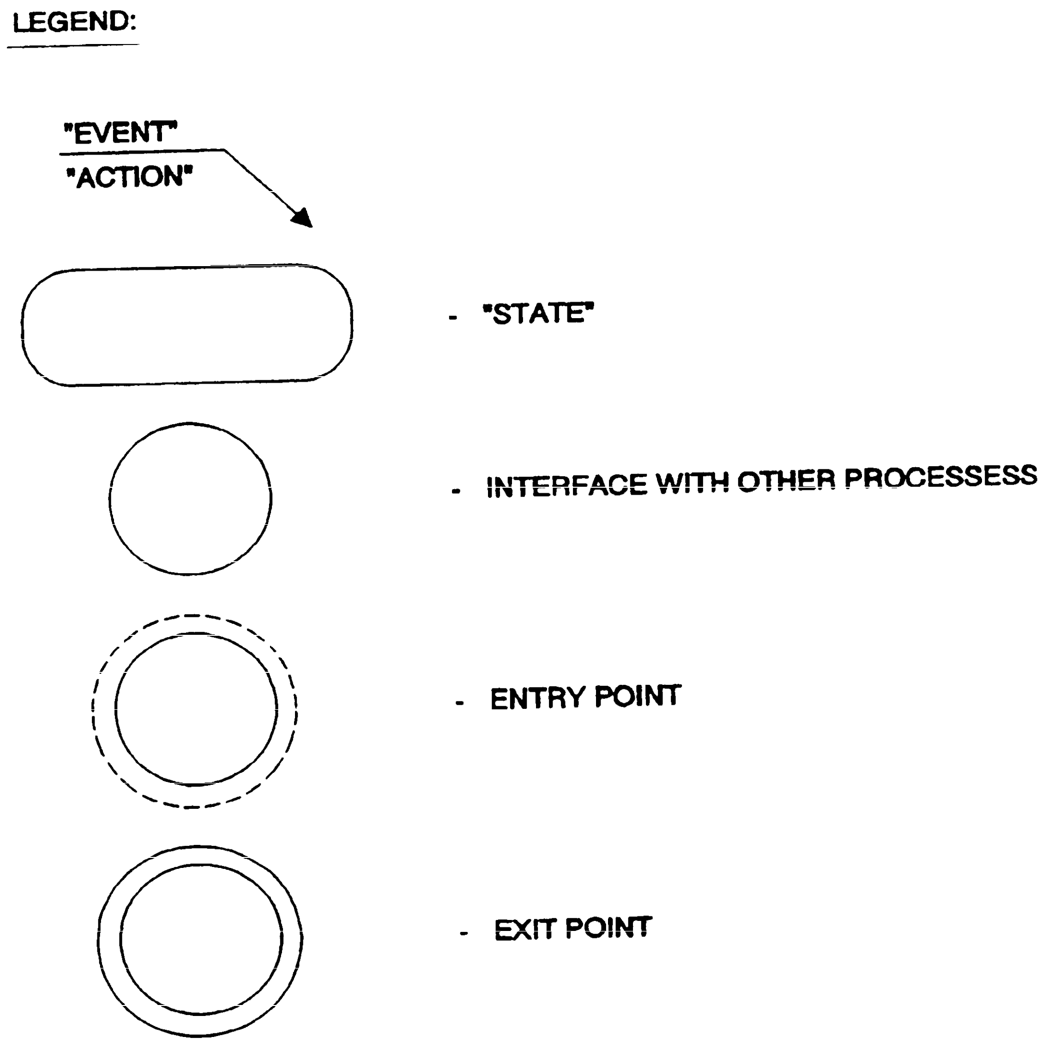


FIGURE 8. Document convention.

