1. SCOPE

1.1 Purpose. This military standard (MIL-STD) establishes mandatory requirements applicable to satellite communications (SATCOM) terminals that are required for demand assigned multiple access (DAMA) operation over 5-kHz ultra high frequency (UHF) SATCOM channels. The requirements specified herein represent the minimum set required for interoperability; such requirements may be exceeded by equipment developers to satisfy specific service requirements, provided that interoperability is maintained. For example, the incorporation of additional standard and nonstandard interfaces is not precluded.

1.2 Scope. This MIL-STD is mandatory within the Department of Defense (DoD) and shall be invoked by equipment specifications for all future terminals required to operate in the DAMA mode over 5-kHz UHF SATCOM channels.

1.3 Application guidance. In this MIL-STD, the word *shall* identifies mandatory system standards. The word *should* identifies design objectives that are desirable but not mandatory. The terms *system standard* and *design objective* are defined in FED-STD-1037.

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2. APPLICABLE DOCUMENTS

2.1 Government documents

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

MILITARY SPECIFICATIONS

MIL-C-28883A	Military Specification for the Advanced Narrowband Digital Voice Terminal (ANDVT) Set, AN/USC-43(V)

FEDERAL STANDARDS

FED-STD-1037	Glossary of Telecommunication Terms

MILITARY STANDARDS

MIL-STD-188-181	Interoperability Standard for Dedicated 5-kHz and 25-kHz UHF Satellite Communications Channels
MIL-STD-188-183	Interoperability Standard for 25-kHz UHF TDMA/DAMA Terminal Waveform

[Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Naval Publications and Forms Center, (ATTN: NPODS), 5801 Tabor Avenue, Philadelphia, PA 19120-5099.]

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

NSA NO. 82-2B	NSA Performance and Interface Specification for TSEC/KG-84A, General Purpose Encryption Equipment (GPEE)
NSA NO. 87-01	KGV-11 and KGV-11(E2) Interface

Specification

NSA NO. 88-4A	National Security Agency Specification Interface Specification for THORNTON COMSEC/TRANSEC Integrated Circuit (CTIC)

[Copies of NSA documents are available from Director, National Security Agency, ATTN: V76, 9800 Savage Road, Fort George G. Meade, MD 20755-6000.]

2.2 Non-Government publications. The following document(s) form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in the issues of the DODISS cited in the solicitation. Unless otherwise specified, the issues of the documents not listed in the DoDISS are the issues of the documents cited in the solicitation (see 6.2).

No applicable publications

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

3. DEFINITIONS

3.1 Acronyms used in this MIL-STD. The acronyms used in this MIL-STD are defined as follows:

A	signal amplitude
ACC	alternate channel controller
AFB	Air Force Base
AFSATCOM	Air Force Satellite Communications
$a_i(t)$	in-phase data modulation signal
$a_q(t)$	quadrature data modulation signal
$a_m, \ldots, a_0$	data bits, 0 or 1
ANDVT	Advanced Narrowband Digital Voice Terminal
ASCII	American Standard Code for Information Interchange
BER	bit error ratio (bit error rate)
bps	bit(s) per second
CBK	circuit burst kind
CC	channel controller
C/N_o	carrier-power--to--noise-spectral-density ratio
COM	communication
COMSEC	communications security
CRC	cyclic redundancy check
CRS	contention ranging slots
CTIC	COMSEC/TRANSEC integrated circuit
CW	continuous wave
DAMA	demand assignment multiple access

dB	decibel(s)
dB-Hz	decibel(s)-hertz
dBW	decibel(s) relative to 1 W
DCA	Defense Communications Agency
DCAC	DCA circular
DCS	Defense Communications System
DISA	Defense Information Systems Agency
D(x)	data for which CRC is generated
DO	design objective
DoD	Department of Defense
DoDD	DoD directive
DoDISS	DoD Index of Specifications and Standards
E_b/N_o	signal energy per bit to noise spectral density ratio
EMUT	Enhanced Manpack UHF Terminal
FEC	forward error correction
FED-STD	federal standard
FIFO	first in, first out
FOW	forward orderwire
G/T	antenna-gain-to-noise temperature
G(x)	generating polynomial for CRC
Hz	hertz
I	in phase
I/O	input/output
JCS	Joint Chiefs of Staff

