MILITARY STANDARD

INTEROPERABILITY AND PERFORMANCE STANDARD FOR THE ALL-DIGITAL TACTICAL-TO-STRATEGIC GATEWAY

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FOREWORD

1. 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 (CJCS) and the Joint Staff, the Unified and Specified Commands, Department of Defense (DOD) Agencies, and DOD Field Activities.

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

Director
Joint Interoperability and Engineering Organization
ATTN: TBBB
Fort Monmouth, New Jersey 07703-5613

by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this MIL-STD or by letter.

3. Originally, 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).

4. The Defense Information Systems Agency (DISA), formerly the Defense Communications Agency (DCA), published DCA circulars (DCACs) promulgating standards and engineering criteria that apply to the long-haul Defense Communications System (DCS) and to technical support of the National Military Command System (NMCS).

5. 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. This series is subdivided into a MIL-STD-188-100 series, covering common standards for tactical and long-haul communications; a MIL-STD-188-200 series, covering standards for tactical communications only; and a MIL-STD-188-300 series, covering standards for long-haul communications only. Emphasis is being placed on developing common standards for tactical and long-haul communications published in the MIL-STD-188-100 series.

6. This MIL-STD is a further development of sections 4.1.3 and 5.2.4 of the following planning standard: *MIL-STD-187-700, Interoperability and Performance Standards for the Defense Information System.* It defines all technical characteristics essential to achieving interoperability between digital-tactical networks and digital-strategic networks for circuit-switched voice and data subscribers.

7. Users of this MIL-STD should be aware that it is based, at least in part, on the following commercial standards

ANSI T1.216	CCITT I.460
ANSI T1.217	CCITT V110
ANSI T1.403	
ANSI T1.408	
ANSI T1.607	
ANSI T1.610	
ANSI T1.619	

and that there may be patent rights, copyright claims, or both, by companies or individuals on portions of the standard. Before incorporating this MIL-STD into systems or equipment, the user should contact the American National Standards Institute (ANSI) and the International Telegraph and Telephone Consultative Committee (CCITT) regarding claims on conditions pertaining to the use of any of the above standards. Implementors of this MIL-STD shall be solely responsible for compensating companies or individuals entitled to any royalties.

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1. SCOPE

1.1 Purpose. The purpose of this military standard (MIL-STD) is to provide a baseline for a gateway between tactical networks and strategic networks. The tactical networks are digital networks based on Tri-Service Tactical Communications (TRI-TAC) specifications. The strategic networks are digital networks based on Integrated Services Digital Network (ISDN) standards. This MIL-STD addresses the requirements for transmission of voice and data, through the gateway, between tactical and strategic circuit-switched networks. The requirements are specifically for the gateway and do not address requirements for a gateway switch. These requirements further presume that a call is always set up as a dial-up, circuit-switched call and that it progresses such that an inband, end-to-end, encrypted phase can be established with the New Terminal to support secure voice or secure data transmissions. This MIL-STD is a further development of sections 4.1.3 and 5.2.4 of the following planning standard: *MIL-STD-187-700, Interoperability and Performance Standards for the Defense Information System.*

1.2 Applicability. This MIL-STD applies to interfaces between digital communications systems only. Analog interfaces are covered in Joint Interoperability and Engineering Organization (JIEO) Technical Interface Specification (TIS) 9115.

1.3 Objectives. This MIL-STD has three objectives:

a. To achieve interoperability between strategic (ISDN) and tactical (TRI-TAC) digital circuit-switched networks for voice and data.

b. To achieve cost-effective interoperability and performance across the interface by referencing specific subsets of military and commercial standards.

c. To provide the following gateway capabilities:

1. Five levels of precedence and preemption.

2. Common-channel-signaling message conversion.

3. Choice of rate adaption or transcoding for voice algorithm conversion.

4. Direct digital interfacing that preserves bit-count integrity (BCI).

5. Support of end-to-end transmission and reception of secure voice and secure data.

1.4 Defense Information System framework. This MIL-STD is based on the Defense Information System (DIS) framework (see 4.1, Figure 1) described below.

a. The DIS concept provides for an evolutionary integration of existing and future Department of Defense (DOD) computer and telephone communications systems. DOD Services and Agencies adopted the DIS framework as a guide for developing MIL-STD-187-700. The DIS framework provides efficient, end-to-end, integrated services for information sources, sinks, and processors. Integrated services provide for voice, message, graphic, and imagery transfer across a single network interface. By definition, the DIS framework includes all components necessary to achieve interoperability between and among DOD users.

b. The DIS framework consists of three major sections demarcated by reference points A and B. Users may access the DIS through subscriber network elements, such as source, sink, or processor terminal equipment. These terminal equipment include telephones, facsimile machines, and other data terminal equipment (DTE). For the information source, sink, and processor elements to be interoperable, all seven layers of the International Standards Organization (ISO) Open Systems Interconnection (OSI) Reference Model must be interoperable.

c. DTEs exchange information through information-transfer utilities. Information-transfer utilities are composed of local-network elements, wide-network elements, and their respective interoperability reference points. DOD Services and Agencies provide fixed-plant, local-network elements to support strategic users and base operations. They also provide tactical local-network elements to support garrison operations and access to wide-network elements, as well as tactical-network elements to support deployed combat forces. The Defense Information Systems Agency (DISA) provides wide-network elements to interconnect geographically separated local-network elements. The wide-network elements include the Defense Communications System (DCS) and public switched telephone networks (PSTN). Since the local- and wide-network elements and interoperability reference points in the information-transfer utilities represent the telecommunications portion of DIS, their functionality is limited to the lower three layers of the OSI Reference Model.

d. Advances in computer and telephone communications technology allow multiple services to be provided by a single network, such as ISDN. Wherever applicable, the *DIS framework allows the adoption of commercial* standards for ISDN. Within the DIS framework, circuit-switched voice and data services are based on TRI-TAC specifications for tactical systems and ISDN commercial standards for strategic systems.

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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 MIL-STD to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the current issue of the DOD Index of Specifications and Standards (DODISS) and supplements thereto. Only applicable sections of the referenced documents, as identified in sections 4 and 5, are intended to be used.

STANDARDS

Federal

FED-STD-1037	*Glossary of Telecommunication Terms*

Military

MIL-STD-187-700	*Interoperability and Performance Standards for the Defense Information System*
MIL-STD-188-113	*Interoperability and Performance Standards for Analog-to-Digital Conversion Techniques*
MIL-STD-188-194	*Integrated Services Digital Network Profile (ISDNP)*
MIL-STD-188-202	*Interoperability and Performance Standards for Tactical Digital Transmission Groups (Coaxial Cable)*

[Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Commanding Officer, Naval Publications and Forms Center (ATTN: NPODS), 5901 Tabor Avenue, Philadelphia, PA 19120-5099.]

2.1.2 Other government documents, drawings, and publications

DOCUMENTS

Joint Interoperability and Engineering Organization (JIEO)

ICD-003	*Framing and Synchronization Protocols*
TIS-9115	*Defense Switched Network (AUTOVON) to Tactical Analog Gateways*
TT-A3-9016-0056	*Digital Common Channel Signaling/Supervision Plan* (U)
TT-C1-7205-0102 Specification NSA No. 79-20	*Performance and Interface Specification for TSEC/KY-68 Digital Subscriber Voice Terminal, and Ancillaries*

(To obtain other DOD publications not found in the DODISS, contact the Defense Information Systems Agency, Center for Standards, ATTN: TBBF, Fort Monmouth, NJ 07703-5613.)

2.2 Nongovernment documents

2.2.1 ITU-T (CCITT) Recommendations. The International Telecommunications Union-Telecommunication Standardization Sector (ITU-T), formerly known as the International Telegraph and Telephone Consultative Committee (CCITT), is part of the United Nations, a treaty organization. The United States Government participates in it through the Department of State, and although industry representatives may work on its committees, approval of standards (called Recommendations) is by governments. For the purpose of this MIL-STD, the CCITT designation has been retained for standards published before the name change.

CCITT G.711	*Pulse-Code Modulation of Voice Frequencies*
CCITT I.460	*Multiplexing, Rate Adaptation, and Support of Existing Interfaces*
CCITT V.110	*Support of Data Terminal Equipment (DTEs) with V-Series Type Interfaces by an Integrated Services Digital Network (ISDN)*

(Copies of CCITT Recommendations may be obtained from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161.)