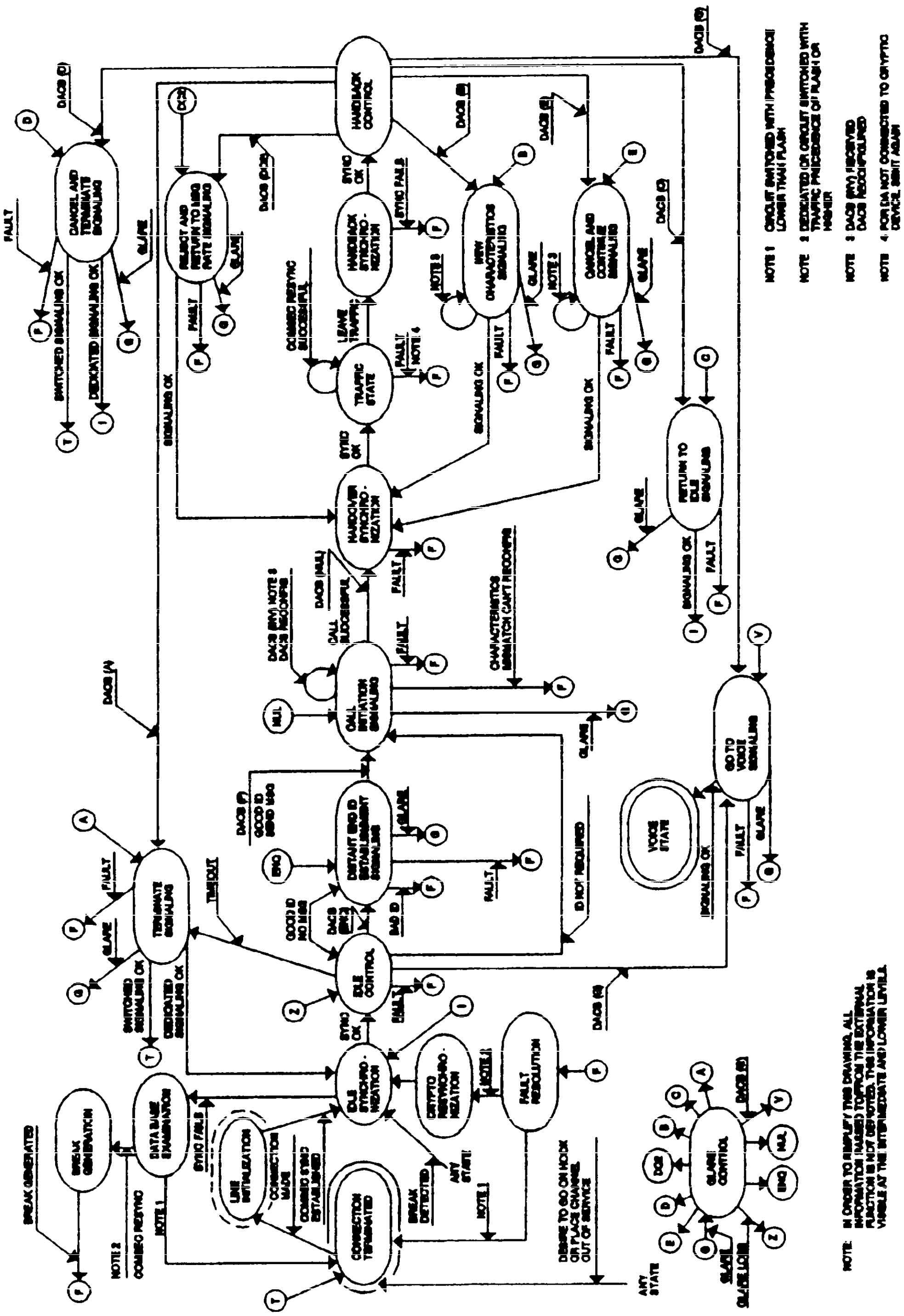


FIGURE 9. Top-level diagram

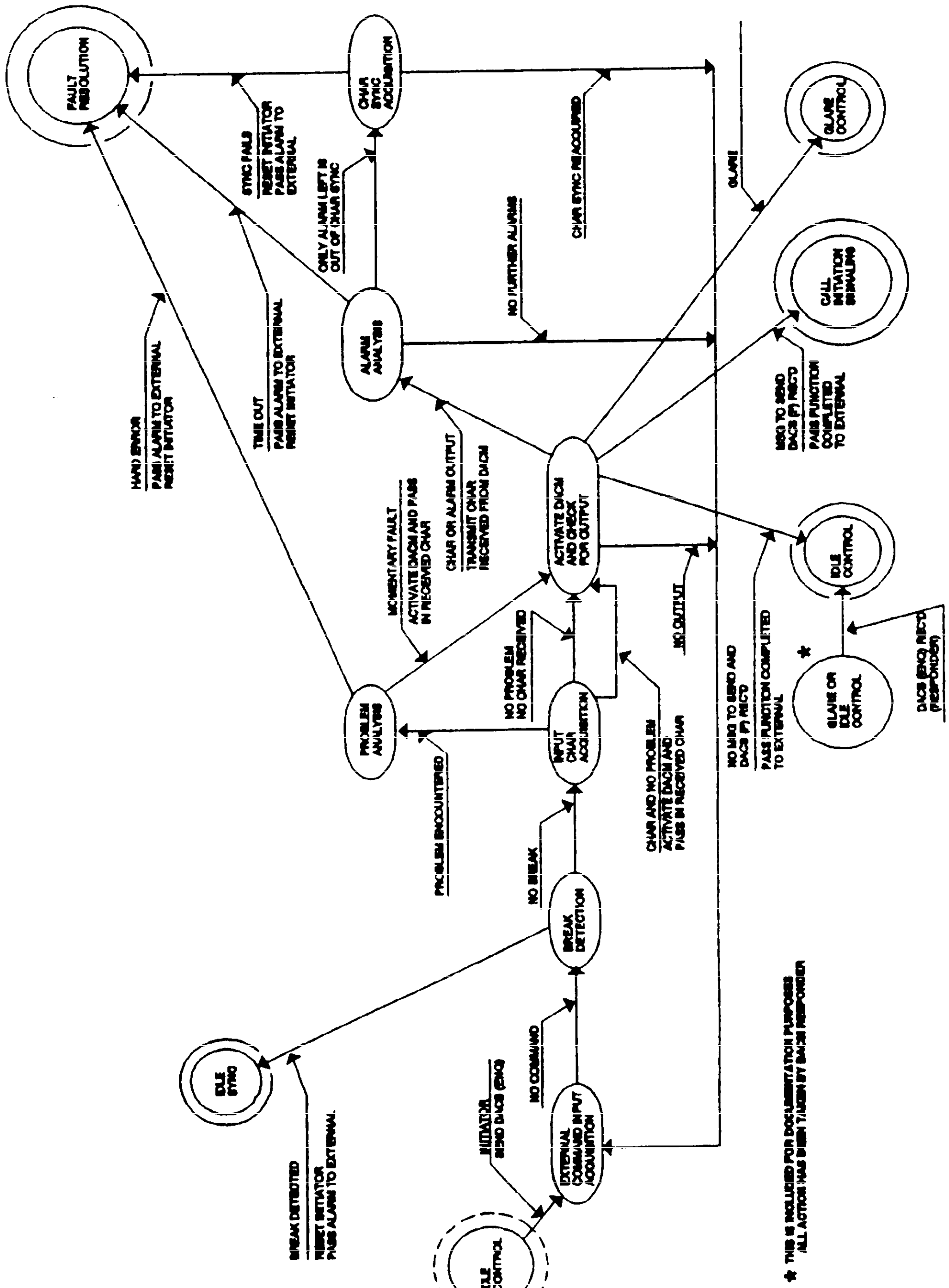


FIGURE 10. Distant end ID establishment initiator

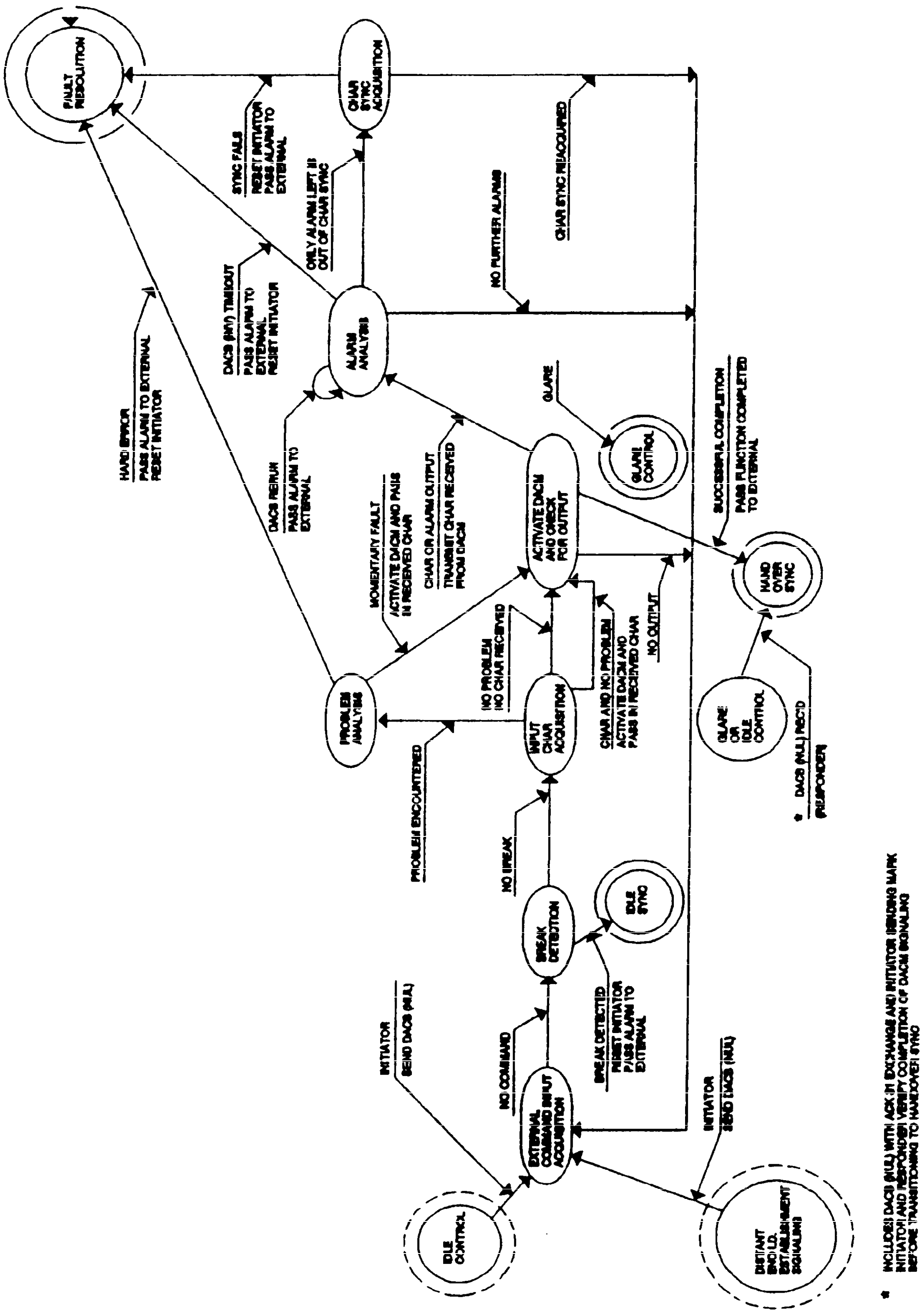


FIGURE 11. Call initiation

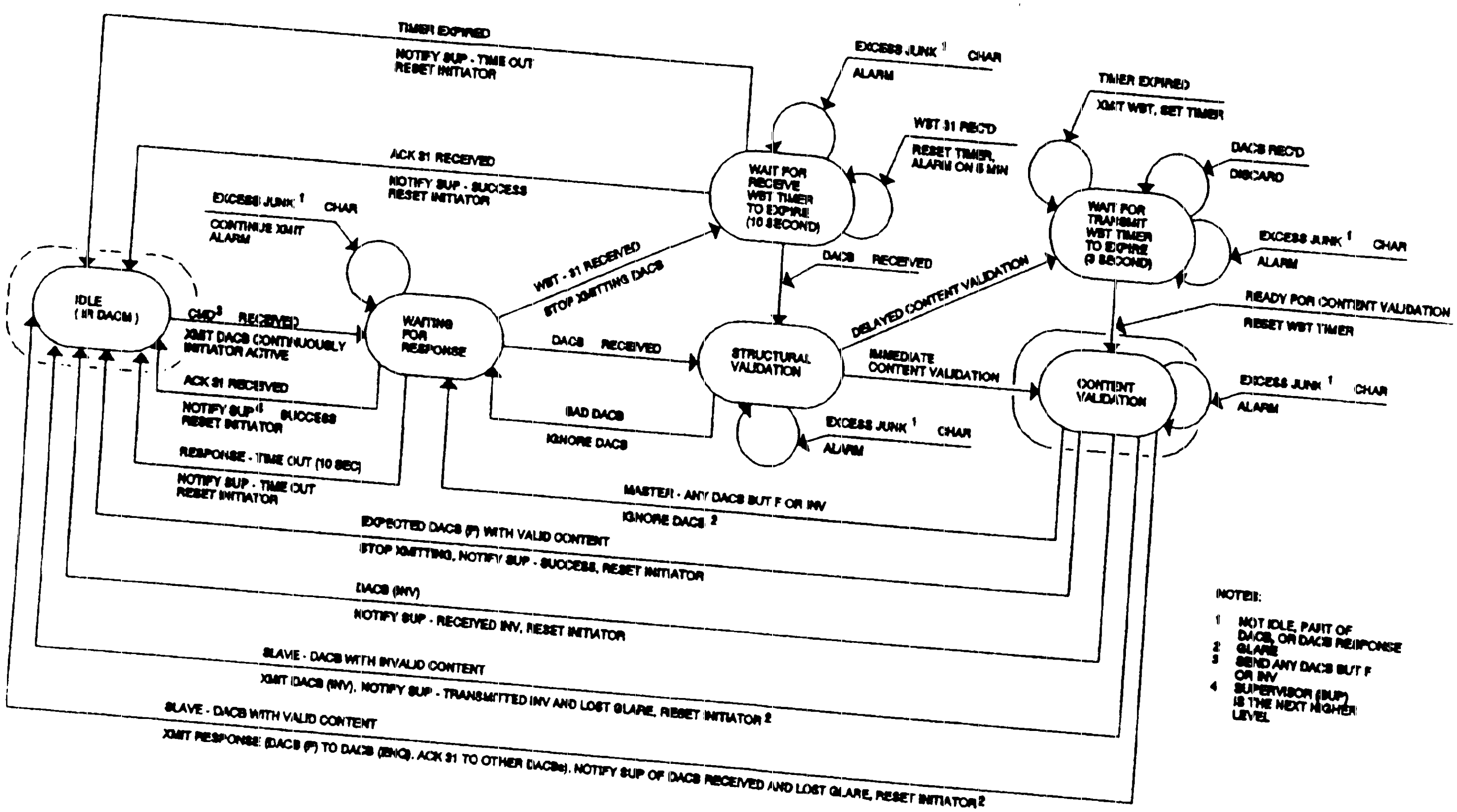


FIGURE 12. DACM initiator.

40.2.2 <u>DACM protocol subdivisions</u>. The DACM protocol is subdivided into the synchronization process, the DACM protocol process, and other processes. These processes are broken down in subparagraphs 40.2.2.1 through 40.2.2.3.

40.2.2.1 <u>Synchronization process</u>

a. Idle synchronization.

b. Handover synchronization.

c. Handback synchronization.

40.2.2.2 <u>DACM protocol process</u>

a. Control

(1) Idle
(2) Handback
(3) Glare.

b. Signaling

(1) Distant end I.D. establishment
(2) Call initiation
(3) Terminate
(4) Go to voice
(5) Reject and return to message rate
(6) Cancel and terminate
(7) Message finished and continue
(8) Cancel and continue
(9) Return to idle.

40.2.2.3 <u>Other processes</u>

a. Break generation.

b. Traffic state.

c. Fault resolution.

d. Data base examination.

40.3 <u>Introduction to intermediate-level diagram</u>. The processes described in 40.2.1 and 40.2.2 which require a more detailed description have these details provided in intermediate-level diagrams. These diagrams divide the process into functions and their relationships. Although all of these processes have something in common, the DACM protocol and traffic-state processes are similar enough that it is worth while to describe their details generally.

Each process is made up of:

a. Transitions to and from other processes.

b. Communication to and from the high-level functions described in 40.1.

c. Process-dependent functions (DACB signaling, timer functions, etc.).

d. Basic functions

(1) External input acquisition.
(2) Break detection.
(3) Input line character acquisition.
(4) Problem analysis.
(5) Alarm analysis.
(6) Character synchronization.
(7) Output line character transmission.

40.4 Relationship of functions. This appendix presents the functions as a serial loop with exits (transactions) to other processes. To simulate simultaneity, an event or lack of event causes transition to the next function (state). This documentation approach neither excludes a simultaneous implementation nor requires a serial implementation. It requires only that all functions be implemented.

50. DETAILED REQUIREMENTS

50.1 Details of basic functions

50.1.1 External input acquisition. This external input acquisition function covers the input of commands and data base parameters. A command is an external input (see 40.1) requesting a function to be performed by DACB signaling or traffic signalling (examples - cancel, reject, go to idle, and terminate). The commands can cause transition to another process or actions within this process. An example of action within the process is message cancellation. An example of transition to another state command is leave traffic state.

50.1.2 Break detection. See 5.2.7.2

50.1.3 Input line character acquisition. This is the process of decoding the bits received and transforming them into characters. Some of the possible errors which may be encountered are listed in 5.3.1.1, 5.3.1.4, and 5.3.1.5. This function is also assigned (for documentation purposes) the task of detecting the incoming DC4s that force handback (see 5.2.6).

50.1.4 Problem verification. This is a process-independent function. It determines whether any errors of input line character acquisition are "hard" or are the product of a momentary line disturbance (see 5.3.2).

50.1.5 Alarm analysis. This is a process-dependent function. Different processes have different alarms. Alarm processing falls into four categories.

a. Fatal - cause alarm and exit from process.

b. Non fatal - cause alarm but do not exit from process.

c. Loss of character synchronization.

d. No alarms.

50.1.6 Character synchronization. See 5.3.1.5.

50.1.7 Output line character transmission. This is the process of transforming a character into encoded bits and transmitting them.

50.2 Synchronization processes. See 5.3.1.

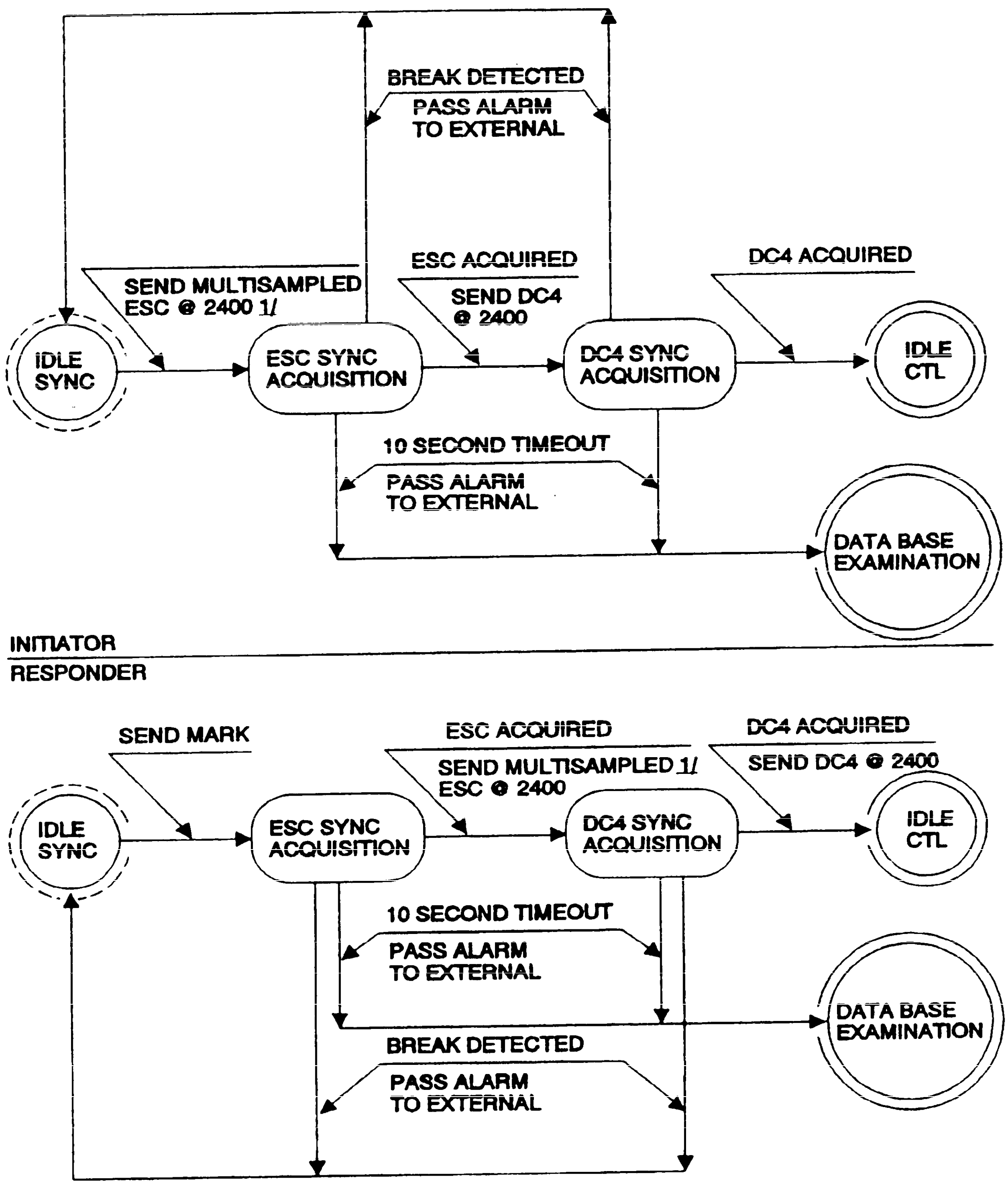
50.2.1 Idle synchronization. This process (figure 13) is used to establish character synchronization at the link idle rate of 2400 bps (information rate). Only multisampling is used for rate conversion and error correction. Idle synchronization may be preceded by the following processes, for which initiator and responder relationships are defined to resolve potential glare.

a. Call initiation - The master is the initiator and the slave is the responder for the idle synchronization process.

b. Break sequence - Regardless of who initiates the break sequence, afterwards the master is the initiator of the idle synchronization process. The slave is the responder for the idle synchronization process.

c. DACB sent - The initiator is the DA/MS successfully transmitting the DACB (i.e., DACB is ACKed), independent of the master/slave relationship.

d. Fault resolution and cryptographic synchronization - The master is the initiator and the slave is the responder for the idle synchronization process.



NOTE: 1/ If loop rate is greater than 2400 bps

FIGURE 13. Idle synchronization.