JIEO	Joint Interoperability and Engineering Organization
JTCO	Joint Tactical Communications Office
k	constraint length
kHz	kilohertz
LSB	least significant bit
m	index
MIL-STD	military standard
MJCS	Joint Chiefs of Staff memorandum
ms	millisecond(s)
MSB	most significant bit
N	integer number
NCS	network control station
NMCS	National Military Command System
PCC	primary channel controller
OTAR	over the air rekeying
Q	quadrature phase
rf	radio frequency
ROW	return orderwire
SATCOM	satellite communications
SOM	start-of-message
SOQPSK	shaped offset quadrature phase-shift keying
s(t)	transmit signal
sps	symbol(s) per second
T	symbol period

TBD	to be determined
TDMA	time-division multiple access
TRANSEC	transmission security
TSN	time slot number
UHF	ultra high frequency
USTS	UHF Satellite Terminal System (Air Force)
W	watt(s)
ω_o	radian frequency, 2π x frequency in hertz
x	unit delay
$\Phi(t)$	phase

3.2 Definitions of terms. Definitions of terms not listed are as defined in FED-STD-1037.

Access: The ability, permission, or liberty to communicate with, or to make use of, any resource of a system.

Acknowledgment: A message from the addressee indicating that information has been received without error.

Acquisition back-off number: A number used by the terminal in the algorithm used to reduce the possibility of conflicting transmissions during the initial ranging of terminals.

Active ranging: The transmission and subsequent reception of a burst signal used for estimating the range to a satellite.

Active service: A service that has been assigned communications resources and has not been torn down. Active services are either assigned or preempted.

Address: The coded representation of the source or destination of a communication.

Allocation: Channel time made available for a particular function.

Alternate channel controller: A channel controller entity that

monitors the channel and can assume control, either manually by operator action or automatically when it detects that the primary channel controller has failed.

Assigned service: A service being assigned communications resources.

Blocked service: A queued service held from scheduling, awaiting (1) the availability of participating terminals busy with other services, or (2) the completion of setting up the path for a multiple-hop service.

Building block: A fundamental unit of channel time used in determining time within a frame. Used in the allocation of channel resources.

Burst: A time-limited transmission composed of a synchronization preamble and a finite-length data stream.

Burst code: A combination of modulation rate, coding rate, and (for message services) maximum burst size.

Channel: A communications path characterized by such parameters as time, frequency, and bandwidth through which digital or other information may flow.

Channel controller: The entity that provides network control functions.

Channel resources: The available time, bandwidth, and power of a channel.

Circuit: The path between at least two terminals over which one-way or two-way communications may be provided.

Circuit burst kind (CBK): A field that identifies the type of burst being transmitted during a circuit service.

Circuit service: Channel resource assignments in each frame that are dedicated for use by the participating members for the duration of the assignment.

Communications: A method or means of conveying information of any kind from one person or place to another.

Connected: The configuration of a channel controller in which connectivity to adjacent satellite footprints by relay is available.

Contention time slot: A contention time slot can be used by any

network member, in accordance with the procedures in this MIL-STD. Such time slots are used for requesting network resources or for initial ranging.

Data: (1) Any user information transmitted over a channel. (2) Any information that is not voice.

Data block: A quantity of user data (224 bits) used in integer multiples within message service packets.

Degraded: The state of a network when it does not have connectivity to at least one adjacent network.

Demand assignment multiple access (DAMA): A channel access scheme in which access of a channel from geographically distributed communications terminals is allocated in accordance with demand.

Destination terminal: The terminal addressee of a communication.

Downlink acquisition: The condition during initial acquisition of the waveform, when the terminal or a noncontrolling CC receives a correct FOW burst.

Field: A specific portion of a burst.

Flush bits: Bits added to a data field prior to encoding to provide proper operations of convolution decoders.

Forward orderwire (FOW): The orderwire used for transmitting control and status information from a channel controller to terminals in the network.

Frame: A unit of time on the channel. A frame consists of 1024 building blocks.

Full-duplex: (1) Communications that occur in both directions (transmit and receive) within one frame. (2) A characteristic that signifies the terminal's capability to simultaneously receive and transmit rf signals.

Global: A network configuration in which relays are present and data may be routed to a network on another satellite channel.

Guard list: A set of addresses for which a terminal receives services.

Guard time: The time allocated between bursts to allow for timing differences between transmitting terminals.