2.2.2 ANSI standards

ANSI T1.217	*ISDN Management - Primary Rate Physical Layer*
ANSI T1.403	*Carrier to Customer Installation - DS1 Metallic Interface Specification*
ANSI T1.408	*ISDN Primary Rate - Customer Installation Metallic Interfaces, Layer Specification*
ANSI T1.602	*American National Standard for Telecommunications - Integrated Services Digital Network (ISDN) - Data link Layer Signaling Specification for Application* at the *User-Network Interface*
ANSI T1.607	*American National Standard for Telecommunications - Digital Subscriber Signaling System No.1 (DSS1) - Layer 3 Signaling Specification for Circuit-Switched Bearer Service*
ANSI T1.610	*American National Standard for Telecommunications - Digital Subscriber Signaling System No.1 (DSS1) - Generic Procedures for the Control of ISDN Supplementary Services*
ANSI T1.619	*American National Standard for Telecommunications - Multi-Level Precedence and Preemption (MLPP) Service - ISDN Supplementary Service Description*

(Copies of ANSI standards may be obtained from the American National Standards Institute, 1430 Broadway, New York, NY 10018.)

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.

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3. DEFINITIONS

3.1 Definitions of terms. Definitions of terms used in this MIL-STD shall be as specified in FED-STD-1037. Those definitions unique to information systems, and not defined in FED-STD-1037, are provided in this section.

Local-network elements: Local-network elements are the elements that make up a base information-transfer utility for strategic users or a tactical information-transfer utility for tactical users. Local-network elements include such elements as circuit and packet switches and transmission equipment.

Multilevel precedence and preemption (MLPP) domain: An MLPP domain consists of a set of MLPP subscribers (MLPP users) and the network and access resources that are in use by that set of MLPP subscribers at any given time. Connections and resources that are in use by MLPP subscribers may be preempted only by higher-precedence calls from MLPP subscribers within the same domain.

New Terminal: An all-purpose digital-subscriber terminal that can be used in strategic networks or tactical networks. The New Terminal incorporates multiple voice-encoding schemes and encryption algorithms. When used with an ISDN system, the New Terminal will be able to negotiate selection of the appropriate voice-encoding and encryption algorithm, during call setup. In all other cases, it will be permanently enabled to the appropriate voice-encoding and encryption algorithm.

Reference point A: The interface between subscriber-network elements and local-network elements.

Reference point B: The interface between local-network elements and wide-network elements.

Strategic network: A network consisting of strategic subscriber-network elements, local-network elements that constitute base information-transfer systems, and wide-network elements. For MIL-STD-188-105, strategic network elements are based on ISDN standards.

Strategic user: A person, organization, or other entity (including a computer or computer system) not assigned to a combat unit and not specifically assigned to a nuclear strike force who employs the services provided by a strategic telecommunications system, or by a strategic information-processing system, for transfer of information to others.

Subscriber-network elements: Elements such as terminal equipment, end systems, intermediate systems, local-area networks, metropolitan-area networks, and radio networks.

Tactical network: A network consisting of tactical subscriber-network elements and local-network elements that constitute tactical information-transfer systems. For MIL-STD-188-105, tactical network elements are based on TRI-TAC specifications.

Tactical user: A person, organization, or other entity (including a computer or computer system) in support of a joint task force who employs the services provided by a tactical telecommunications system, or by a tactical information-processing system, for transfer of information to others.

Terminal adapter: A device used to map a non-ISDN terminal into an ISDN interface. A terminal adapter may be physically located in the local ISDN switch, with the terminal equipment at the subscriber's site or at an intermediate site. Terminal adapters may be used to perform the following functions: bit rate adaptation, signaling conversion, physical interface conversion, and analog-to-digital conversion.

Transcoder: A device that performs direct digital-to-digital conversion between two different voice-encoding schemes without returning the signals to analog form.

Wide-network elements: Elements, such as circuit switches, packet switches, and transmission equipment, that form the Defense Communications System (DCS) and public switched telephone networks (PSTN).

3.2 Acronyms and abbreviations used in this MIL-STD

ADPCM	adaptive differential pulse-code modulation
AIS	alarm indication signal
ANSI	American National Standards Institute
ASCII	American Standard Code for Information Interchange
AUTOVON	automatic voice network
B8ZS	bipolar with 8-zero substitution
BCI	bit-count integrity
bps	bit(s) per second
CCITT	International Telegraph and Telephone Consultative Committee
CJCS	Chairman, Joint Chiefs of Staff
CRC	cyclic redundancy check
CVSD	continuously variable slope delta
DCA	Defense Communications Agency
DCAC	DCA circular
DCS	Defense Communications System
DIS	Defense Information System
DISA	Defense Information Systems Agency
DL	data link
DOD	Department of Defense

DODISS	DOD Index of Specifications and Standards
DS1	Digital Interface Rate 1 (1.544 Mbps)
DSN	Defense Switched Network
DSS1	Digital Subscriber Signaling System No. 1
DTE	data terminal equipment
DTG	digital transmission group
DNVT	digital nonsecure voice terminal
DSVT	digital subscriber voice terminal
EOC	embedded operations channel
EOM	end of message
ESF	extended super frame
ET	ISDN Exchange Termination
FAS	frame alignment signal
F-bit	frame bit
FDX	full duplex
FED-STD	federal standard
Ia	Network Interface to gateway on network side (physical)
ICD	interface control document
IE	information element
ISDN	Integrated Services Digital Network
ISDNP	ISDN Profile
ISO	International Standards Organization
ITU-T	International Telecommunications Union-Telecommunications Standardization Sector
JCS	Joint Chiefs of Staff
JIEO	Joint Interoperability and Engineering Organization
kbps	kilobit(s) per second
kHz	kilohertz
LAN	local-area network
LFB	Look-ahead for busy
LPC	linear predictive coding
Mbps	megabit(s) per second
MF	message field
MIL-STD	military standard
MILDEP	military department
MLPP	multilevel precedence and preemption
N.A.	not applicable
NI	Network Interface (physical)
NMCS	National Military Command System
NSA	National Security Agency
OSI	Open Systems Interconnection
PCM	pulse-code modulation
PRI	primary rate interface
PSTN	public switched telephone network
S&F	store and forward
SLC	satellite link count
SOM	start of message
TIS	technical interface specification
TRI-TAC	Tri-Service Tactical Communications

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4. GENERAL REQUIREMENTS

4.1 System requirements. The following general system requirements affect not only the design of the gateway, but also the design of the terminal equipment (information sources and sinks), local-network elements, and wide-network elements, as described in the Defense Information System (DIS) framework (see 1.4 and Figure 1). New switching systems that support Integrated Services Digital Network (ISDN) features shall comply with MIL-STD-188-194.

4.1.1 End-to-end digital services. All signals entering the local- and wide-network elements shall be digital and shall remain in a digital form until the signals exit the local network at reference point A. Analog-to-digital and digital-to-analog conversion, when required, shall be accomplished in the terminal equipment or in a terminal adapter. Bit-count integrity (BCI) shall be preserved through the aggregate of network elements for voice and data service.

4.1.2 Gateway signaling. The gateway shall provide for internetwork signaling between Tri-Service Tactical Communications (TRI-TAC) common-channel signaling trunks and ISDN Digital Subscriber Signaling System No.1 (DSS1) trunks.

4.1.3 Gateway function. Reference point B, as defined in the DIS framework, shall include a gateway to achieve interoperability between tactical and strategic subscribers. Tactical subscribers are serviced by TRI-TAC-type switching equipment, and strategic subscribers are serviced by ISDN equipment. The gateway function consists of signaling message conversion, negotiation during call setup, transcoding, and rate adaptation.

4.1.3.1 Signaling message conversion. The gateway shall convert common-channel signaling messages associated with the ISDN DSS1 to appropriate signaling messages associated with TRI-TAC common-channel signaling.