50.2.2 Handover synchronization. This process (figures 14, 15, and 16) is used to progress from the current DACM state to the traffic state (where subscriber messages are exchanged). This progression involves a step-by-step handshaking procedure between the two DA/MSs, wherein the old set of rate conversion and error correction procedures and COMSEC operation are exchanged for those required in the new traffic state. When handover synchronization is successfully completed, the link will be in character synchronization with the idle character to be used in the traffic state. The MS/DA successfully transmitting the DACB that initiates handover synchronization is the initiator, independent of the master/slave relationship.

50.2.3 Handback synchronization. This process (figure 17) is used to leave the current traffic mode and go back to DACM. However, the methods of rate conversion and error correction which were in use in the described traffic state remain in use. The idle pattern is DC4. The lower levels of synchronization (Golay, bit stuff, and framing) which were in effect in the traffic state are maintained during handback synchronization. Only character synchronization shall be done and a transition between traffic mode and DACM shall be made. Either the master or the slave may initiate handback synchronization.

50.3 DACM protocol processes

50.3.1 Control processes. In addition to the basic functions provided by all DACM processes, the control processes provide the transition between signaling and synchronization processes. The transition is caused either by an external command or a received DACB.

50.3.1.1 Idle control. This process is used at idle rate when DA/MS is waiting for something (an external input or received DACB) to transition it to a signaling process (see figure 18).

50.3.1.2 Handback control. This process is used at the message rate when the DA/MS is waiting for an external input or received DACB to send it to a signaling process (see figure 19).

50.3.1.3 Glare control. A glare situation exists when both ends of a line try to initiate DACB signaling. Glare is recognized by the end that cannot complete its signaling (the loser). Glare control is an approach to allow the loser to transfer to the signaling process desired by the winner.

50.3.2 Signaling processes. The DACB signaling processes provide for a transition to the next state. The transition is dependent upon:

a. signaling success or failure.
b. signaling type and the DACM signaling function.

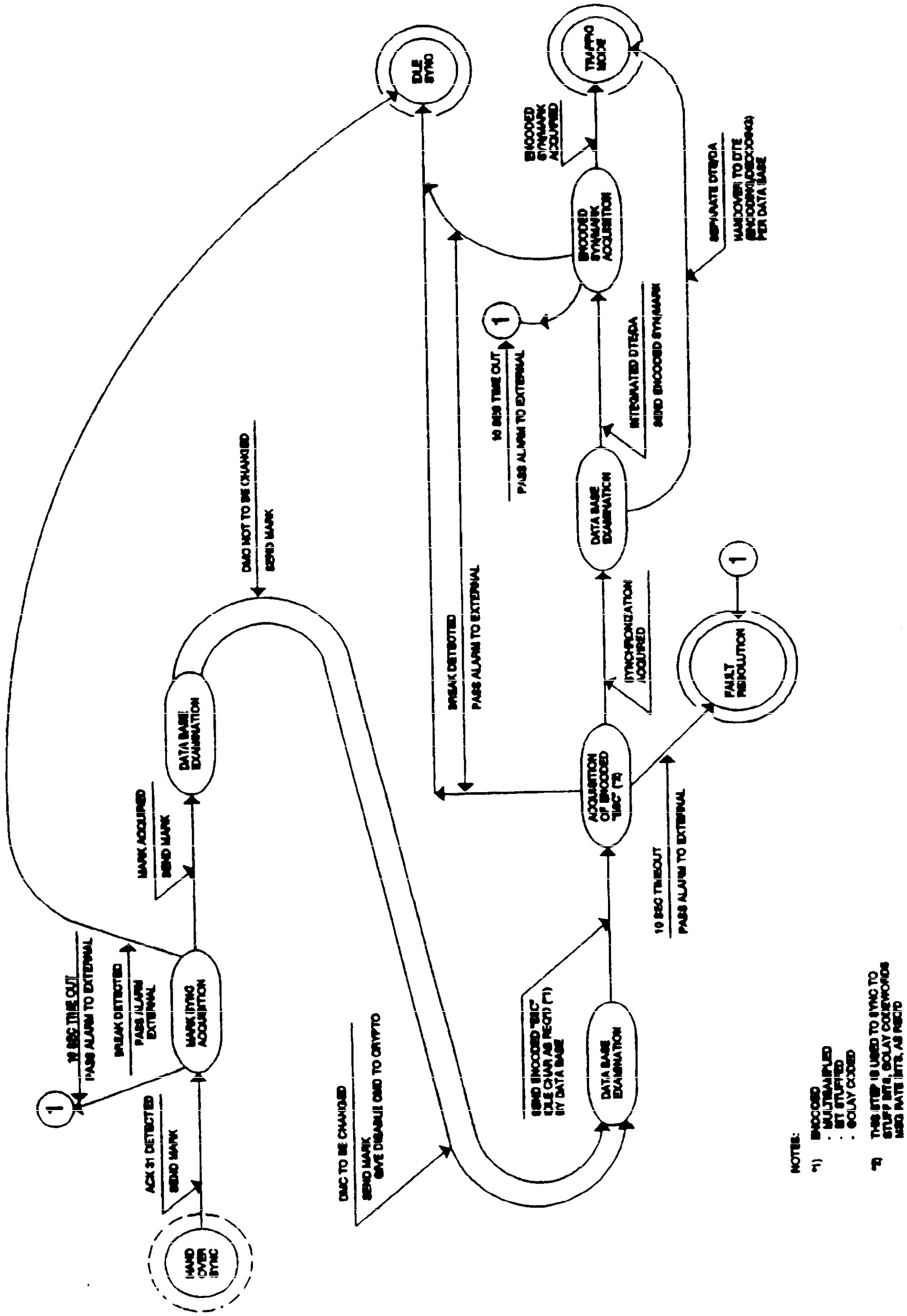


FIGURE 14. Handover synchronization - Initiator

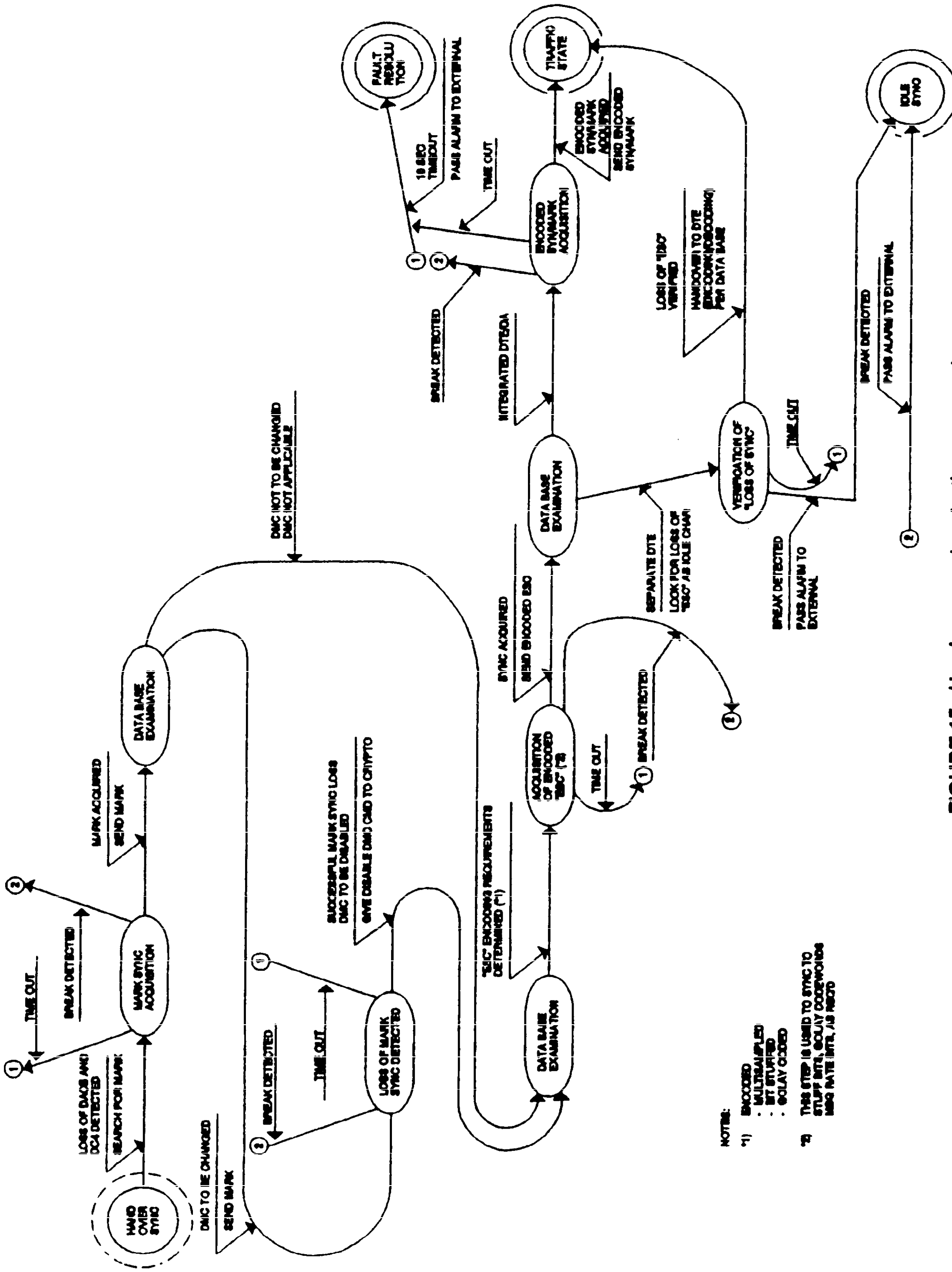
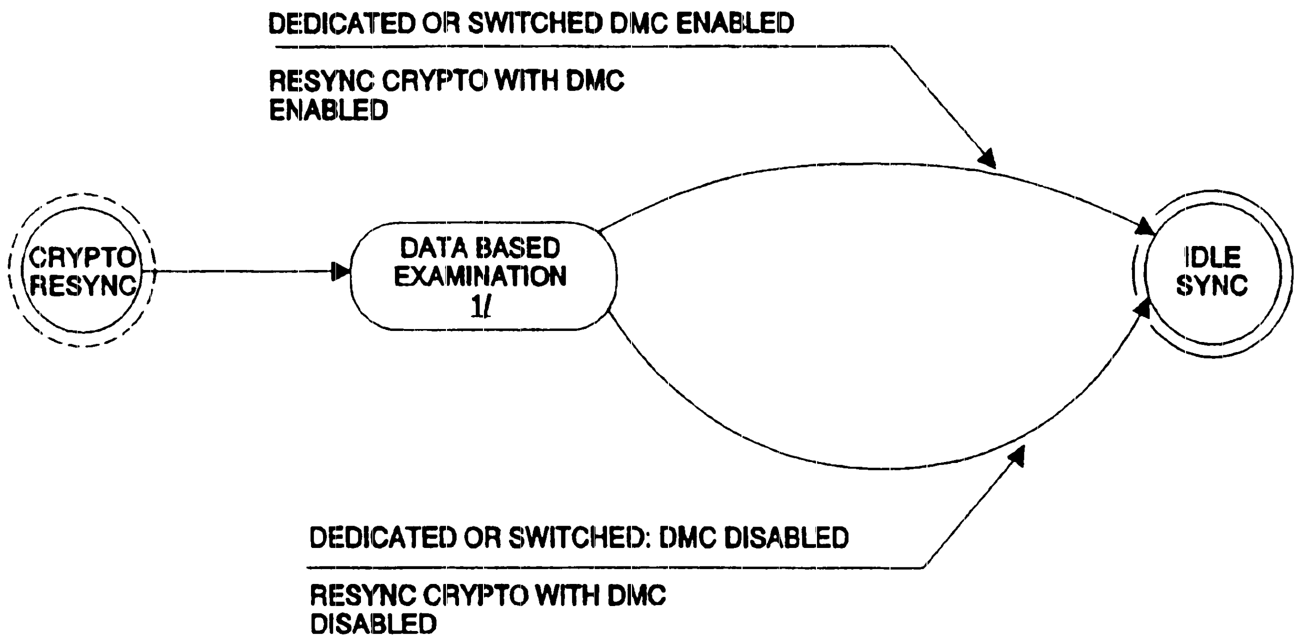


FIGURE 15. Handover synchronization - responder



NOTE:

1/ DATABASE INCLUDES CHARACTERISTICS SPECIFIED IN DACB EXCHANGE

FIGURE 16. Crypto resynchronization state.