Half-duplex: A characteristic that allows the terminal to receive and transmit signals, but not both at the same time.

Indicator: A symbol, flag, or signal that serves to identify a specific state or item.

Information: The meaning that a person assigns to data, using certain conventions applied to those data.

I/O rate: The rate at which bits are received from an I/O device, in units of bits per second.

Link: The communications connections between two nodes of a

network.

Local: (1) Operations within a channel or group of channels in a single footprint controlled by one PCC. (2) Initiations by an equipment operator.

Local footprint: The satellite coverage area of a PCC and the terminals operating under its control.

Message: (1) Alphanumeric information. (2) Information contained in orderwire transmissions. (3) Any information prepared in a form suitable for transmission.

Message service: A service that provides resources for the transmission of messages, using a packet-oriented protocol.

Modulation rate: The rate at which information is transferred across a satellite channel, in units of symbols per second.

Multi-channel: The network capability of automatically switching from channel to channel within a single satellite footprint for transmit and receive services when commanded by the PCC.

Multiple hop: Operations that relay information between two or more satellite channels.

Network: A collection of terminals capable of interterminal communications.

Network control station (NCS): The equipment in which one or more channel controllers reside.

Node: A terminal or channel controller in a network.

Nonprocessed channel: A transponder (e.g., a satellite repeater) in which digital signals are not reconstituted.

Operator: The person involved in control and operation of a communications terminal.

Orderwire: The portion of the DAMA frame used for transmission of management, control, and status information among the channel controllers and terminal users.

Originator: A person or terminal that initiates a communication.

Packet: For message service, the information transmitted in one burst.

Passive ranging: A process by which the terminal determines the signal propagation time to the satellite by means other than transmitting a ranging signal.

Pending service: A queued service that is not blocked, but is awaiting the availability of communications resources on the channel.

Preassigned service: A type of service whose channel allocation is scheduled and set up well in advance of being used.

Preempted service: A service that has been interrupted to allow for higher-precedence network activities.

Primary channel controller: The NCS function that actively controls the DAMA channel.

Protocol: The set of rules for a communications system operation that must be followed if communication is to occur.

Queued service: A service on the request queue at the PCC, waiting to be assigned communications resources. Queued services are either blocked or pending.

Ranging: A process by which a terminal determines the propagation time to the satellite, to establish uplink timing. See *active ranging* and *passive ranging*.

Relay: A method of communications in which data is passed from one DAMA channel to another so as to achieve greater connectivity than that which is provided by the one channel.

Return orderwire (ROW): The orderwire used to transmit control and status information from local network terminals to the channel controller.

Service: A basic means of providing communications.

Source terminal: The terminal from which information is considered to originate.

Subnet: A shared communications service involving two or more terminals.

Teardown: Termination of an established communication.

Terminal: An equipment or function that originates or terminates communications traffic.

Time-division multiple access (TDMA): A communications technique that allows multiple terminals to share a given frequency spectrum. Each terminal has exclusive use of the frequency spectrum for a small time interval (fraction of a frame), which is known as a TDMA time slot.

Time-slot: A time period allocated for the transmission of an orderwire or communications burst.

Transmission: The dispatching of a signal, message, or other form of information by means of radio.

Transmission mode: A terminal configuration (such as modulation rate or I/O rate) specified by the channel controller for a specific transmission.

Uplink acquisition: The status attained by a terminal or an ACC (1) after downlink acquisition is successful, and (2) upon correct reception of a ranging burst or determination of round-trip propagation time to the satellite by some other means. Uplink acquisition is lost if round-trip propagation time to the satellite is not known to within 12.604 ms.

User: A person, organization, or other entity that employs the services provided by a communications system for transfer of information to others.

Waveform: The combination of baseband signal structure, rf signal structure, and protocols required to define a signal transmission and reception.