4.1.3.2 Negotiation during call setup. The gateway function shall perform mode negotiation with ISDN terminals to determine if the terminal has a voice-encoding mode common to the voice-encoding mode used in tactical networks. This negotiation, which will take place in the signaling channel, is described in section 5. If commonality exists, the gateway function will perform rate adaptation, as described in 5.6. Negotiation may continue in-band between the tactical and strategic terminals to setup an end-to-end secure call after a circuit-switched connection has been established (see 4.1.4). If the ISDN terminal does not have the common voice-encoding mode, only

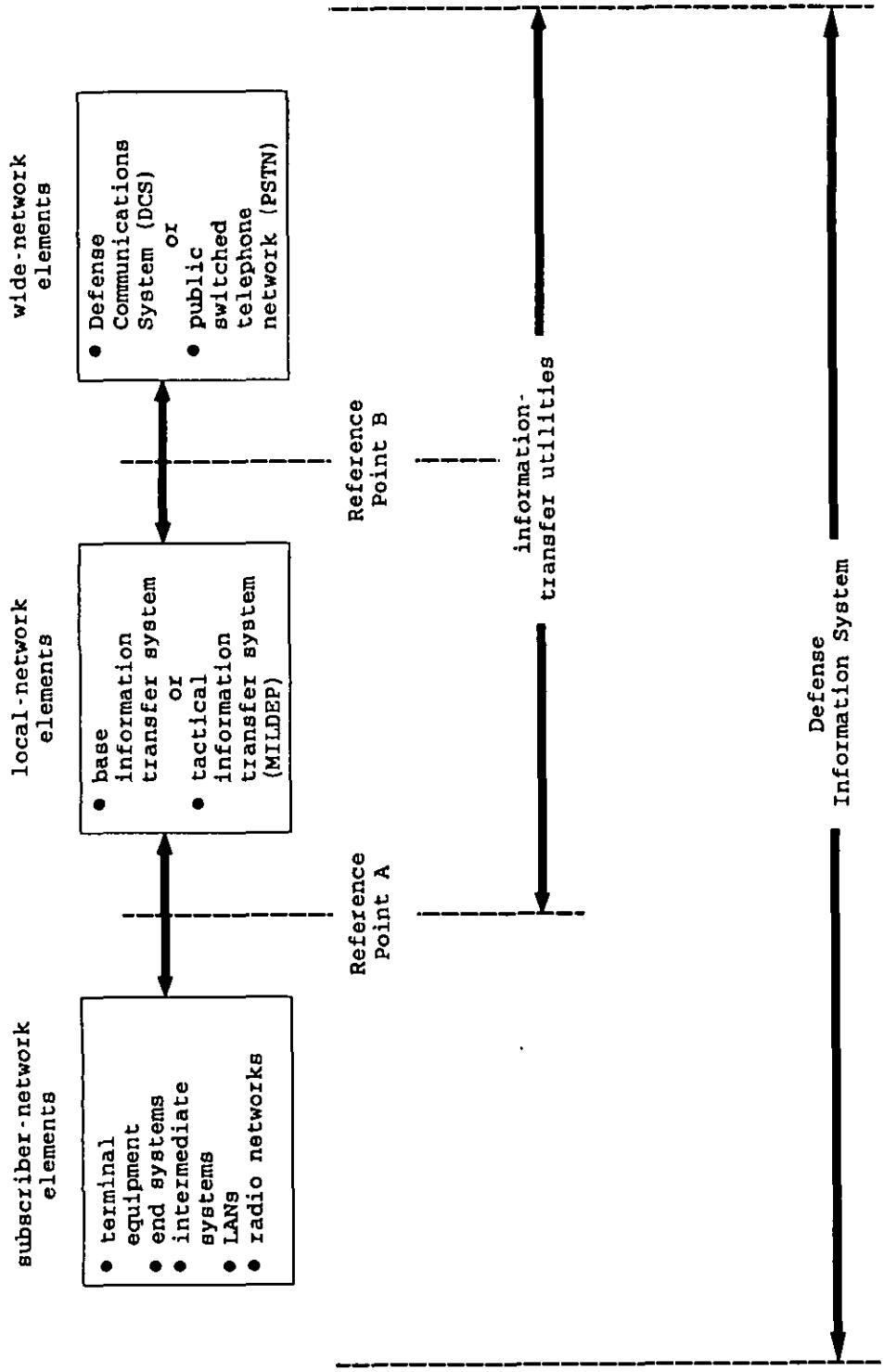


Figure 1. DIS framework.

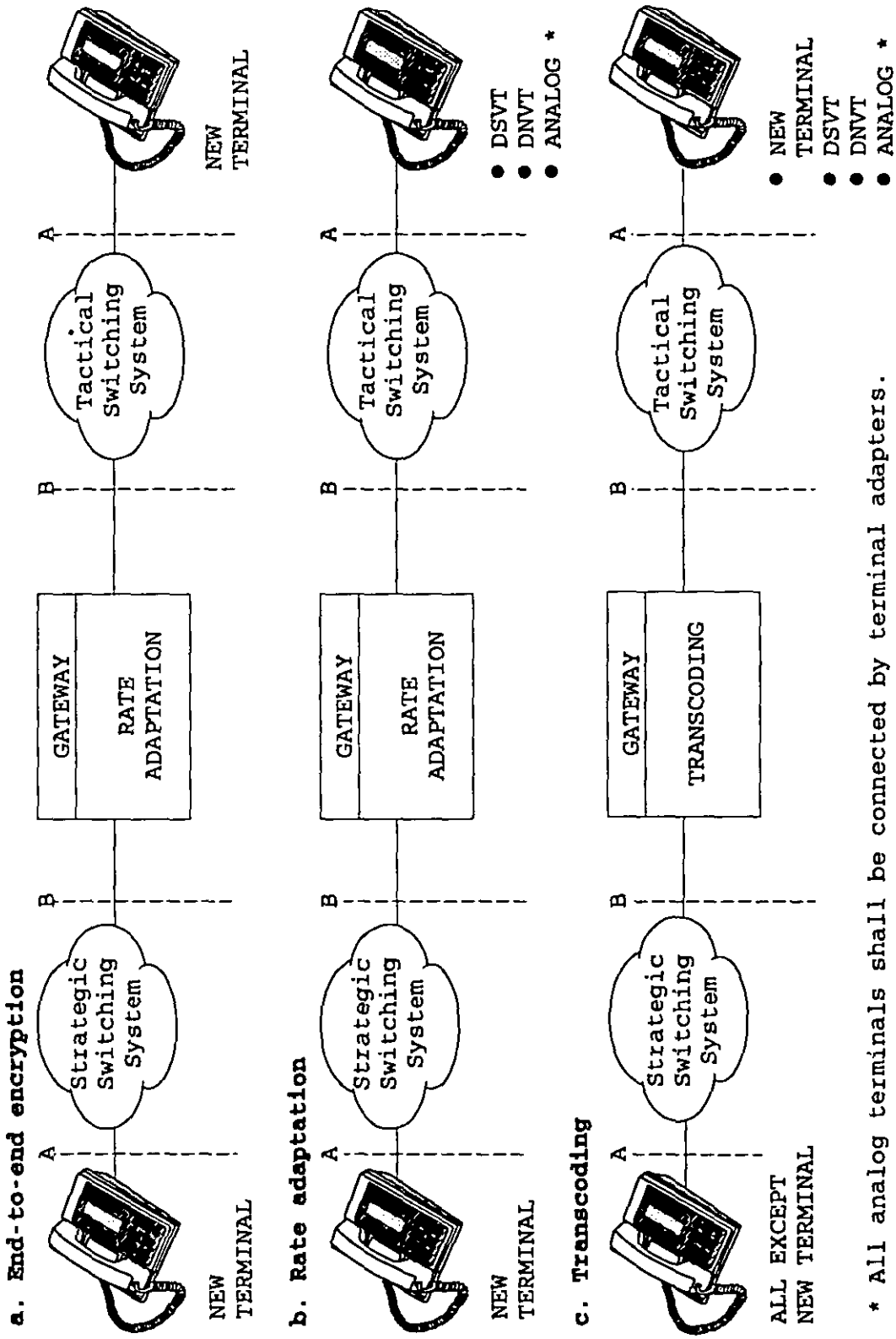
nonsecure voice traffic can be supported. In this case the gateway function shall perform transcoding, as described in 5.5.

4.1.3.3 Transcoding. The gateway function shall provide a transcoder to convert the tactical voice digitization algorithm from/to 16-kbps continuously variable slope delta (CVSD) (optionally 32-kbps CVSD) modulation to/from the strategic voice digitization algorithm based on 64-kbps pulse-code modulation (PCM), using mu-law companding.