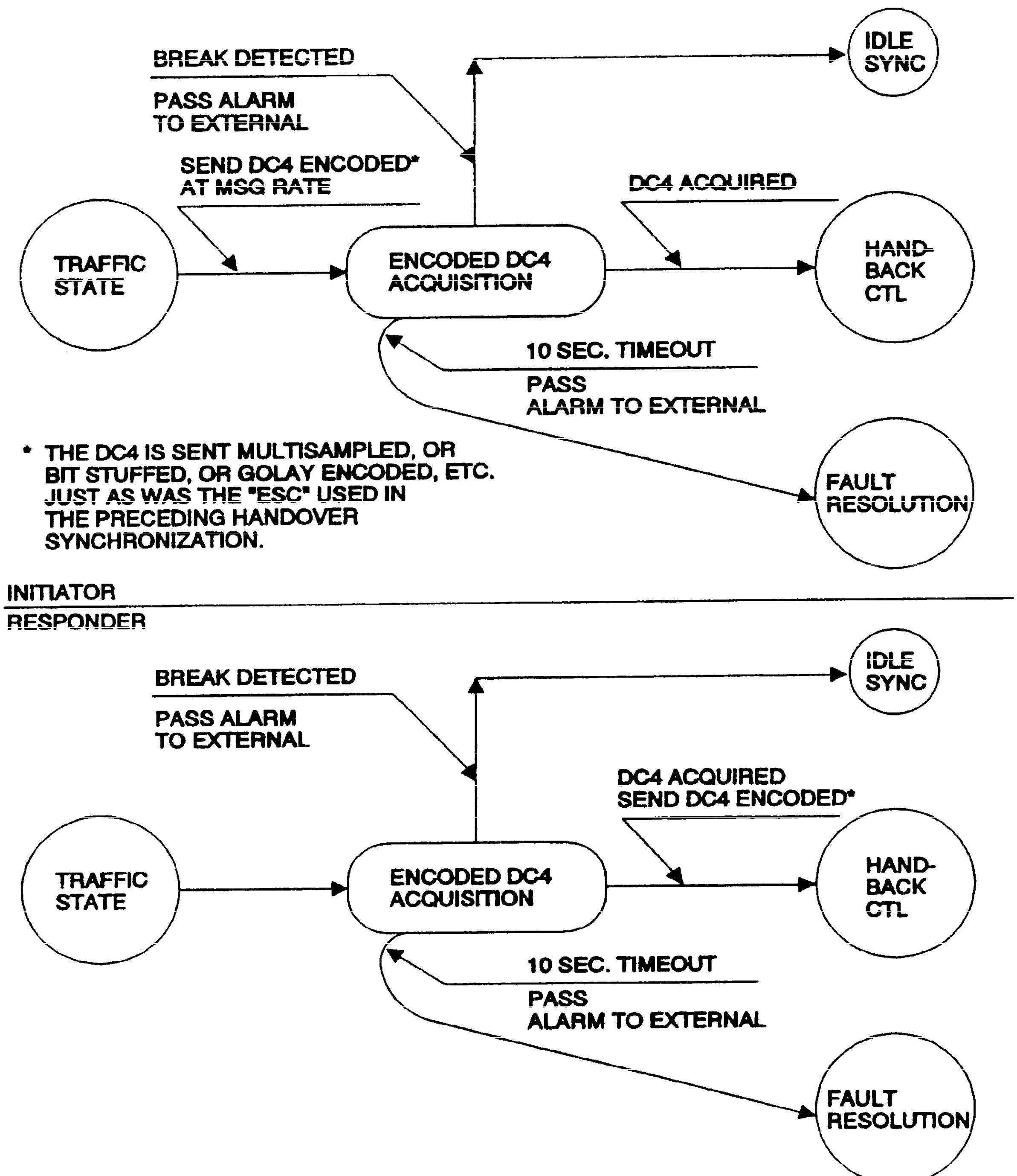


FIGURE 17. Handbook synchronization.

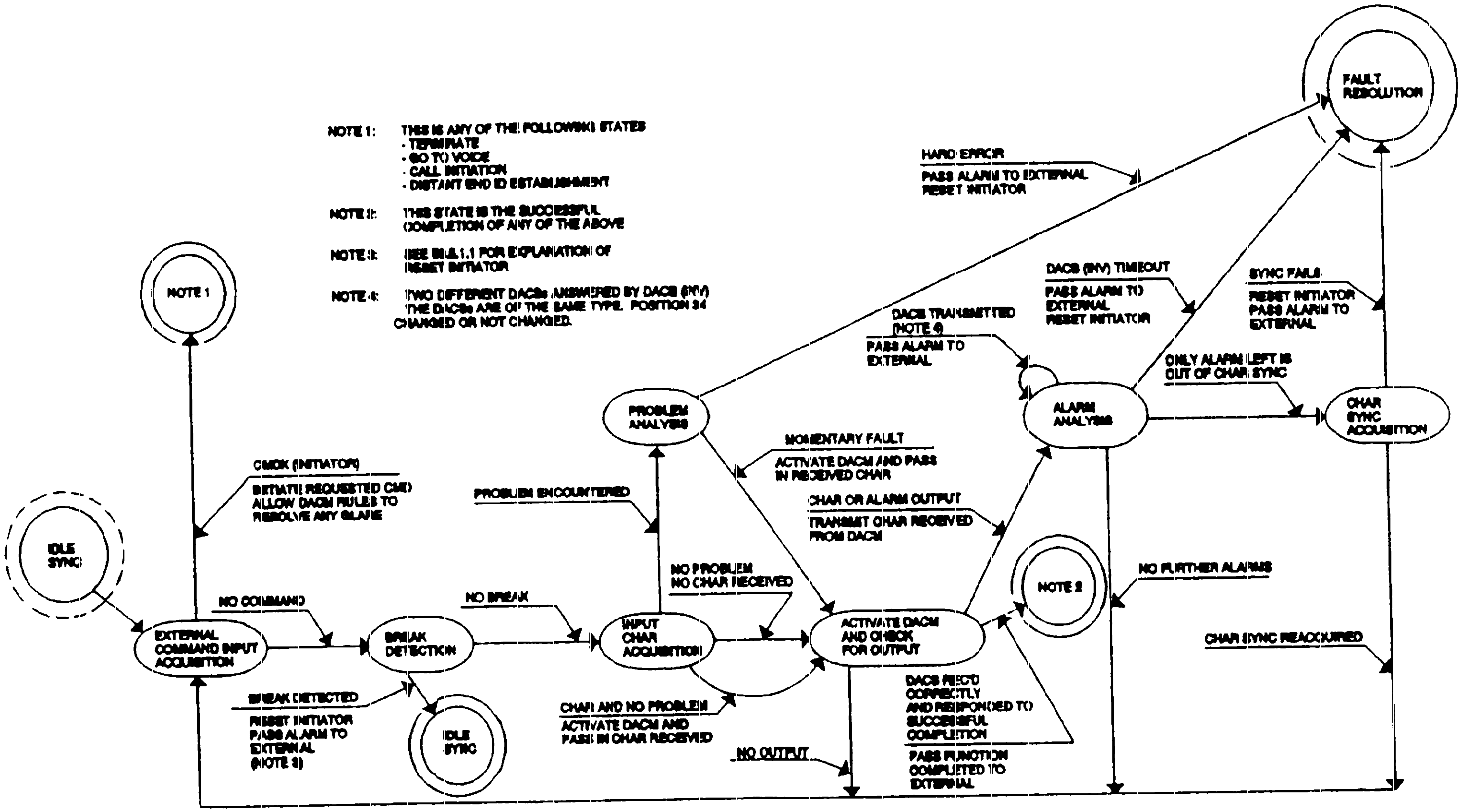


FIGURE 18. Idle control.

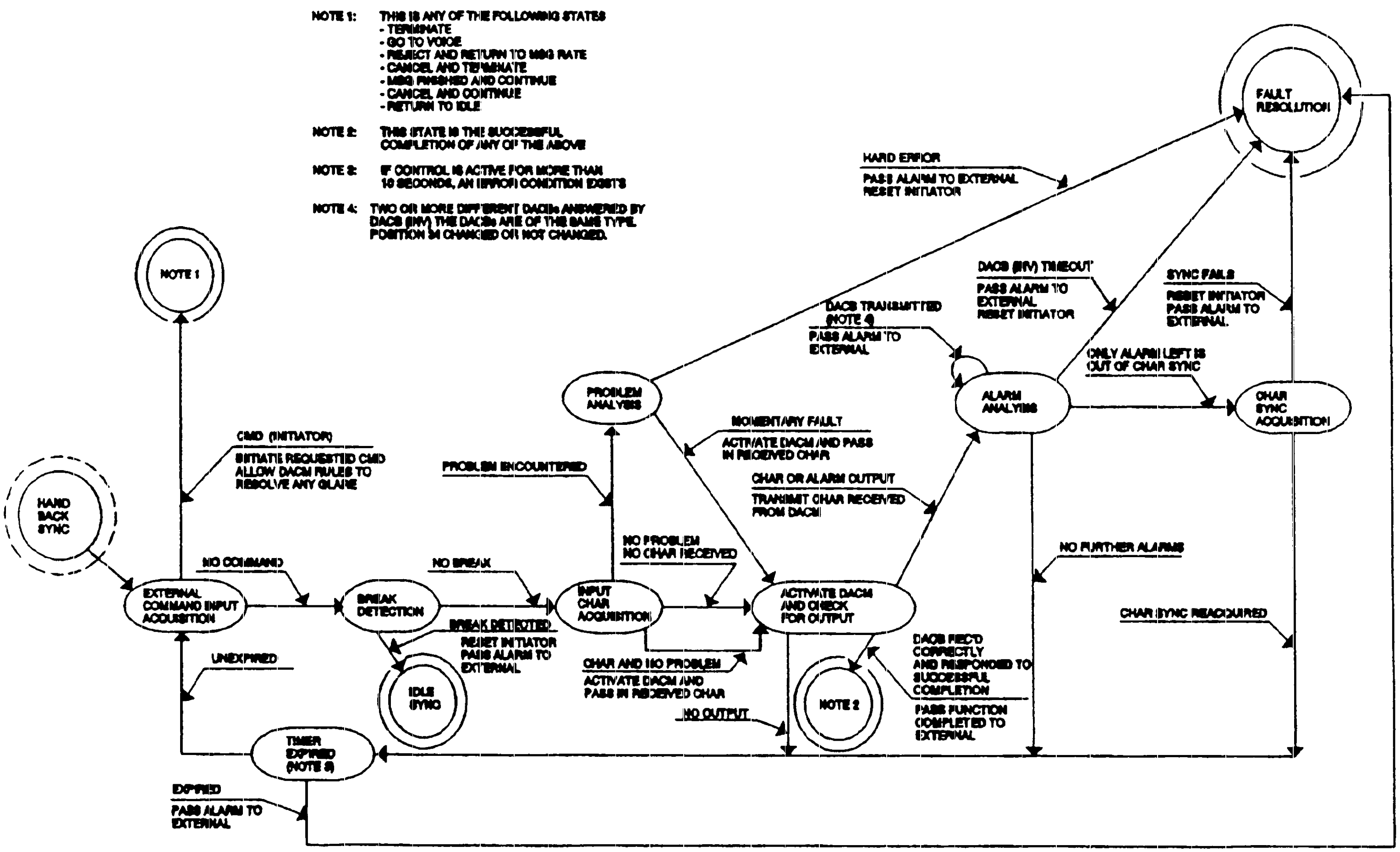


FIGURE 19. Handback control.

50.3.2.1 Distant end I.D. establishment. See figure 10.

50.3.2.2 Call initiation. See figure 11.

50.3.2.3 Terminate. See figure 20.

50.3.2.4 Go to voice. See figure 21.

50.3.2.5 Reject and return to message rate. See figure 22.

50.3.2.6 Cancel and terminate. See figure 23.

50.3.2.7 Message complete and change characteristics. See figure 24.

50.3.2.8 Cancel and continue with new characteristics. See figure 25.

50.3.2.9 Return to idle. See figure 26.

50.4 Others

50.4.1 Break generation. This process is used to force idle synchronization when normal processing has failed to obtain successful synchronization. Break generation is passed as an alarm to external. Break generation can be accomplished as described in 5.2.7.

50.4.2 Traffic state. The purpose of figure 27 is to show the general functions affecting the overall processing of message data. This figure shows the internal processing of the traffic mode activation state shown on the intermediate-level diagram. The type of alarms generated by the lower-level processing functions will cause the alarm analysis state to determine if the traffic mode state can continue normal message processing or if termination may be required by the fault resolution state.

50.4.3 Fault resolution. The purpose of this process is to determine if the connection will continue or be released. The basis for the decision is as described in 5.3.3.1, 5.3.3.2, and 5.3.3.3 for time-outs.

50.4.4 Data base examination. The purpose of this process is to determine the action to be taken depending on both the fixed line characteristics and the information specified in the last DACB transaction.

50.4.5 Line initialization. The purpose of this process is to allow for delays in establishment of the data connection and to provide for initial COMSEC synchronization.