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4. GENERAL REQUIREMENTS

4.1 Communications system characteristics. The DAMA waveform defined in this MIL-STD provides for dynamic sharing of one or more nonprocessed UHF SATCOM channels, in dedicated or DAMA mode, among numerous users. Thousands of satellite terminals, within the same satellite coverage area, may share the channels of one or more satellites. Worldwide multiuser SATCOM is provided by using a relay scheme between channels on adjacent DoD UHF communications satellites. Below are highlighted three major benefits of this waveform: efficiency, centralized control, and global communications.

a. Efficiency. The 5-kHz UHF DAMA waveform provides efficient handling of short command and control (C2) messages, as well as effective resource-sharing between voice and data communications. This waveform, when used on one 5-kHz channel, can support a message throughput of 900 messages per hour, with an average message length of 200 characters. Secure voice, operating at a 2400-bps rate, is supported, as are circuit and block message capabilities for handling digital data. In addition to demand assignment of channel resources, provisions exist for preassignment of channel resources.

b. Centralized control. The 5-kHz DAMA network is controlled by a primary channel controller (PCC) which provides real-time control of the channel. The PCC receives and processes service requests and broadcasts assignments to terminals. Service requests are generated by network terminals and sent to the PCC over the satellite path, using the return orderwire (ROW). The PCC responds with allocations of channel resources, using the forward orderwire (FOW).

c. Global communications. The network control station (NCS) performs the relay functions necessary to provide multiple-hop (global) circuit communications. The NCS located in areas of overlapping satellite footprints can simultaneously access one or more channels on each of the two adjacent satellites or two or more channels on the same satellite. A terminal in one satellite footprint makes use of the automatic NCS relay function to send information through one or more NCSs to the desired destination terminal in another satellite footprint.

4.2 Waveform description. The 5-kHz DAMA waveform provides communications among geographically dispersed terminals, using nonprocessed SATCOM channels. All signals within the channel bandwidth received at the satellite are translated in frequency and retransmitted with no digital processing. The communications

signals consist of bursts of digitally encoded information. Transmission time and duration, as specified in this MIL-STD, depend on the nature of the information and are under PCC control.

4.2.1 General waveform structure. All channel time is divided into fixed intervals called *frames*. A frame time is further divided into 1024 increments known as *building blocks*. A single building block is 8.75 ms long. The building blocks are grouped into three segments, which vary in length and contain functionally related information that may be transmitted from more than one source. These segments are called the *FOW segment*, the *ROW segment*, and the *communications (COM) segment*. Segments are subdivided into one or more time-slots that may be of various lengths. Figure 1 illustrates the location of the segments within the frame.

a. A transmission from a single source (a terminal or a CC) occurs within a time-slot. The time-slots may be of various lengths in building block increments. The FOW segment is composed of a single time-slot. However, the ROW and COM segments may each contain more than one time-slot. Each time-slot contains information from a single source at a single modulation rate.

b. Each slot within the waveform consists of three time elements: (1) the synchronization element, a known signal that the receiver needs for carrier, bit, and data synchronization; (2) the data element, in which the information is transmitted; and (3) the guard-time element, in which no transmission occurs but which is required to avoid user-to-user interference between adjacent slots.

4.2.1.1 Waveform segment description. Channel resource control occurs through the use of two communications mechanisms, the FOW and ROW, which are transmitted in the FOW segment and ROW segment, respectively. The FOW originates at the PCC. The ROW originates at communications terminal equipment or at an ACC. User data is transmitted in the COM segment.

4.2.1.1.1 Forward orderwire segment. The FOW contains information that enables terminals to acquire and maintain frame time and cryptographic synchronization with the PCC. The FOW is transmitted at the beginning of each frame and contains DAMA control information for the next frame. The DAMA control information is provided in the form of system and directed messages. System messages broadcast system status and waveform restrictions to the communications terminals. Appendix A describes FOW system messages. Directed messages are used by the controlling PCC to allocate time channel resources, to respond to

terminal login/logout requests, and to transmit other direct information necessary for managing the waveform. Table I lists the full set of FOW directed messages; Appendix B describes these in detail.