4.1.3.4 Rate adaptation. The gateway shall rate-adapt 16-kbps signals (optionally 32 kbps) from the tactical network into 64-kbps signals for the strategic network and vice versa. The gateway facility shall use standard International Telegraph and Telephone Consultative Committee (CCITT) I.460 bit-rate adaptation techniques to rate-adapt 16-kbps signals (optionally 32-kbps signals) into 64-kbps channels. This will allow the gateway to maintain BCI, as required in 4.1.4.2, to maintain cryptographic synchronization between calling and called secure terminals.

4.1.4 End-to-end encrypted telephone service. For end-to-end encrypted calls, it is necessary to use the same voice-encoding and encryption methods at each terminal. Negotiations occur during call setup to determine if a common voice-encoding mode exists. If a common voice-encoding mode exists, the call shall be established using rate adaptation at the gateway function. Nonsecure voice coordination can then be used to initiate an in-band signaling sequence between the end instruments, to determine if they have interoperable encryption algorithms. Figure 2 depicts all the possible combinations of end-to-end telephone services. New Terminals will be needed in both networks to achieve end-to-end encrypted calls across the gateway. All other combinations of terminals listed in Figure 2 will support only nonsecure telephone service. A description of the New Terminal is given in 4.1.4.1. The general requirements applicable to the gateway and end-to-end secure telephone service are given in 4.1.4.2.

4.1.4.1 New Terminal. The New Terminal will have at least 2 voice-encoding modes: 64-kbps PCM with mu-law companding and 16-kbps CVSD. When a New Terminal is used in an ISDN network, the New Terminal will be ISDN-capable with direct 64-kbps digital access to the strategic switch, and it will be able to negotiate with the gateway during call setup. When used in the ISDN network, the New Terminal will negotiate with the gateway, during call setup, to determine which voice-encoding algorithm will be used. The 64-kbps PCM with mu-law companding shall be the default case. When used in the tactical network, the New Terminal will use 16-kbps CVSD (optionally 32-kbps CVSD).



* All analog terminals shall be connected by terminal adapters.

Figure 2. End-to-end telephone service.

Voice digitization, encryption, and key management shall be common to all New Terminals.

4.1.4.2 Gateway. The gateway shall be transparent to terminals making end-to-end secure calls, when the gateway is in the rate adaptation mode. The gateway shall further be required to maintain BCI. This is necessary to maintain cryptographic synchronization between calling and called secure terminals.

4.1.5 Voice digitization. CVSD, and PCM voice digitization methods, shall be employed in strategic and tactical terminals, as defined in 5.7.

4.1.6 Circuit-switched data services. Transmission of nonsecure data is not permitted, due to present tactical network specifications. Secure data may be transmitted by first establishing a circuit-switched call and then using rate adaptation to transfer the encrypted data.

4.2 Supplementary services. The gateway shall be transparent to all supplementary services as defined in MIL-STD-188-194, except for multilevel precedence and preemption (MLPP) and a restricted usage of "User-to-User signaling." The detailed requirements for MLPP are given in section 5.4.6. The gateway invokes the User-to-User signaling supplementary service only to allow end-to-end encrypted calls to be established (see sections 4.1.3 through 4.1.4 and Tables II, III, IV, VI, and VIII through XIII).

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5. DETAILED REQUIREMENTS

5.1 Introduction. This section defines the standards applicable to the interface between tactical-network elements and strategic-network elements. This interface corresponds to reference point B, as described in the DIS framework (see 1.4) and illustrated in Figure 1. A gateway function is required at reference point B. The standards applicable to the strategic side of the gateway function are provided in 5.2. The standards applicable to the tactical side of the gateway function are provided in 5.3. Standards applicable to signaling and signaling message conversion are provided in 5.4. Transcoding of dissimilar voice-encoding methods is addressed in 5.5. The standard method for bit-rate adaptation necessary to exchange data between tactical and strategic subscribers is covered in 5.6. The standards applicable to terminal equipment and reference point A that are necessary for end-to-end secure voice interoperability are discussed in 5.7.

5.2 Strategic network interface to reference point B. The strategic network interface shall comply with 5.2.1 to 5.2.3 at reference point B.

5.2.1 Layer 1. The strategic-network layer 1 interface to reference point B shall comply with the following parameters, as specified in American National Standards Institute (ANSI) T1.408 for primary rate interfaces:

a. Line code. Bipolar with 8-zero substitution (B8ZS) and 50% duty cycle.

b. B8ZS. Eight consecutive zeros shall be replaced with 000+-0-+ if the preceding pulse was positive, and with 000-+0+- if the preceding pulse was negative.

c. Bit rate. 1.544 Mbps

d. Number of channels. 24 (Normally 23 channels are used as information-bearer channels, and 1 channel is reserved for common-channel signaling.)

e. Framing format. 193-bit frame. (See Figure 3.)

f. Frame repetition rate. 8000 frames per second.

g. Extended super frame format. 24 frames. (See Table I.)

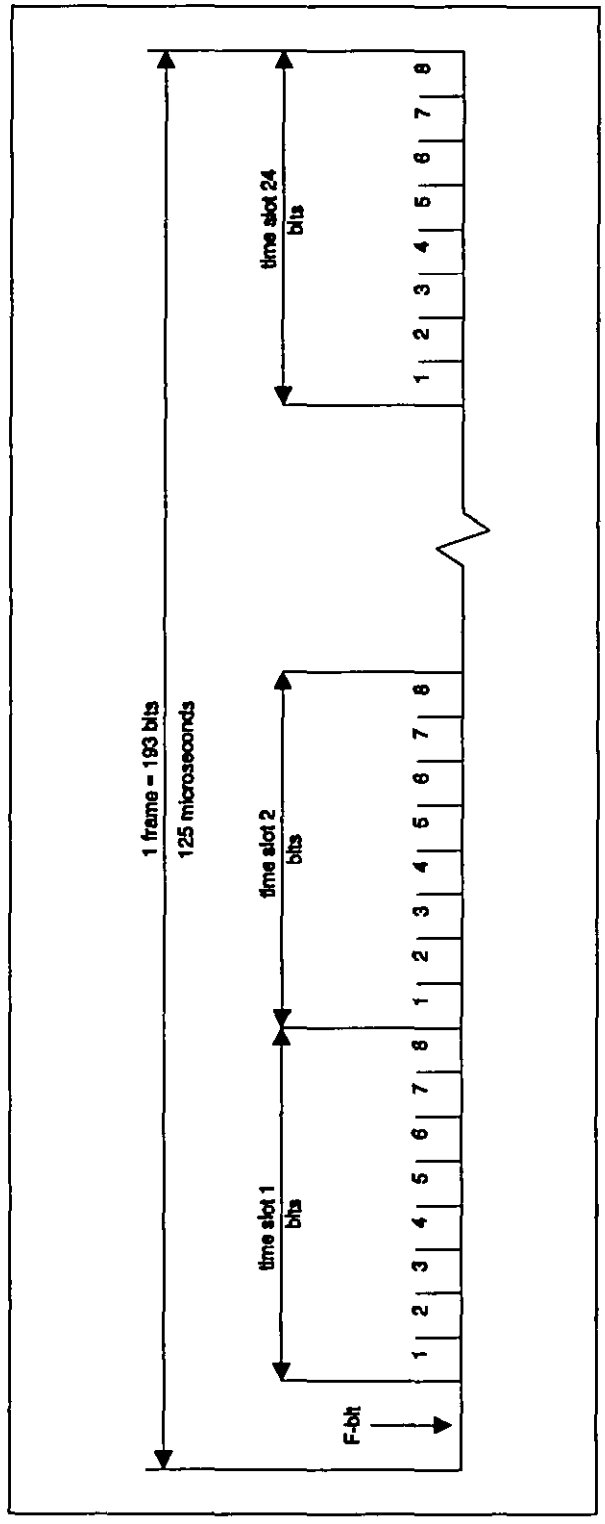

Figure 3. Frame format for a 1.544-Mbps signal.

Table I. F-bit signal format.