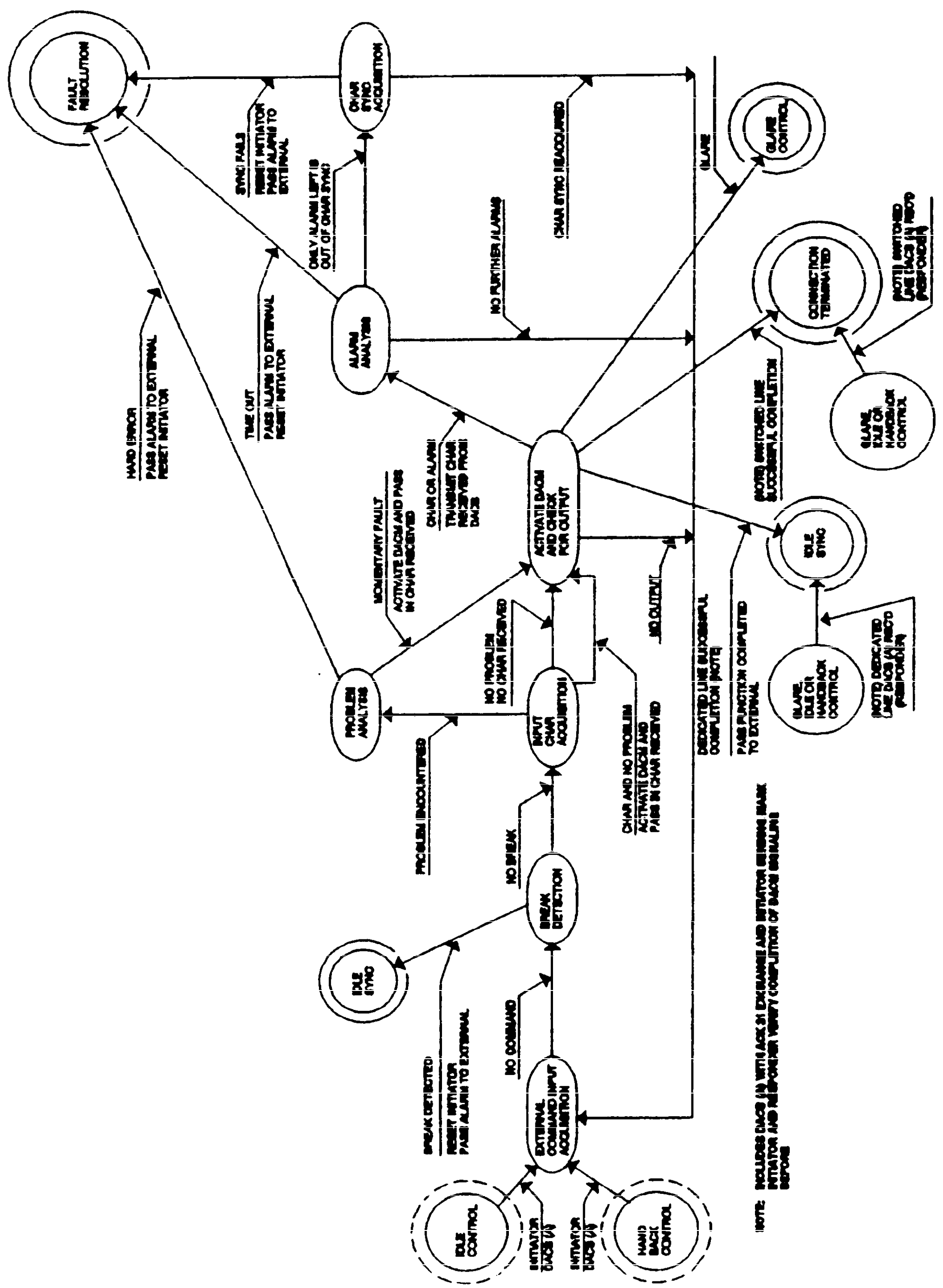


FIGURE 20. Terminate.

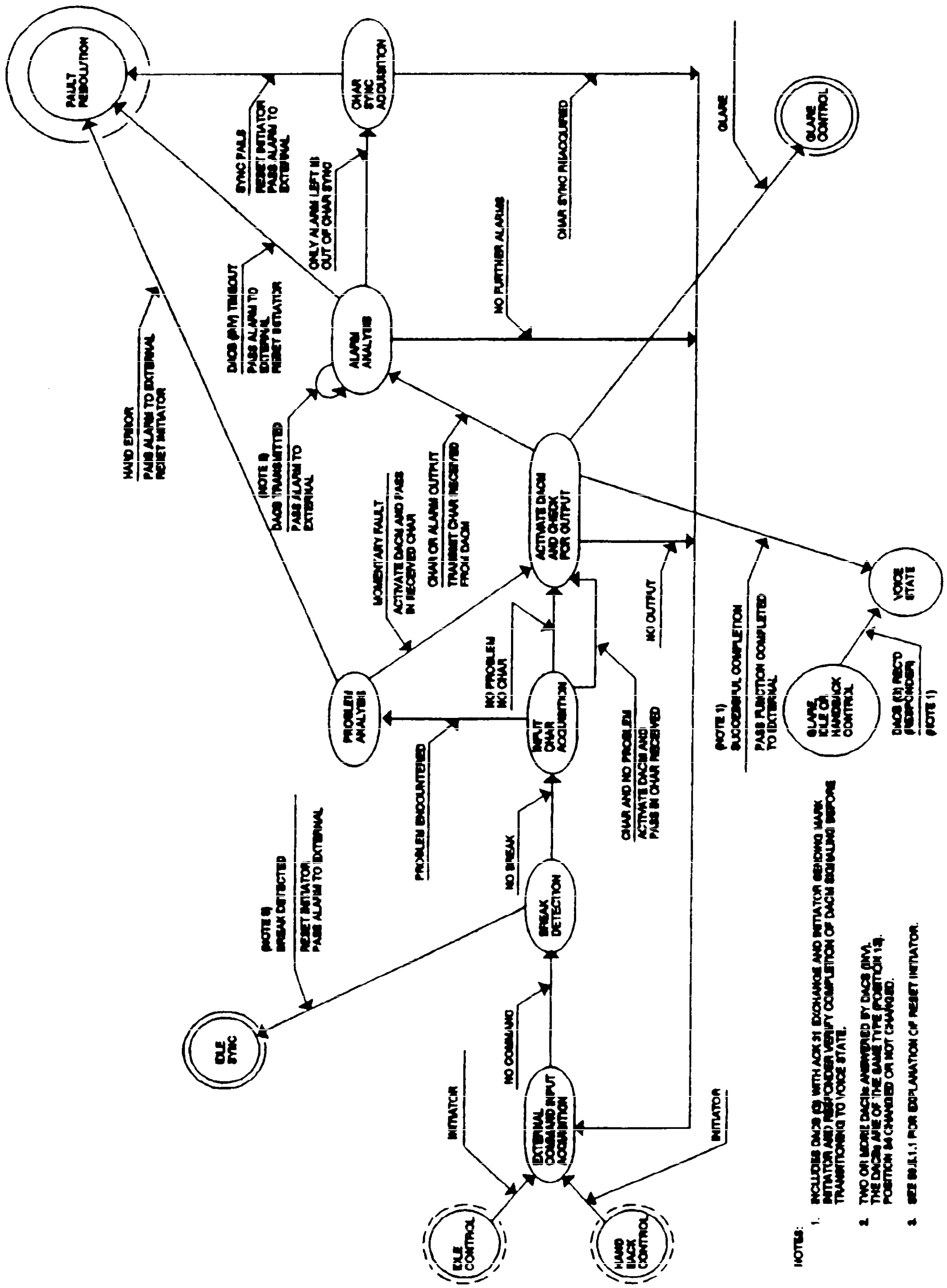


FIGURE 21. Go to voice

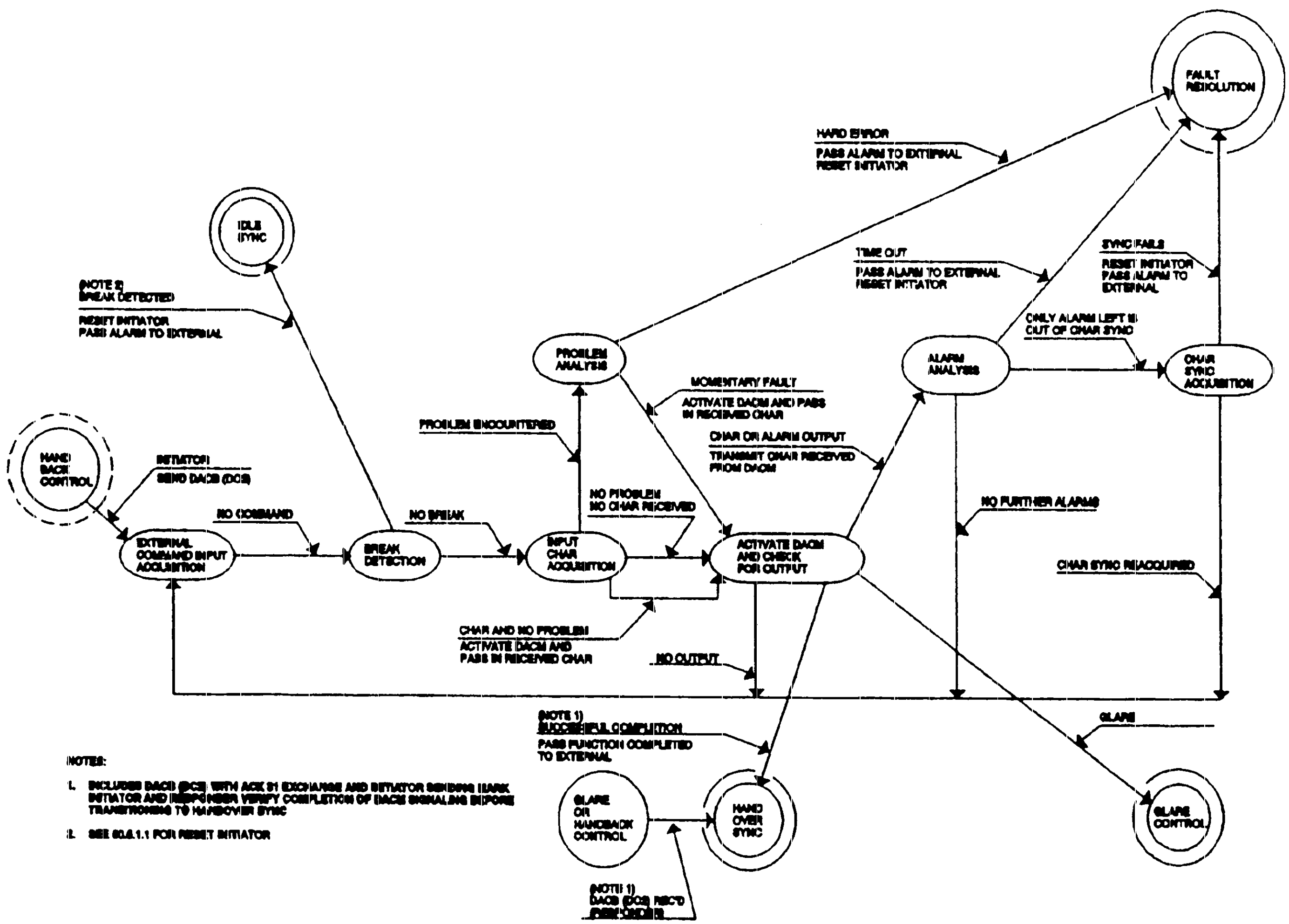


FIGURE 22. Reject and return to mag rate.