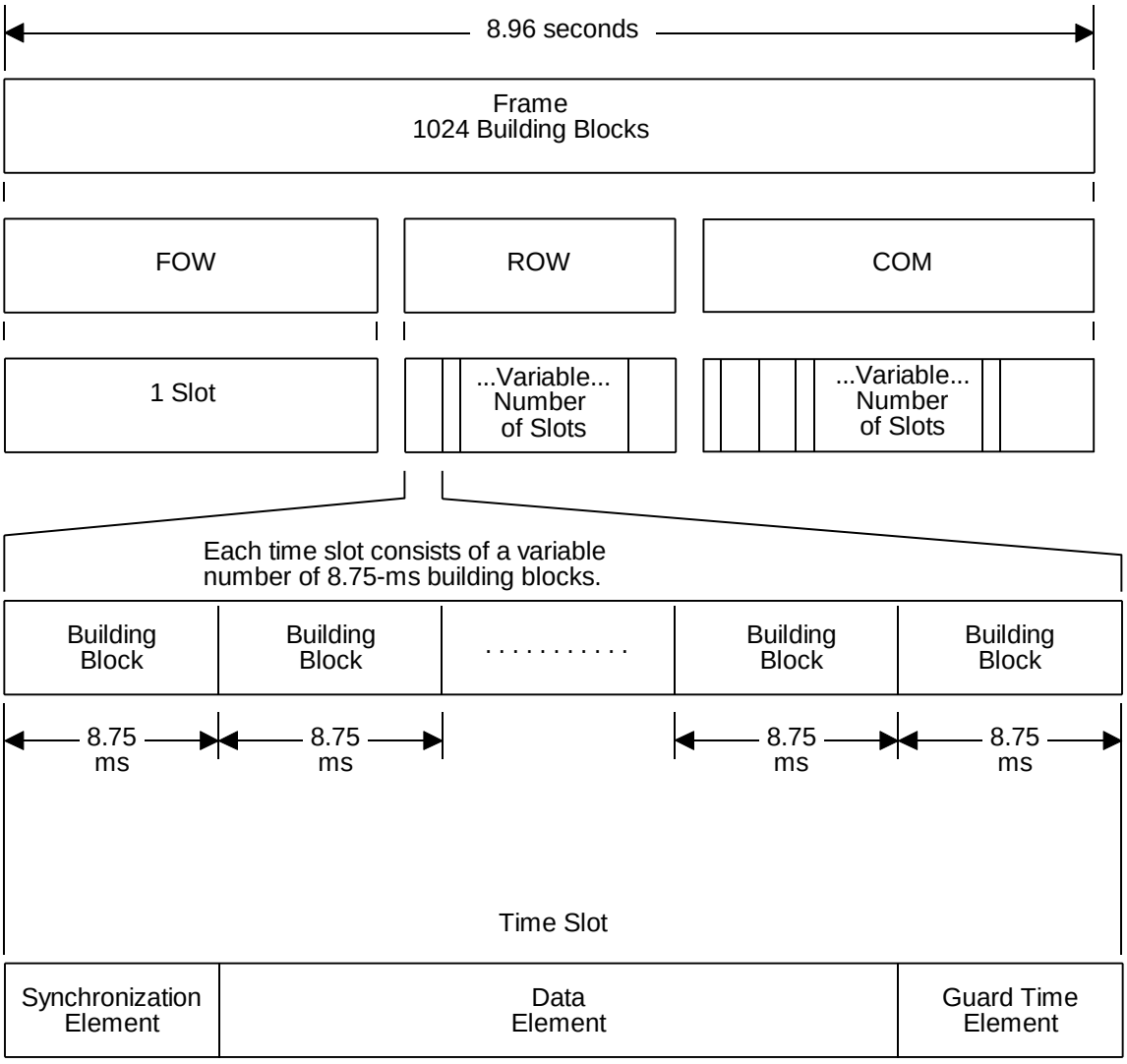

Figure 1. Frame Format.

TABLE I. FOW directed messages.

MESSAGE TYPE	NAME	DIRECTED TO TERMINAL*
0	FOW:Acknowledge Message	Yes
1	FOW:Acknowledge Blocks	Yes
2	FOW:Alternate Channel Controller Designate Response	No
3	FOW:Circuit Assignment	Yes
4	FOW:Circuit Setup Response	Yes
5	FOW:Circuit Teardown	Yes
6	FOW:Login Response	Yes
7	FOW:Logout Response	Yes
8	FOW:Message Acknowledgment	Yes
9	FOW:Message Assignment	Yes
10	FOW:Message Setup Response	Yes
11	FOW:Message Teardown	Yes
12	FOW:Multiple-Hop Begin Assignments Response	No
13	FOW:Multiple-Hop Circuit Assignment	Yes
14	FOW:Multiple-Hop Circuit Preemption Response	No
15	FOW:Multiple-Hop Circuit Teardown	Yes
16	FOW:Network Status	No
17	FOW:Network Status Response	No
18	FOW:Null Assignment	Yes
19	FOW:Participant Status Data Base	Yes
20	FOW:Primary Channel Controller Designate	No
21	FOW:Ranging Assignment	Yes
22	FOW:Relay Ringup	No
23	FOW:Relay Ringup Response	No
24	FOW:Relay Select	No
25	FOW:Relay Select Response	No
26	FOW:Report Status	Yes
27	FOW:Report Terminal Address	Yes
28	FOW:Terminal Address Add or Delete	Yes
29	FOW:Terminal Channel Assignment	Yes
30	FOW:Terminal Channel Return Response	Yes

NOTE:
* Messages not directed to the terminals are directed to other CCs.