Frame Number	F-Bits			
	Bit Number	FAS	DL	CRC
1	1		m	
2	194			C1
3	387		m	
4	580	0		
5	773		m	
6	966			C2
7	1159		m	
8	1352	0		
9	1545		m	
10	1738			C3
11	1931		m	
12	2124	1		
13	2317		m	
14	2510			C4
15	2703		m	
16	2896	0		
17	3089		m	
18	3282			C5
19	3475		m	
20	3668	1		
21	3861		m	
22	4054			C6
23	4247		m	
24	4440	1		

FAS = frame alignment signal
DL = 4-kbps data link
CRC = CRC-6 cyclic redundancy check
m = data bit in maintenance channel (data link)

h. F-bit signal bit rate and allocation. Of the 8000-bps F-bit signal, 2000 bps shall be used for the frame alignment signal (FAS). To convey fault status and maintenance information, 4000 bps shall be available for use as a data link (data orderwire). Using the CRC-6 cyclic redundancy check, as defined in ANSI T1.408, 2000 bps shall be available for performance monitoring.

i. F-bit signal format. See Table I.

j. Time-slot assignment. Time slot 24 shall be used to transfer common-channel signaling information (D-channel), when it is present. A channel shall occupy an integer number of time slots and the same time-slot positions in every frame. A B-channel may be assigned any time slot in the frame. The assignment may vary call-by-call.

k. Signaling data-link. The signaling data-link bit rate shall be 64 kbps. The signaling data-link shall be a bidirectional transmission path for common-channel signaling, comprising two "data channels" operating together in opposite directions at the same data rate. The signaling data-link constitutes the lowest functional level (layer 1) in the ISDN DSS1 functional hierarchy. ISDN DSS1 shall be able to operate over both terrestrial and satellite transmission links.

5.2.2 Layer 2. The data-link layer shall provide for reliable transfer of common-channel signaling information across the physical channel between the strategic network and the gateway facility. This shall include error control, message sequencing, and message delimitation. Data-link signaling functions and procedures shall comply with ANSI T1.602.

5.2.3 Layer 3. Layer 3 protocols shall comply with ANSI standards T1.607, T1.610, and T1.619 for user-to-network interfaces.

5.3 Tactical network interface to reference point B. The standard for tactical local-network elements shall comply with 5.3.1 to 5.3.3 at reference point B.

5.3.1 Layer 1. The gateway shall be configurable to operate with a variety of tactical trunk-group sizes as identified in MIL-STD-188-202. The gateway shall support 16-kbps channel rates and optionally be configurable to support 32-kbps channel rates.

a. Signaling channel. Tactical common-channel signaling and supervision shall use formatted messages over a common signaling channel, which may be composed of 16-kbps (optionally 32-kbps) digital channels. The information carried by these channels shall occur at half the overhead channel bit rate.

b. Traffic channels. Traffic channels within a trunk group are either all 16-kbps or all 32-kbps channels. Overhead channels shall be multiplexed with the traffic channels in a digital transmission group (DTG), in accordance with MIL-STD-188-202.

5.3.2 Layer 2. Digital common-channel signaling messages shall be composed of 8-bit characters. The eighth bit of each message character shall be set to produce odd parity. These 8-bit characters shall be encoded into 16-bit blocks by employing the error detection and correction encoding described in TT-A3-9016-0056, the section titled *Trunk signaling message processing*.

5.3.3 Layer 3. Tactical common-channel signaling messages shall consist of a fixed number of fields, each comprised of 1 or more 8-bit characters. Each 8-bit character shall have 6 bits to carry trunk-signaling information. The other 2 bits shall be reserved for control and parity. Most messages have additional fields between the message-type field and the end-of-message field. The message fields and formats shall be in accordance with TT-A3-9016-0056, the section titled *Common-channel signaling messages*.

5.4 Signaling message processing. Interoperability between tactical circuit switches and strategic circuit switches shall be accomplished through appropriate processing of signaling messages, using the gateway function located at reference point B. The gateway function shall process all common-channel signaling messages exchanged between tactical circuit-switched networks and strategic circuit-switched networks. The gateway function shall discard information present in messages received from one network that is not required for the proper operation of the other network. Signaling messages that appear on the tactical side of the gateway function are described in 5.4.1. Signaling messages that appear on the ISDN network side of the gateway function are described in 5.4.2. The gateway function shall process signaling messages as necessary to achieve orderly call-establishment and call-clearing phases. For establishment of calls between tactical and strategic networks, the gateway function shall process signaling messages in accordance with 5.4.3. For clearing calls placed between tactical and strategic networks, the gateway function shall process the signaling messages in accordance with 5.4.4. The gateway function shall

also comply with the standards for glare, MLPP, test services, restart, and unsuccessful calls, provided in 5.4.5 through 5.4.10.

5.4.1 Tactical signaling messages

a. Messages to and from the tactical circuit-switched network side of the gateway function shall comply with TT-A3-9016-0056, which specifies the tactical signaling messages, their data fields, and codings, as well as the conditions of their use. A list of the tactical signaling messages defined in TT-A3-9016-0056 is provided in Figure 4. Messages that will be mapped to support calls across the gateway function are identified by an asterisk (*).

b. Every tactical signaling message includes five basic message fields:

- start-of-message (SOM)
- end-of-message (EOM)
- message-parity
- message-number
- message-type

The first four (SOM, EOM, message-parity, and message-number) are link layer (layer 2) functions and are not mapped to and from ISDN signaling messages. The fifth, message-type, also appears as an information element in every ISDN signaling message. The gateway function shall map the tactical message-type field to and from the ISDN message-type information element, in accordance with the time sequence diagrams (see Figures 5 to 8). As the five basic message fields are treated the same in every message, they do not appear in the signaling-message-mapping tables discussed later in this section.

c. When there are no tactical signaling messages to transmit, the gateway function shall send idle characters to the tactical network. The idle character consists of all zeros, except for the parity bit, which is set to one to conform to the odd-parity rule applicable to tactical signaling messages.

1.0 CALL-ESTABLISHMENT PHASE

- 1.1 Call-initiate*
- 1.2 Call-answer*
- 1.3 Call-complete*
- 1.4 Interface-complete
- 1.5 Rekey-initiate
- 1.6 Rekey-confirm
- 1.7 Rekey-complete

2.0 CALL-CLEARING PHASE

- 2.1 Release messages:
  - Call-release*
  - Preempt-release*
  - Called-party-unavailable*
  - Unassigned-loop*
  - Incompatible-connection*
  - Called-DSVT-zeroized*
- 2.2 Route release messages:
  - All-trunks busy*
  - Busy-release*
  - Invalid-route*

3.0 MISCELLANEOUS

- 3.1 Satellite link control
- 3.2 Execute satellite instructions
- 3.3 Satellite terminal report
- 3.4 Test messages:
  - Test-synch*
  - Loopback-trunk*
  - Loopback-complete*
- 3.5 Request trunk for in-band signaling
- 3.6 Acknowledge messages:
  - Acknowledge*
  - Nonacknowledge*
  - Glare*
  - Out-of-service

* Messages that are mapped to support calls.

Figure 4. Tactical (TT-A3-9016-0056) signaling messages call-phase classification.