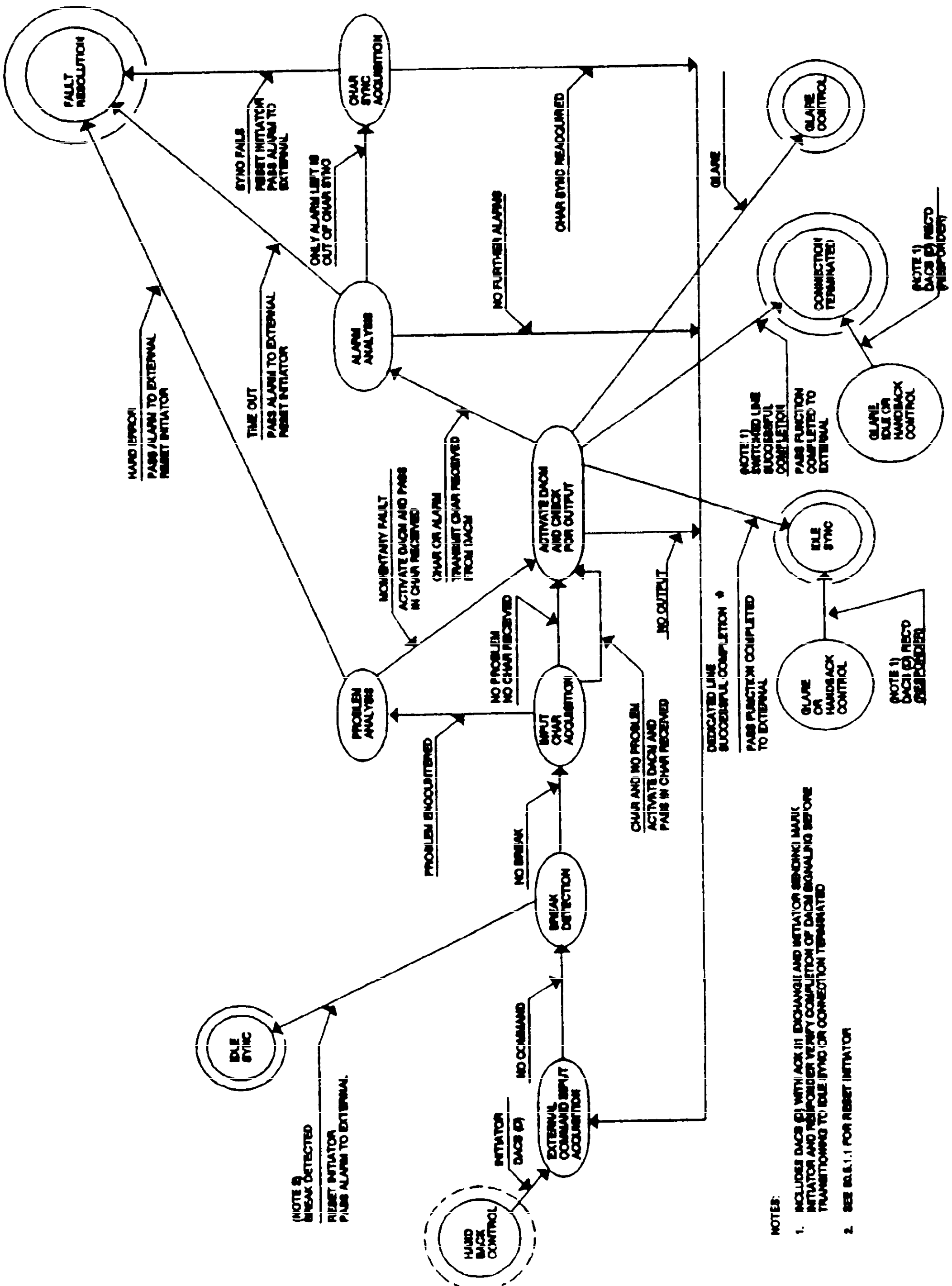
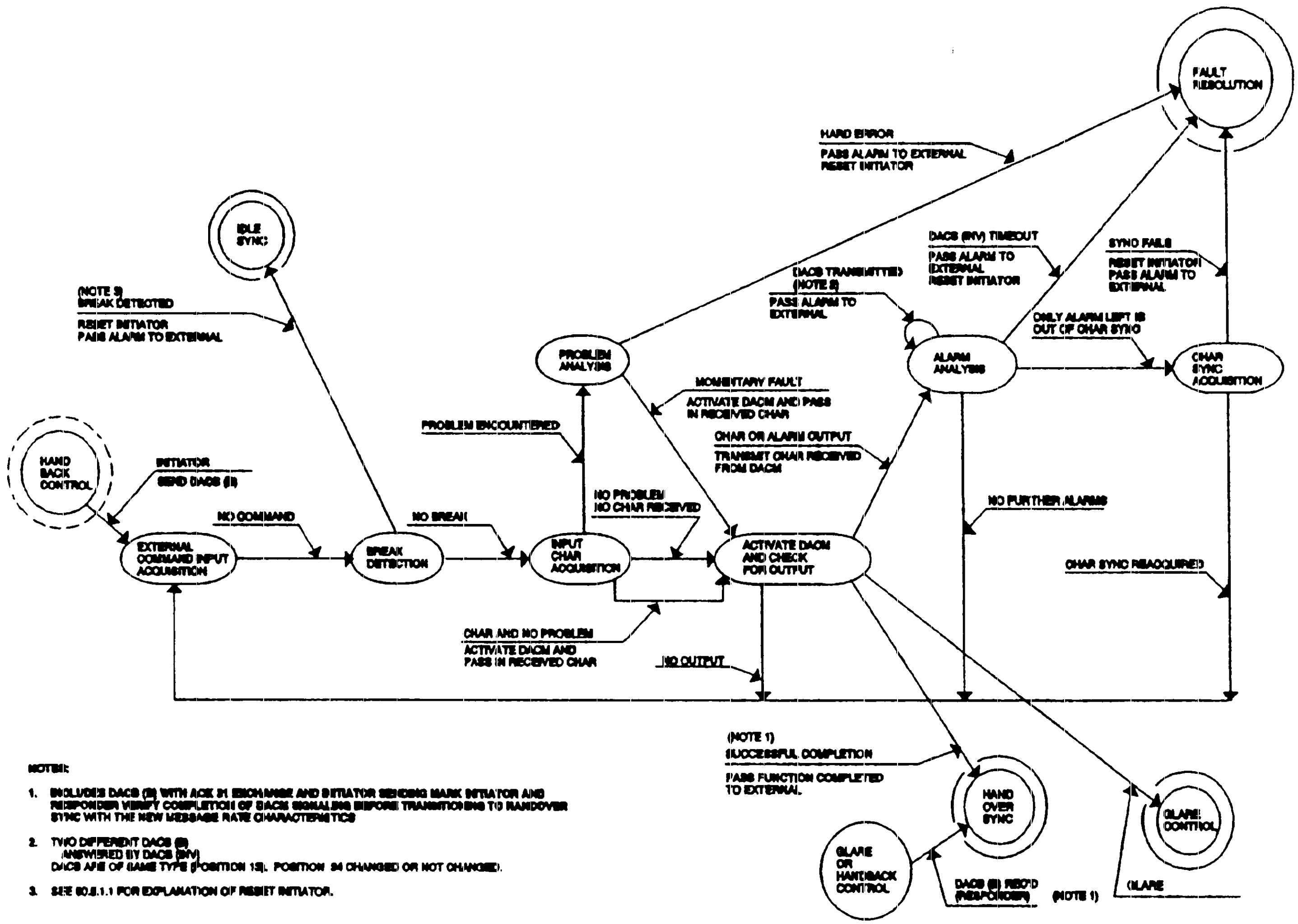


FIGURE 23. Cancel and terminate.



NOTES:

1. INCLUDES DACS (S) WITH ACK IN EXCHANGE AND INITIATOR SENDING MARK INITIATOR AND RESPONDER VERIFY COMPLETION OF DACS SIGNALING BEFORE TRANSITIONING TO HANDOVER SYNC WITH THE NEW MESSAGE RATE CHARACTERISTICS
2. TWO DIFFERENT DACS (S) ANSWERED BY DACS (RV) DACS ARE OF SAME TYPE (POSITION 13). POSITION 14 CHANGED OR NOT CHANGED.
3. SEE 50.8.1.1 FOR EXPLANATION OF RESET INITIATOR.

FIGURE 24. Message complete and change characteristic

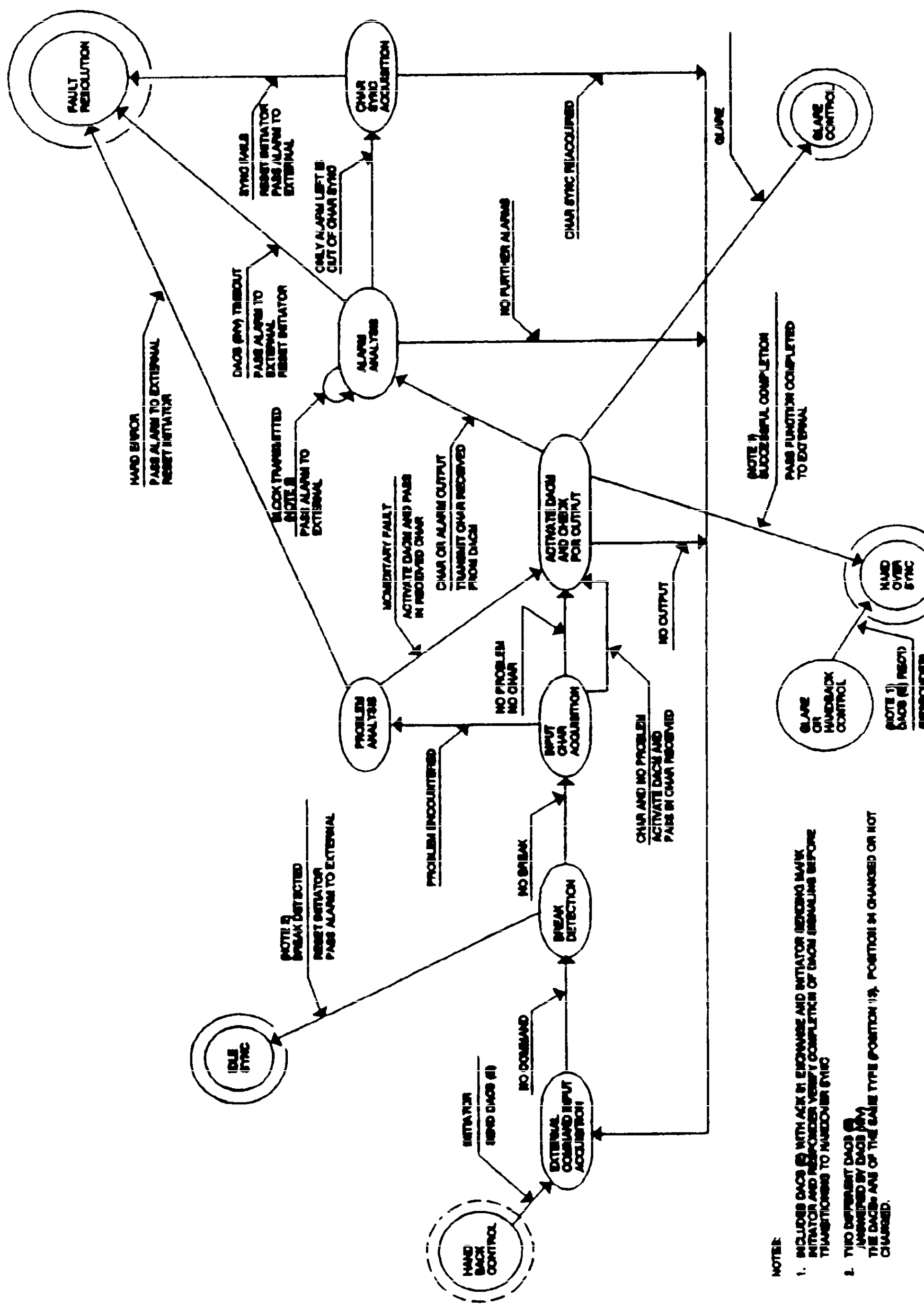


FIGURE 25. Cancel and continue new call characteristics.

NOTES:

1. INCLUDES DACS (C) WITH ACK 31 EXCHANGE AND INITIATOR SENDING MARK INITIATOR AND RESPONDER VERIFY COMPLETION OF DACM SIGNALING BEFORE TRANSITIONING TO IDLE SYNC.
2. TWO OR MORE DIFFERENT DACMs ANSWERED BY DACS (INV). POSITION 34 CHANGED OR NOT CHANGED.
3. SEE 50.5.1.1 FOR EXPLANATION OF RESET INITIATOR.

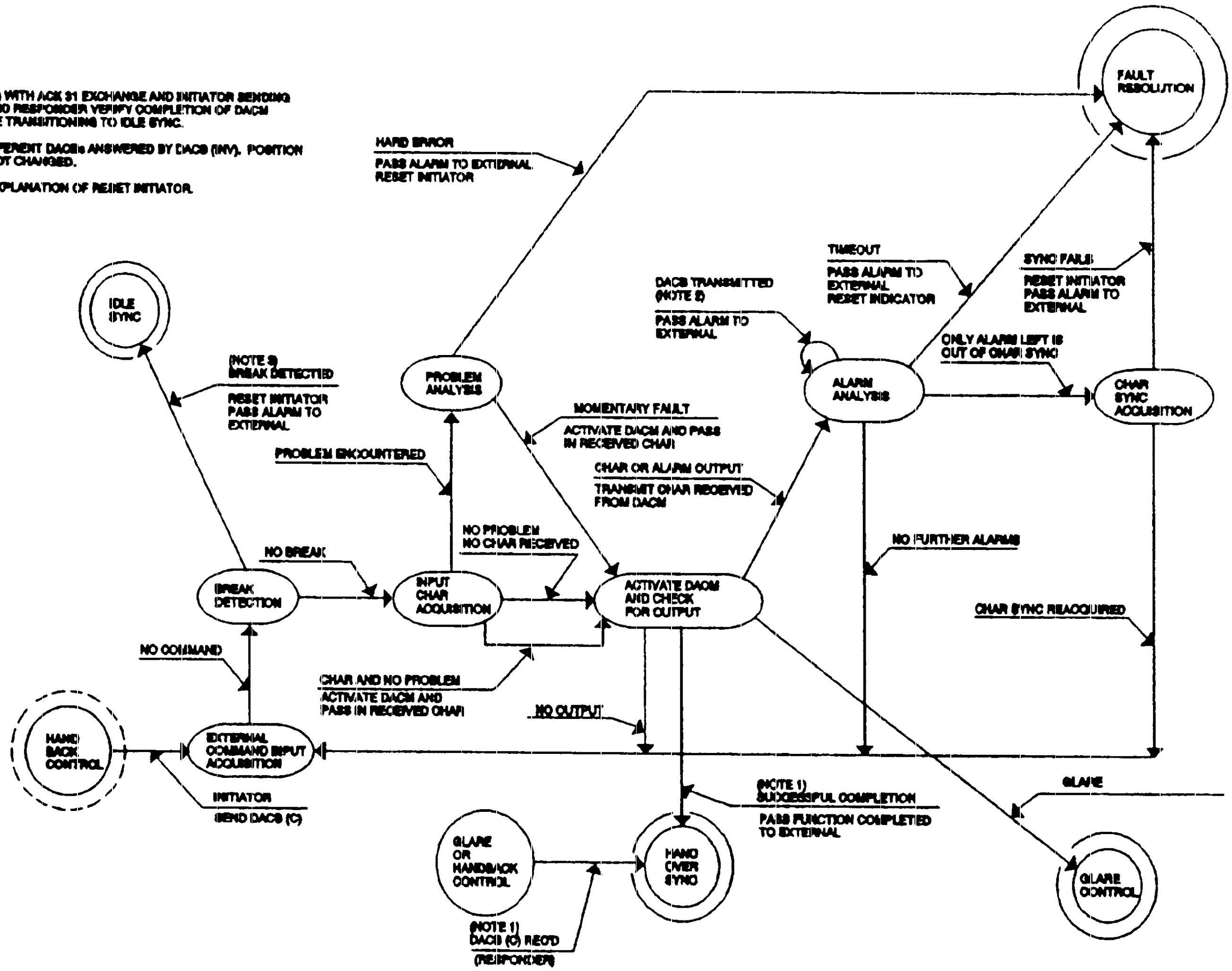


FIGURE 26. Return to Idle.