4.2.1.1.2 Return orderwire segment. The ROW segment contains information from terminals and ACCs. The information is sent to the PCC. Also, ACCs and terminals range in the ROW segment.

4.2.1.1.2.1 Return orderwire message time-slots. Table II lists the full set of ROW messages. Appendix C describes these in detail.

4.2.1.1.2.2 Return orderwire ranging time-slots. ROW ranging time-slots are used to make round-trip propagation time measurements for proper transmit timing. ROW ranging time-slots are longer than ROW message time-slots. ROW ranging time-slots provide additional guard time to ensure that a ranging burst does not interfere with transmissions. One or more contention ranging slot(s) are always at the beginning of the ROW segment.

4.2.1.1.3 Communications segment. Terminals communicate with other terminals, using assigned time-slots within the COM segment. Two communications capabilities are supported, circuit service and message service. Circuit service, which involves a fixed-duration time-slot allocation for each frame, provides data and digital voice communications among terminals and CCs. Message service, which provides more flexible and efficient use of channel resources (time), provides data communications capabilities.

4.2.2 Error control

4.2.2.1 Error detection. CRCs are used for error detection. Two CRC code lengths are used in the transmission of orderwire and communications data. A long code (16 bits) is used on the FOW transmissions, on message service data blocks, and as a check of guard-list consistency. A short code (8 bits) is used on the ROW messages and ranging transmissions.

4.2.2.2 Error correction. Error correction encoding and decoding is used for all orderwire messages and selected communications. Forward error correction (FEC) encoding is performed using a rate of 1/2, constraint length seven, convolutional code. The decoder performance gain shall be at least equal to that of the Viterbi decoder.

4.2.2.3 Interleaving/deinterleaving. Block interleaving is used for selected fields of COM transmissions. The block interleaving structure consists of two independently constructed blocks of 112 code bits used in sequence. The interleaving process is reversed by a deinterleaving operation at the receiver.

4.2.3 Modulation

4.2.3.1 Modulation format. The modulation for all transmissions is interoperable with shaped offset quadrature phase-shift keying (SOQPSK).

TABLE II. ROW messages.

MESSAGE TYPE	NAME	SLOT TYPE*	ORIGINATED BY TERMINALS**
0	ROW:Alternate Channel Controller Designate	Contention	No
1	ROW:Assign Ranging	Contention	Yes
2	ROW:Channel Controller Login	Contention	No
3	ROW:Channel Controller Status Report	Assigned	No
4	ROW:Circuit Setup	Contention	Yes
5	ROW:Circuit Teardown	Contention	Yes
6	ROW:Login	Contention	Yes
7	ROW:Logout	Contention	Yes
8	ROW:Message Acknowledgment	Assigned	Yes
9	ROW:Message Setup	Contention	Yes
10	ROW:Message Teardown	Contention	Yes
11	ROW:Multiple-Hop Begin Assignments	Contention	No
12	ROW:Multiple-Hop Circuit Preemption	Contention	No
13	ROW:Multiple-Hop Circuit Resumption	Contention	No
14	ROW:Multiple-Hop Circuit Teardown	Contention	No
15	ROW:Multiple-Hop Circuit Teardown Response	Assigned	No
16	ROW:Network Status	Contention	No
17	ROW:Network Status Response	Assigned	No
18	ROW:Blocks Acknowledgment	Assigned	Yes
19	ROW:Primary Channel Controller Designate Response	Assigned	No
20	ROW:Relay Ringup	Contention	No
21	ROW:Relay Ringup Response	Assigned	No
22	ROW:Relay Select	Contention	No
23	ROW:Relay Select Response	Assigned	No
24	ROW:Status Report	Assigned	Yes
25	ROW:Terminal Address Add or Delete Response	Assigned	Yes
26	ROW:Terminal Address Report	Assigned	Yes
27	ROW:Terminal Channel Assignment Response	Assigned	Yes
28	ROW:Terminal Channel Return	Contention	Yes

NOTES:

* Defined in 5.4.2.1.7.3

** Messages marked Yes are originated by the terminals or ACCs. Messages marked No are transmitted only by ACCs.

4.2.3.2 Modulation rates. The modulation rates shall be 600, 800, 1200, 2400, and 3000 symbols per second (sps), as specified in Table III.