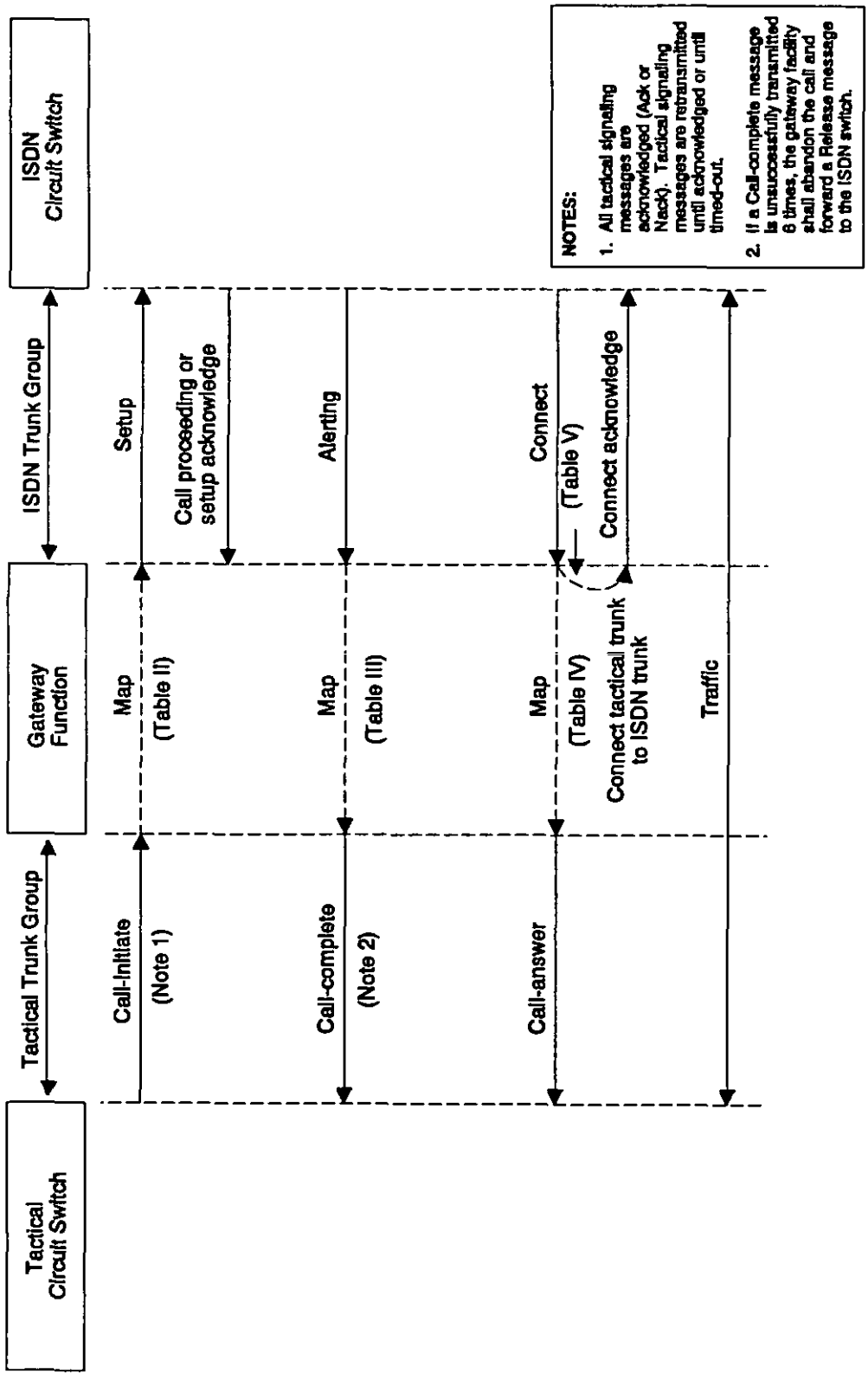

Figure 5. Time sequence diagram for call-establishment phase: call initiated in the tactical circuit-switched network.

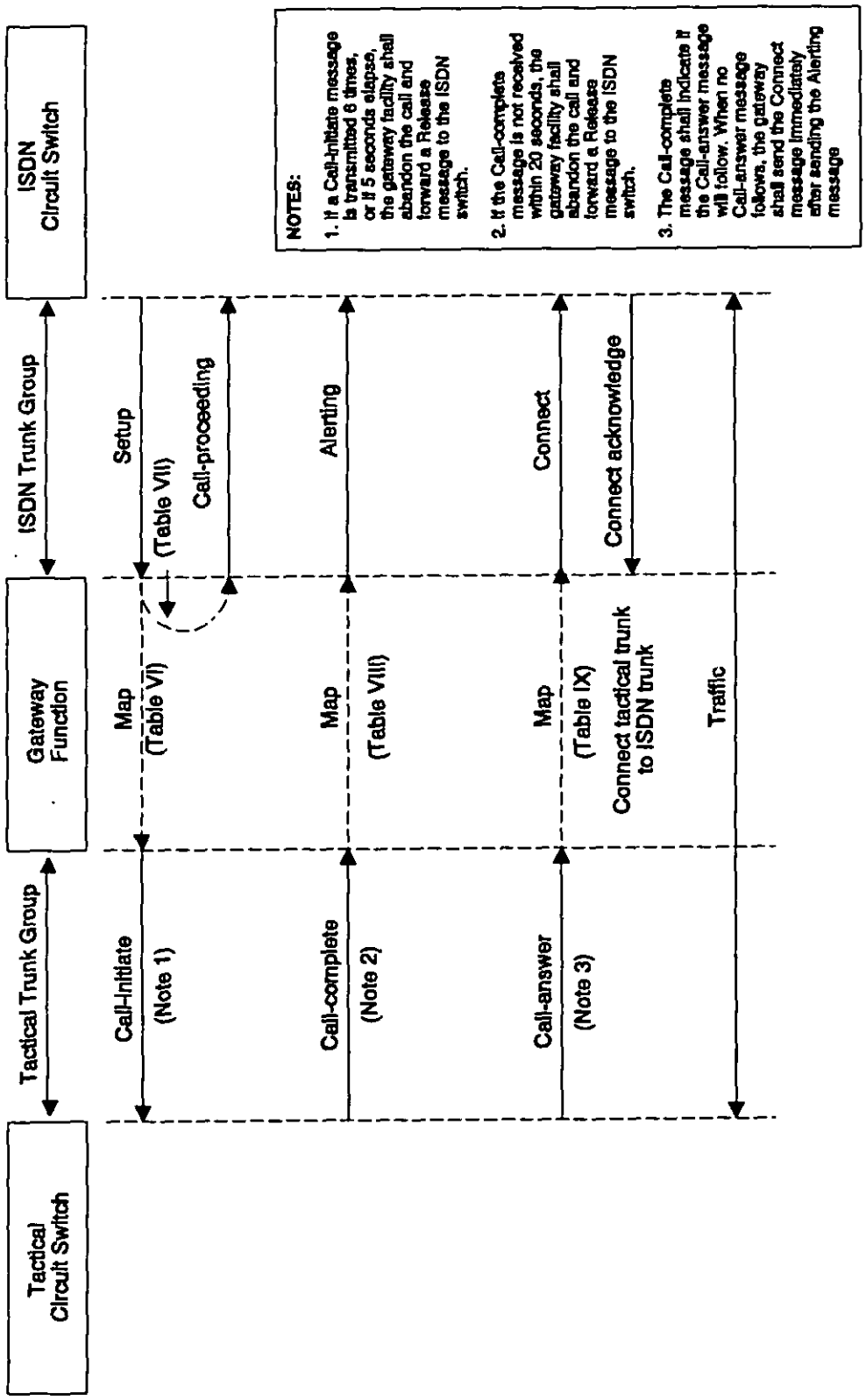

Figure 6. Time sequence diagram for call-establishment phase: call initiated in the ISDN circuit-switched network.