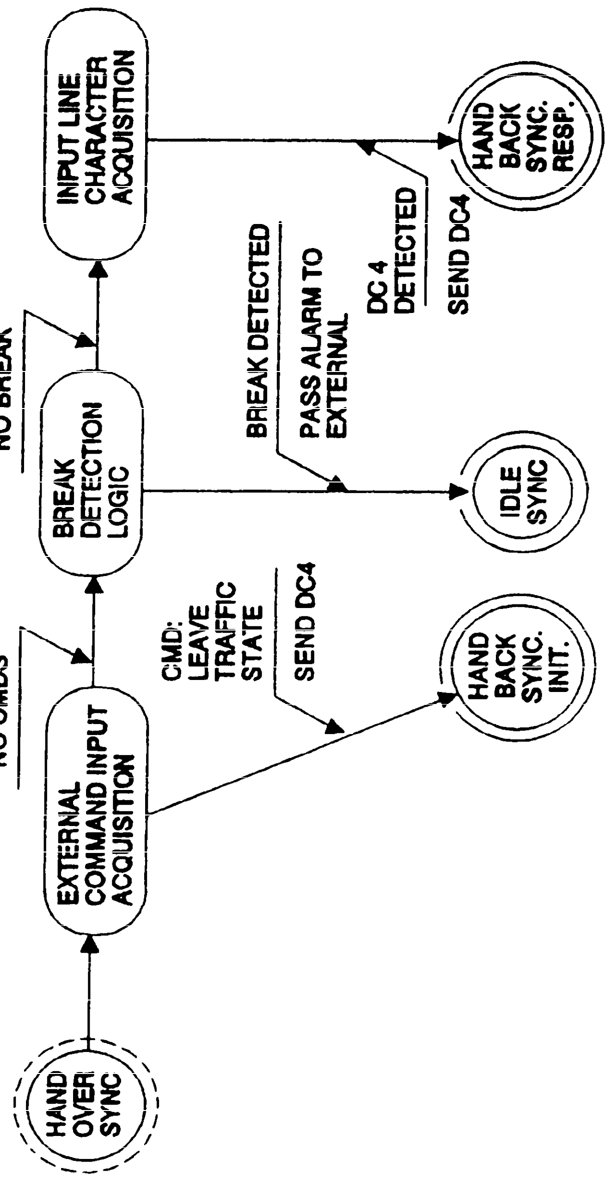


Figure 27. Intermediate level diagram traffic state

50.5 Lower-level diagrams

50.5.1 Data adapter control mode. DACM is a signaling method which translates process requests to output DACBs and input DACBs to process requests. The process requests are those listed under DACM protocol processes (signaling) (see 50.3). Only one may be active at a time because of the nature of these process requests. The majority of the requests require transition to another state. If more than one were processed simultaneously, the next state could be indeterminate. It is the responsibility of the process requestor (an external function) to have only one request outstanding. It is the responsibility of DACM to resolve a process request and an incoming DACB (which signals a request from the distant end). The rules for translating a process request are called DACM responder (see figure 28). The function of deciding which set of rules applies is called the DACM arbiter.

50.5.1.1 DACM arbiter. The rule for the DACM arbiter is simple. If the initiator function is not active, the responder function is active. The initiator function is made active whenever a command (CMD) is received from the MS/DTE. The initiator function is made inactive (reset) whenever:

a. DACM signaling is successfully completed.

b. DACM signaling backs down because of glare.

c. DACM signaling is not completed due to exit for reasons external to DACM rules, such as break detection or exit for failures covered by DACM rules.

50.5.1.2 DACM initiator. When a CMD is received, transmission of the proper DACB is initiated. The DACB is transmitted continuously until:

a. An answer is received. An answer is defined as:

   (1) ACK 31.
   (2) WBT 31.
   (3) Response DACB. See responder for description of DACB validation.

b. A time-out occurs.

c. A glare is detected.

d. Transmission is terminated.

50.5.1.3 DACM responder. When a valid DACB is received, it is acknowledged and the process it requested is communicated to a higher level.

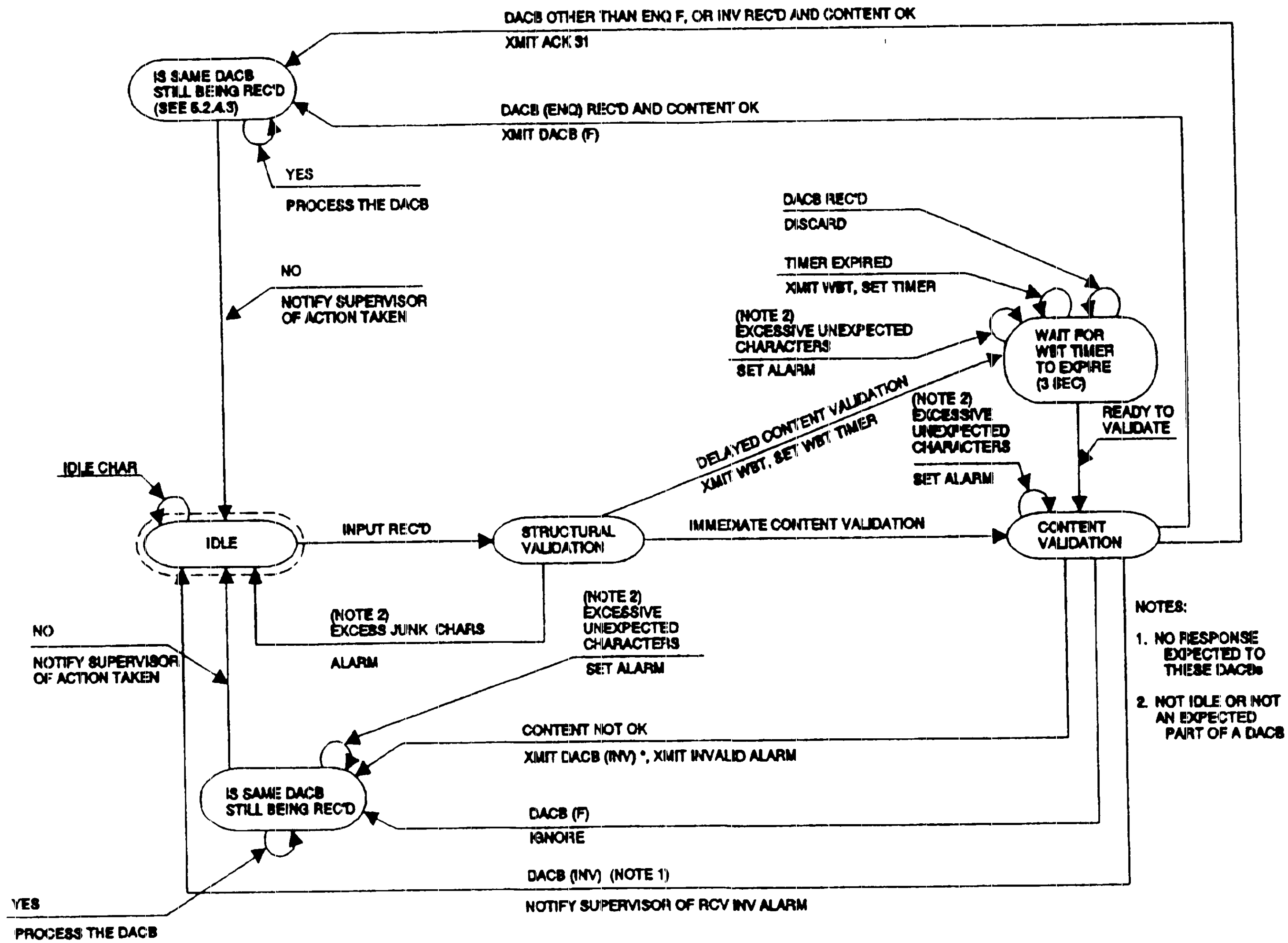


FIGURE 28. DACM responder.

APPENDIX D

GOLAY CODING FOR DACM AND MESSAGE TRAFFIC

Appendix D contains specific information in support of MIL-STD-188-216. Appendix D is not a mandatory part of this document. Implementation of the Golay Code is optional, but when implemented, it shall be accomplished in accordance with this Appendix (APPENDIX D).

10. GENERAL

10.1 Purpose. The purpose of this appendix is to explain how Golay coding is used for DACM and message traffic.

10.2 Scope. This appendix contains information pertaining to Golay coding that will assist the user in better understanding its relationship with the main body of this document.

20. APPLICABLE DOCUMENTS

Not applicable.

30. DEFINITIONS

For purpose of this appendix, the definitions of section 3 of this document and FED-STD-1037 shall apply.

40. GENERAL REQUIREMENTS

40.1 Forward error correction (FEC) capability. FEC is capable of being utilized for data rate transformations listed in table XXX. For start-stop data, Golay Coding shall only be utilized with data which are bit synchronized to the DA clock and have integral bit length start-stop bits.

40.1.1 The 1/2 rate Golay code. The 1/2 rate Golay code is based on use of the [23, 12] Golay code, extended to 24 bits total length by addition of a zero bit. Eleven check bits are derived for each sequence of twelve information bits. The eleven check bits follow the twelve information bits, and the twenty-fourth bit is set to zero. Transmission of the resulting 24 bit code word shall constitute 1/2 rate Golay code transmission (see figures 29 and 30 for specific examples). Bit 1 of the 24 bit FEC code word is bit 1 (b_1) or bit 5 (b_5) of a DACM character. DACM characters are the ESC, DC4, DACB characters, and DACB acknowledgements. Bit 1 of the 24 bit FEC code word is bit 1 (b_1) or bit 5 (b_5) of the Mode I or Mode VI characters (data, control, framing, sync, ACKs, CAN, CAK, etc.).

TABLE XXX. Forward error correcting technique.

Loop Transmission Rate (bps)	Information Rate (bps) (Bit Synchronous)	FEC TECHNIQUE Golay Code
2400	300 600 1200	Quadruple Codeword (1/8 Rate) Double Codeword (1/4 Rate) Half Rate (1/2 Rate)
4800	600 1200 2400	1/8 Rate 1/4 Rate 1/2 Rate
9600	1200 2400 4800	1/8 Rate 1/4 Rate 1/2 Rate
16000	1200 2400 4800 2000 4000 8000	1/8 Rate, Stuffed to 16000 1/4 Rate, Stuffed to 16000 1/2 Rate, Stuffed to 16000 1/8 Rate 1/4 Rate 1/2 Rate
32000	2400 4800 9600 4000 8000 16000	1/8 Rate, Stuffed to 32000 1/4 Rate, Stuffed to 32000 1/2 Rate, Stuffed to 32000 1/8 Rate 1/4 Rate 1/2 Rate

[1] Error-Correcting Codes, by W. Wesley Peterson and E.J. Weldon, Jr., The MIT Press, Second Edition, 1972.

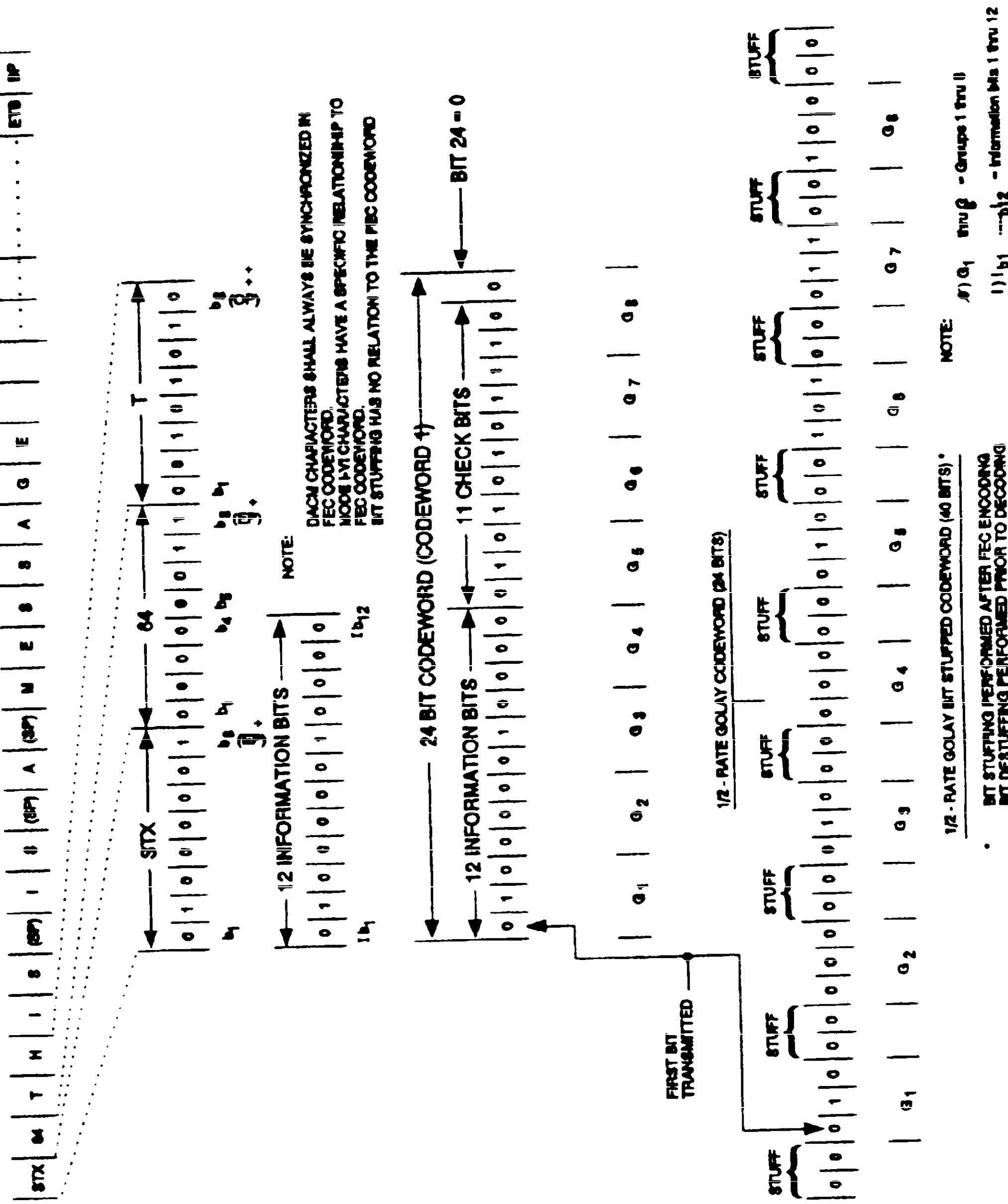


FIGURE 29. 1/2 rate Golay codeword generation (mode VI block example).