TABLE III. Modulation rates.

TYPE OF BURST	MODULATION RATE (sps)				
	600	800	1200	2400	3000
FOW	X				
ROW Message				X	
ROW Ranging		X			
COM	X		X	X	X

4.3 Terminal performance requirements. The waveform defined in this MIL-STD has been designed to operate on 5-kHz nonprocessed channels of current and planned UHF SATCOM satellites. The transmit terminal power received at the satellite shall be at least -169 decibels relative to 1 watt (dBW). The terminal receiver system shall be designed to provide error-free reception of the FOW burst for at least 99 of 100 FOW bursts, with a confidence of 98 percent. Error-free reception implies both successful acquisition of the burst and error-free reception of all data covered by the CRC. To satisfy this requirement, it shall be assumed that FOWs have an average length of 1400 bits, where bit length is the value indicated in the FOW field called *Length of this FOW* (see 5.1.1i) and that the controller power received at the satellite is at least -169 dBW. Terminal specifications shall define the parameters that must be met for them to comply with the requirements of this paragraph.

4.3.1 Uplink frequency accuracy. The uplink carrier frequency, as received at the satellite, shall be within 400 Hz of the allocated channel frequency. The uplink carrier frequency for FOW bursts from the PCC, as received at the satellite, will be within 100 Hz of the allocated channel frequency. The terminal receiver system shall accommodate these amounts of uplink frequency offset in the terminal uplink frequency offset budget. Note that the frequency offset addressed by this requirement includes errors introduced by terminal and satellite relative velocities and terminal frequency drift.

4.3.2 Terminal duplex. If a terminal has the capability to transmit and receive concurrently, then in the ROW:Login message and in the ROW:Status Report message the terminal shall identify itself as full-duplex. If a terminal cannot concurrently receive

and transmit, then the terminal shall identify itself as half-duplex. A full-duplex terminal may be assigned adjacent transmit and receive time-slots directed to this node address, however, a half-duplex terminal will have at least 32 building blocks between any receive and transmit time-slot directed to its node address.

4.4 Communications options. This waveform supports circuit and message communications services. Communications options available for circuit services shall be as specified in Table IV. Communications options available for message services shall be as specified in Table V. The PCC commands the modulation rate of all COM segment transmissions. The terminal sends data-rate and other service characteristics over the ROW to the PCC. Then the PCC specifies the modulation rate and coding requirements, based on end-to-end link-quality criteria, and other considerations.

4.5 Security characteristics. Security for orderwire, voice and data is presented in 5.5.

TABLE IV. Circuit-service communications options.

DATA OR VOICE	I/O DATA RATE (bps)	FULL- OR HALF-DUPLEX (1)	COMPUTED END-TO-END LINK QUALITY C/N_o (dB-Hz)(2)	MODULATION RATE (sps)	CODED (3)	TIME-SLOT SIZE (4)
Data	75	Either	<36.8	600	Yes	166
Data	75	Either	[36.8, 39.8)	1200	Yes	86
Data	75	Either	[39.8, 40.8)	2400	Yes	46
Data	75	Either	[40.8, 48.2)	3000	Yes	38
Data	75	Either	[48.2, 49.2)	2400	No	30
Data	75	Either	≥49.2	3000	No	25
Data	300	Half	<36.8	600	Yes	550
Data	300	Half	[36.8, 39.8)	1200	Yes	278
Data	300	Half	[39.8, 40.8)	2400	Yes	142
Data	300	Half	[40.8, 48.2)	3000	Yes	115
Data	300	Half	[48.2, 49.2)	2400	No	78
Data	300	Half	≥49.2	3000	No	64
Data	300	Full	<39.8	1200	Yes	278
Data	300	Full	[39.8, 40.8)	2400	Yes	142
Data	300	Full	[40.8, 48.2)	3000	Yes	115
Data	300	Full	[48.2, 49.2)	2400	No	78
Data	300	Full	≥49.2	3000	No	64
Data	600	Half	<39.8	1200	Yes	534
Data	600	Half	[39.8, 40.8)	2400	Yes	270
Data	600	Half	[40.8, 48.2)	3000	Yes	218
Data	600	Half	[48.2, 49.2)	2400	No	142
Data	600	Half	≥49.2	3000	No	115
Data	600	Full	<40.8	2400	Yes	270
Data	600	Full	[40.8, 48.2)	3000	Yes	218
Data	600	Full	[48.2, 49.2)	2400	No	142
Data	600	Full	≥49.2	3000	No	115