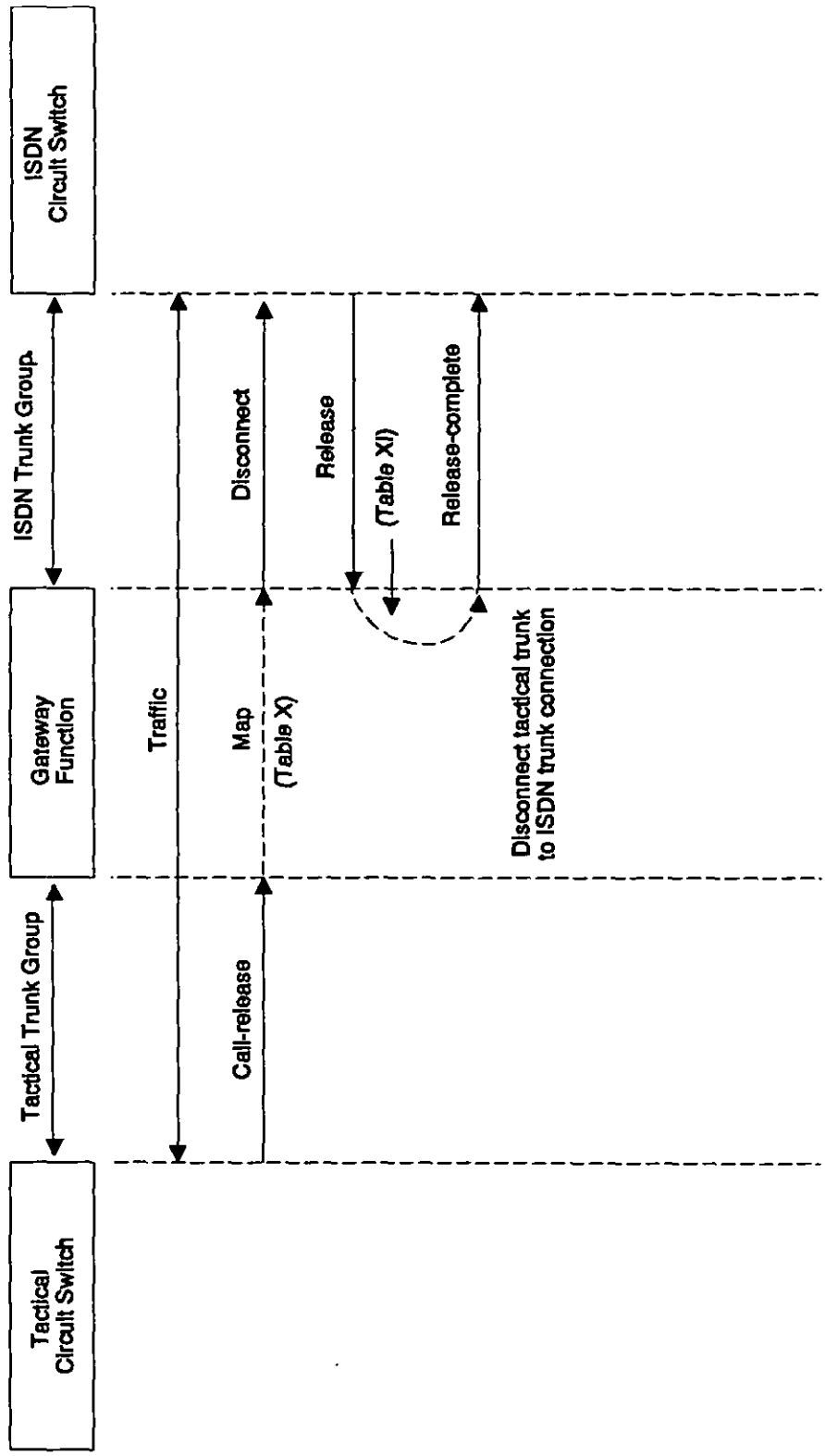

Figure 7. Time sequence diagram for call-clearing phase: call-clearing initiated in the tactical circuit-switched network.

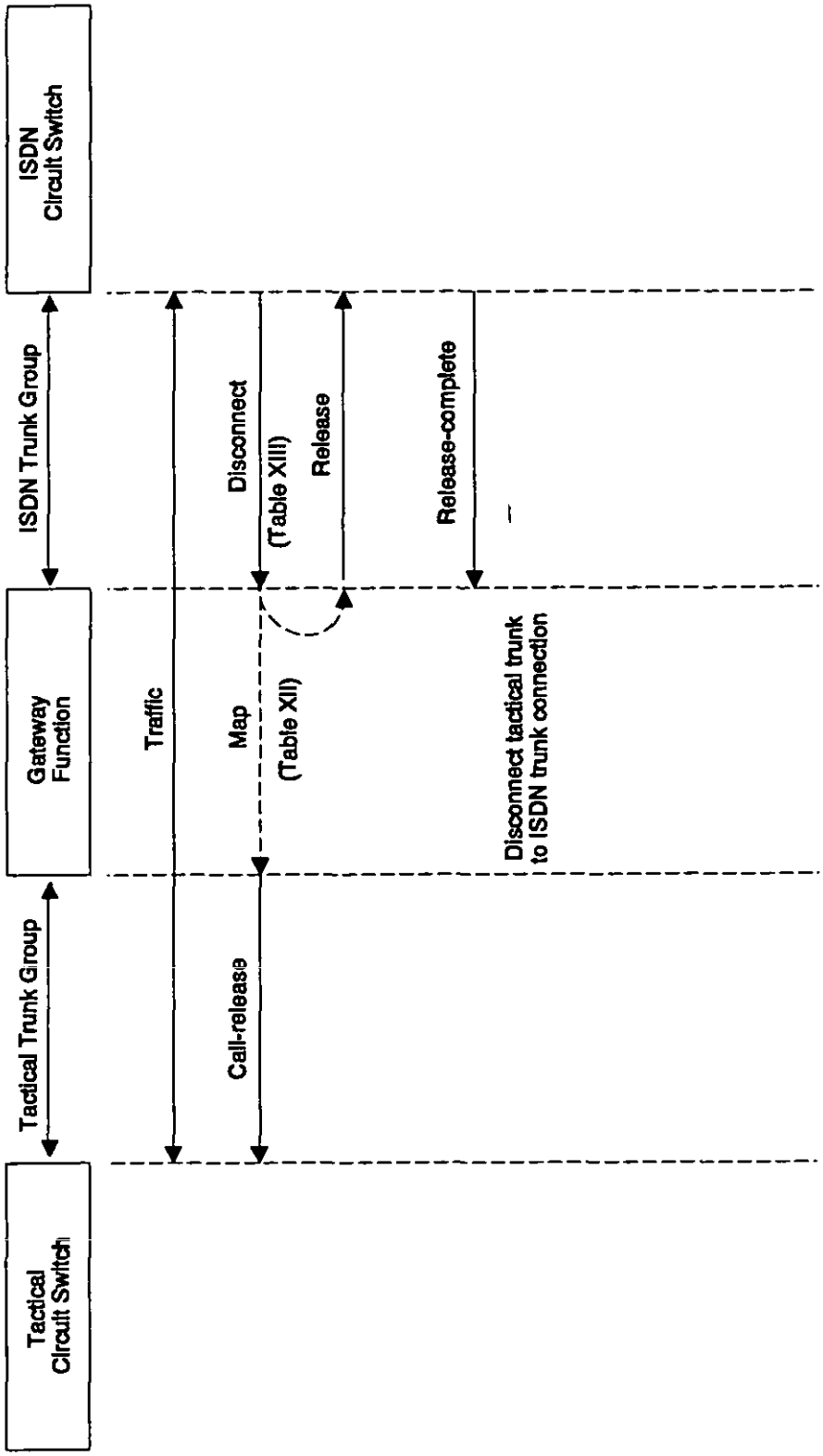

Figure 8. Time sequence diagram for call-clearing phase: call-clearing initiated in the ISDN circuit-switched network.

5.4.2 ISDN signaling messages

a. Messages to and from the strategic side of the gateway function shall comply with ANSI standards T1.607, T1.610, and T1.619 for ISDN DSS1 subscriber-to-network interfaces. T1.607 specifies the ISDN DSS1 signaling messages, their data fields, codings, and conditions of use. T1.610 provides generic signaling methods for invoking supplementary services. T1.619 specifies the signaling messages required for the supplementary service of MLPP. A list of the DSS1 signaling messages defined in ANSI T1.607, T1.610, and T1.619 is provided in Figure 9. Messages that will be mapped to support calls across the gateway function are identified by an asterisk (*).

b. Every DSS1 signaling message includes three basic information elements:

- protocol discriminator
- call reference
- message-type

The *protocol discriminator* is the first part of every DSS1 signaling message. Its purpose is to identify ISDN signaling messages as ANSI T1.607 (DSS1) user-network call-control messages.

The *call reference* is the second part of every DSS1 message. The purpose of the call reference is to identify the call to which a particular message applies. Call-reference values shall be assigned by the gateway function for calls initiated in the tactical network, and by ISDN switches for calls initiated in the ISDN network. Call-reference values shall be assigned at the beginning of each call and shall remain fixed for the duration of the call. The gateway function shall use the call-reference values to help correlate tactical trunks and ISDN channels involved in each call.

The *message-type* is the third part of every DSS1 message. It shall be used by the gateway function to identify the function of each DSS1 message. For ISDN messages mapped into tactical messages, the DSS1 message-type shall be mapped into the corresponding tactical message-type.

As the three basic information elements are common to all DSS1 messages, they do not (with the exception of call reference) appear in the signaling-message-mapping

tables discussed later in this section. The call-reference value has been included in some tables. It is needed by the gateway function to unambiguously identify the tactical trunk number associated with the DSS1 signaling message.