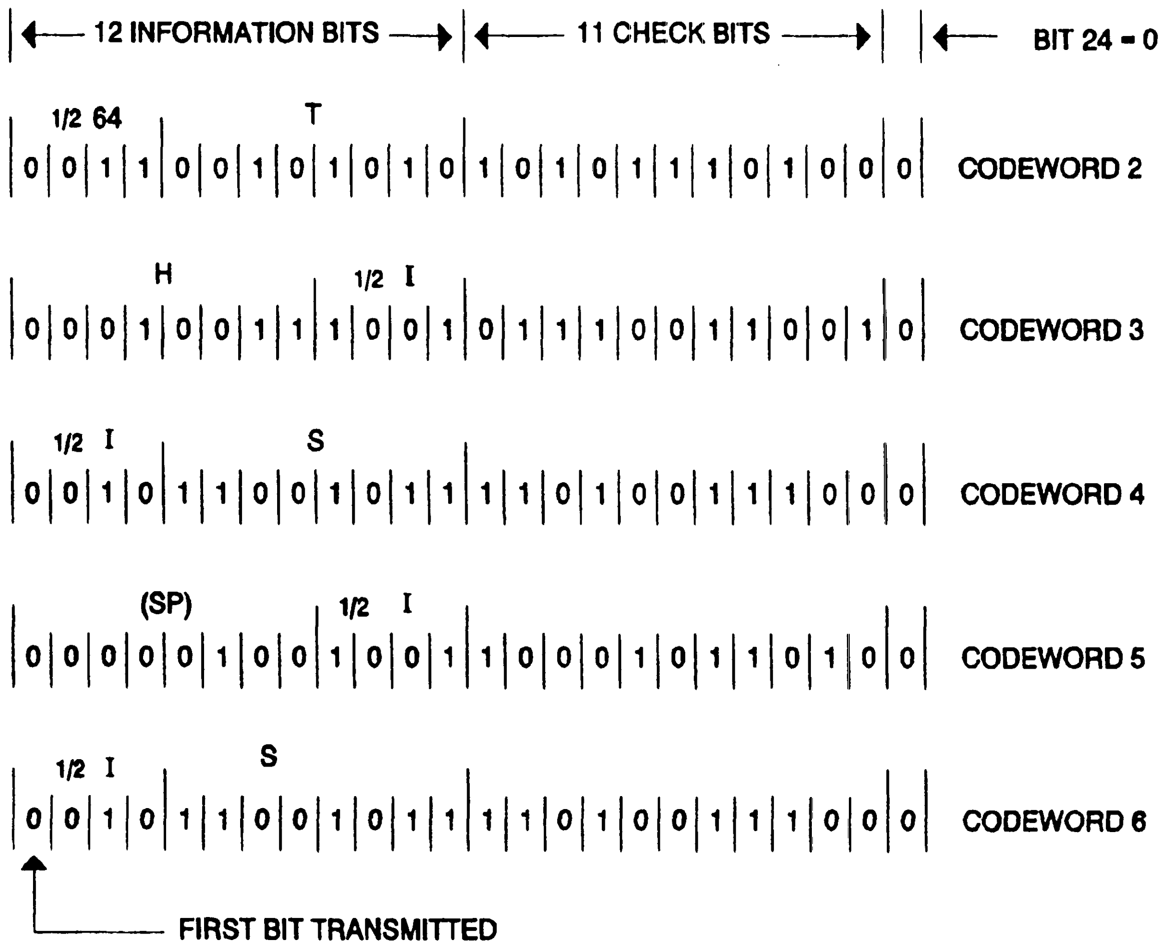


FIGURE 29A. 1/2 Rate Golay Codeword Generation (Mode VI Block Example) - continued.

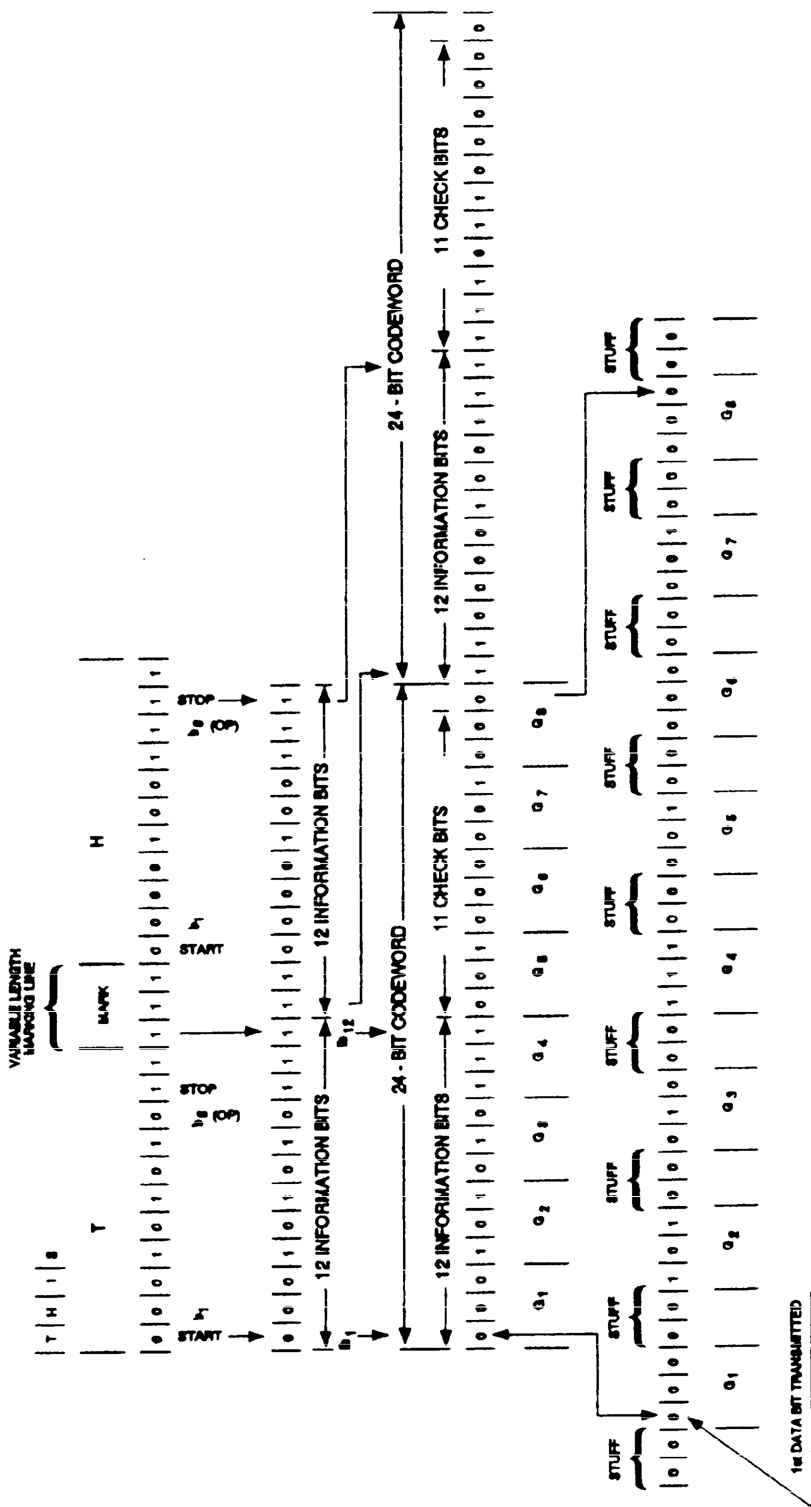


FIGURE 30. Start - stop example 1/2 rate Golay codeword generation (ASCII, odd parity 2 stop bits).

40.1.1.1 Check bits derivation. The transmitting DA/MS shall generate the check bits using the following generator polynomial:

$$g(x)=x^{11}+x^{10}+x^{6}+x^{5}+x^{4}+x^{2}+1$$

as specified herein. Note, that, using modulo 2 addition,

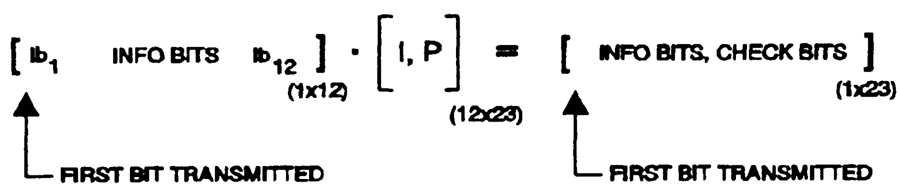
$$x^{23}+1=\underbrace{(x^{11}+x^{10}+x^{6}+x^{5}+x^{4}+x^{2}+1)}_{g(x)}(x^{11}+x^{9}+x^{7}+x^{6}+x^{5}+x+1)(x+1)$$

The eleven check bits shall be as derived from the following generator matrix G:

where the matrix contains the coefficients of the polynomials on the left. By interchanging the I and P columns to obtain matrix T; i.e.

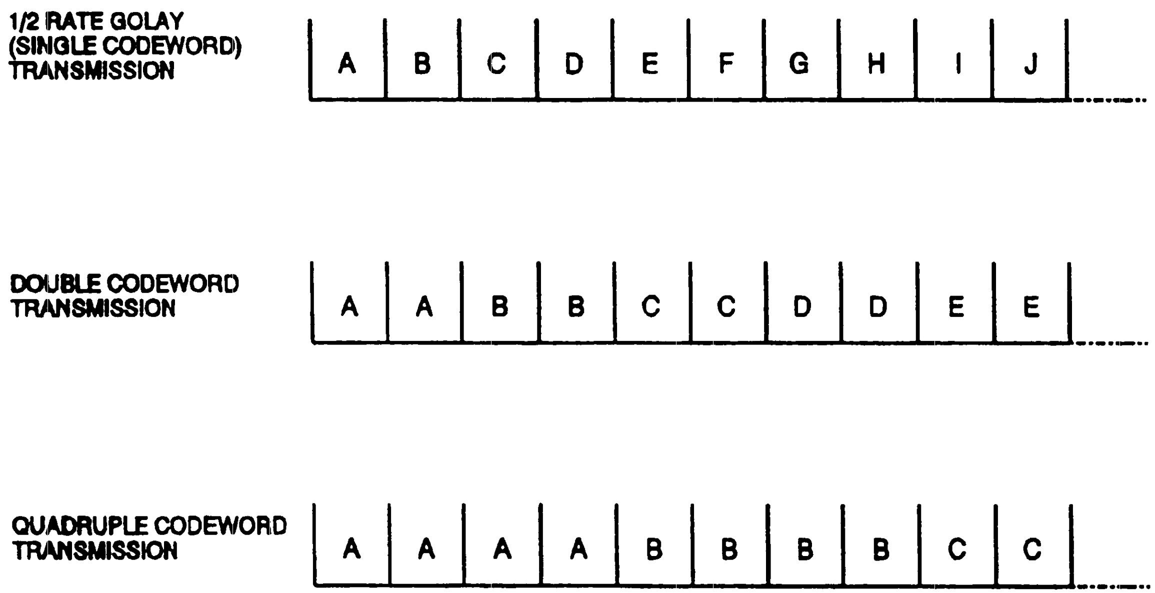
$$G=[P,I]_{(12x23)}=>[I,P]_{(12x23)}=T$$

the transmission order and value of the code word bits can be obtained by matrix multiplication (modulo 2 addition without carry) as follows:



40.1.2 Double code word transmission. Double code word transmission (1/4 rate Golay) is the transmission of a 1/2 rate Golay code word twice contiguously (see figure 31).

40.1.3 Quadruple code word transmission. Quadruple code word transmission (1/8 rate Golay) is the transmission of a 1/2 rate Golay code word four times contiguously (see figure 31).



A, B, C, ... ARE 1/2 RATE GOLAY CODEWORDS.

CODEWORDS ARE EITHER NOT STUFFED (24 BIT) OR STUFFED (40 BIT) AS REQUIRED FOR DTE TO LOOP TRANSFORMATION (SEE TABLE 1).

CODEWORD BITS ARE SINGULARLY SAMPLED AT LOOP BIT RATE.

FIGURE 31. Types of codeword transmission.

CONCLUDING MATERIAL

Custodians:

Army - SC

Navy - EC

Air Force - 90

DISA - DC

Review Activities:

Army - AC

Navy - NC, TD, OM

Air Force - 02, 17

DISA

OASD - IR

User Activities:

Army - CR

Navy - MC

Air Force - 13

DISA

Preparing Activity:

DLA - DH

DISA - DC

(Project TCTS-2610)

(This page intentionally left blank.)

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.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER MIL-STD-188-216A	2. DOCUMENT DATE (YYMMDD) 93 FEB 20

3. DOCUMENT TITLE
Interoperability Standard for Data Adapter Control Mode

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) AUTOVON (If applicable)	7. DATE SUBMITTED (YYMMDD)

8. PREPARING ACTIVITY

a. NAME	b. TELEPHONE *(Include Area Code)*	
Director, Joint Interoperability and Engineering Organization (JIEO)	(1) Commercial (908) 532-7726	(2) AUTOVON AV 992-7726
c. ADDRESS *(Include Zip Code)* ATTN: TBBD Fort Monmouth, NJ 07703-5613	IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466 Telephone (703) 756-2340 AUTOVON 289-2340	

DD Form 1426, OCT 89 *Previous editions are obsolete* 198/290