NOTES:

(1) A full-duplex service requires assignment of two time-slots. For example, to perform a full-duplex, 1200-bps service, for which the modulation rate assigned by the PCC is 3000-sps, uncoded in each direction, two 217-building block assignments in the same frame are made by the PCC.

(2) The bracket [indicates end point is included. The parenthesis) indicates end point is not included.

(3) Rate 1/2, constraint length seven convolutional code.

(4) Time-slot size is the number of building blocks.

TABLE IV. Circuit-service communications options (concluded).

DATA OR VOICE	I/O DATA RATE (bps)	FULL- OR HALF-DUPLEX (1)	COMPUTED END-TO-END LINK QUALITY C/N_o (dB-Hz) (2)	MODULATION RATE (sps)	CODED (3)	TIME-SLOT SIZE (4)
Data	1200	Half	<40.8	2400	Yes	526
Data	1200	Half	[40.8, 48.2)	3000	Yes	422
Data	1200	Half	[48.2, 49.2)	2400	No	270
Data	1200	Half	≥49.2	3000	No	217
Data	1200	Full	<48.2	3000	Yes	422
Data	1200	Full	[48.2, 49.2)	2400	No	270
Data	1200	Full	≥49.2	3000	No	217
Data	2400	Half	<48.2	3000	Yes	832
Data	2400	Half	[48.2,49.2)	2400	No	526
Data	2400	Half	≥49.2	3000	No	422
Voice	2400	Half	<46.2	3000	Yes	832
Voice	2400	Half	[46.2, 47.2)	2400	No	526
Voice	2400	Half	≥47.2	3000	No	422

NOTES:

(1) A full-duplex service requires assignment of two time-slots. For example, to perform a full-duplex, 1200-bps service, for which the modulation rate assigned by the PCC is 3000-sps, uncoded in each direction, two 217-building block assignments in the same frame are made by the PCC.

(2) The bracket [indicates end point is included. The parenthesis) indicates end point is not included.

(3) Rate 1/2, constraint length seven convolutional code.

(4) Time-slot size is the number of building blocks.

TABLE V. Message-service communications options.

COMPUTED END-TO-END LINK QUALITY C/N_0(dB-Hz)(1)	MODULATION RATE (sps)	CODED (2)	PACKET SIZES (3)	TIME-SLOT SIZE (4)
<32.11	600	Yes	1	83
[32.11,34.0)	600	Yes	1, 2, 3	83, 126, 169
[34.0, 36.0)	600	Yes	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	83, 126, 169, 211, 254, 297, 339, 382, 425, 467
[36.0, 38.4)	1200	Yes	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	44, 66, 87, 108, 130, 151, 172, 194, 215, 236
[38.4, 39.8)	2400	Yes	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	25, 36 47, 57, 68, 79, 89, 100, 111, 121
[39.8, 41.6)	3000	Yes	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	22, 30, 39, 47, 56, 65, 73, 82, 90, 99
[41.6, 45.5)	2400	No	2, 4, 6, 8, 10, 12, 14, 16, 18, 20	24, 35, 46, 56, 67, 78, 88, 99, 110, 120
≥45.5	3000	No	2, 4, 6, 8, 10, 12, 14, 16, 18, 20	21, 30, 38, 47, 55, 64, 72, 81, 89, 98

NOTES:

(1) The bracket [indicates end point is included. The parenthesis) indicates end point is not included.

(2) Rate 1/2, constraint length seven convolutional code.

(3) Packet size in number of 224-bit data blocks to be transmitted within a single burst. The largest listed packet size is assigned unless either a) the last data blocks in the message are being scheduled and fit into a smaller packet size, or b) if at the time at which the service is scheduled, the number of building blocks remaining in the frame being scheduled is less than the number needed for the largest listed packet size.

(4) Time-slot size is the number of building blocks.

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