1.0 CALL-ESTABLISHMENT PHASE 1.1 Alerting* 1.2 Call-proceeding* 1.3 Connect* 1.4 Connect-acknowledge* 1.5 Progress 1.6 Setup* 1.7 Setup-acknowledge*
2.0 CALL-CLEARING PHASE 2.1 Disconnect* 2.2 Release* 2.3 Release-complete*
3.0 MISCELLANEOUS 3.1 Information 3.2 Notify 3.3 Status 3.4 Status-enquiry
4.0 GLOBAL CALL REFERENCE 4.1 Restart* 4.2 Restart-acknowledge* 4.3 Status
5.0 MLPP MESSAGES 5.1 Hold (preempt notification) 5.2 Hold-acknowledge (implicit accept preempt) 5.3 Hold-reject (accept preempt) 5.4 Register (look ahead for busy)

* Messages that are mapped to support calls.

Figure 9. DSS1 (ANSI T1.607-1990) signaling messages call-phase classification.

c. When there are no ISDN signaling messages to transmit, the gateway function shall send flag characters, consisting of 01111110, to the ISDN network.

5.4.3 Call-establishment phase. The time sequence diagram for the call-establishment phase for calls initiated in the tactical network is shown in Figure 5 and discussed in 5.4.3.1. The time sequence diagram for the call-establishment phase for calls initiated in the strategic network is shown in Figure 6 and discussed in 5.4.3.2.

5.4.3.1 Call initiated in the tactical network. (See Figure 5.)

a. When a call is initiated in the tactical circuit-switched network, the gateway function receives a Call-initiate message from the tactical circuit-switched network. The gateway function shall then create a Setup message, which shall be forwarded to the ISDN network. The Setup message created by the gateway function shall include information mapped (or extracted) from the tactical Call-initiate message and other information expected by the ISDN network. The Setup message created by the gateway facility shall comply with Table II.

b. The ISDN network acknowledges receipt of the Setup message, indicating that the call is being processed by the ISDN network, by sending either a Call-proceeding or a Setup-acknowledge message. This will be followed by the Alerting message when user-alerting is initiated in the ISDN network. (For the purpose of this MIL-STD, the Alerting message indicates that the ISDN telephone is ringing.) The gateway function shall then create a Call-complete message, which will be forwarded to the tactical network. The Call-complete message created by the gateway function shall include information mapped (or extracted) from the ISDN Alerting message and other information expected by the tactical network. The Call-complete message created by the gateway facility shall comply with Table III.

Table II. Mapping of the tactical Call-initiate message to the ISDN Setup message.

TT-A3-9016-0056 Call-initiate message fields/subfields (3.5.1)	→ GATEWAY ACTIONS →	ANSI T1.607 Setup-message information elements (3.1.11)
not applicable (N.A.)	The gateway function shall select the call-reference value. The call-reference flag shall equal zero. The call-reference value shall remain fixed for the duration of the call.	Call reference (4.3 and 5.1)
N.A.	The Repeat-indicator information element shall be omitted from the Setup message.	Repeat indicator (4.5.22)
	The gateway facility shall insert the following information in the Bearer-capability information element:	Bearer capability (4.5.5)
N.A.	Coding standard = CCITT standardized coding;	"
N.A.	Information transfer capability = unrestricted digital information;	"
N.A.	Transfer mode = circuit mode;	"
N.A.	Information transfer rate = 64 kbps;	"
N.A.	Structure = 8-kHz integrity;	"
N.A.	Configuration = point-to-point;	"
N.A.	Establishment = demand;	"
N.A.	Symmetry = bidirectional symmetric; The remaining octets (octets 5, 5a, 5b, 5c, 5d, 6, and 7) shall be omitted from the Bearer-capability information element.	"

(Note: This is an 8-page table.)

Table II. Mapping of the tactical Call-initiate message to the ISDN Setup message (Continued).

TT-A3-9016-0056 Call-initiate message fields/subfields (3.5.1)	→ GATEWAY ACTIONS →	ANSI T1.607 Setup-message information elements (3.1.11)
	The gateway facility shall insert the following information in the Channel-identification information element:	Channel identification (4.5.12)
N.A.	Interface identifier present = interface implicitly identified;	"
N.A.	Interface type = basic interface;	"
N.A.	Preferred/exclusive = Exclusive; only the indicated channel is acceptable;	"
N.A.	D-channel indicator = the channel identified is not the D-channel;	"
N.A.	Information channel selection = as indicated in the following octets:	"
N.A.	Interface identifier shall be omitted;	"
N.A.	Coding standard = CCITT standardized coding;	"
N.A.	Number/map = channel is indicated by number in the following octet (see channel number);	"
N.A.	Channel type/map element type = B-channel units;	"
Trunk number (3.5.1.5.2 and 3.6.4)	Channel number shall = the time-slot number in a primary rate signal. The gateway facility shall map the tactical trunk number into the Channel number field (octet 3.3) of the Channel-identification information element.	"

Table II. Mapping of the tactical Call-initiate message to the ISDN Setup message (Continued).

TT-A3-9016-0056 Call-initiate message fields/subfields (3.5.1)	→ GATEWAY ACTIONS →	ANSI T1.607 Setup-message information elements (3.1.11)
N.A.	The Progress indicator information element shall be omitted. No action required.	Progress indicator (4.5.21)
N.A.	The Network-specific-utilities information field shall be omitted. No action required.	Network-specific utilities (4.5.19)
N.A.	The Display information element shall be omitted. No action required.	Display (4.5.15)
N.A.	The Keypad-facility information element shall be omitted. No action required.	Keypad facility (4.5.17)
N.A.	The Signal information element shall be omitted. No action required. (Note: The Signal information element will be inserted by the terminating ISDN switch, at the called terminal interface, for precedence call alerting.)	Signal (4.5.24)
N.A.	The Calling-party-number information element is required by the ISDN network for MLPP. Reference 6.1.1 of T1.619. The gateway function shall insert the number used by the ISDN network to identify the gateway function.	Calling-party number (4.5.9)
N.A.	The Calling-party-subaddress information element shall be omitted. No action required.	Calling-party subaddress (4.5.10)

Table II. Mapping of the tactical Call-initiate message to the ISDN Setup message (Continued).

TT-A3-9016-0056 Call-initiate message fields/subfields (3.5.1)	→ GATEWAY ACTIONS →	ANSI T1.607 Setup-message information elements (3.1.11)
	The gateway facility shall insert the following information in the Called-party-number information element:	Called-party number (4.5.7)
N.A.	Type of number = Network-specific number;	"
N.A.	Numbering plan identification = Private numbering plan;	"
Called number (3.5.1.5.3 and 3.6.5)	Number digits = the telephone number for the called party. The gateway facility shall map the Called number into the Number digits field of the Called-party-number information element.	"
N.A.	The Called-party-subaddress information element shall be omitted. No action required.	Called-party subaddress (4.5.8)
N.A.	The Transit-network-selection information element shall be omitted. No action required.	Transit network selection (4.5.25)
N.A.	The Low-layer-compatibility information element shall be omitted. No action required.	Low-layer compatibility (4.5.18)
N.A.	The High-layer-compatibility information element shall be omitted. No action required.	High-layer compatibility (4.5.16)
N.A.	The gateway function shall insert 16-kbps CVSD (optionally 32-kbps CVSD) ASCII-coded characters in the User-to-user information element.	User-user (4.5.26)
N.A.	The Operator-system-access information element shall be omitted. No action required.	Operator system access (4.6.1)
N.A.	The Call-identity information element is optional for MLPP. No action required.	Call identity (Reference 6.1.1 and 6.1.3.6 T1.619.)

Table II. Mapping of the tactical Call-initiate message to the ISDN Setup message (Continued).

TT-A3-9016-0056 Call-initiate message fields/subfields (3.5.1)	→ GATEWAY ACTIONS →	ANSI T1.607 Setup-message information elements (3.1.11)
Trunk number (3.5.1.5.2 and 3.6.4)	Channel number = the time-slot number in the primary rate signal. The gateway facility shall map the tactical trunk number into the Channel number field of the Channel-identification-number information element.	Channel identification (4.5.12)
N.A.	The gateway shall insert the following information in the Called-party-number information element:	Called-party number (4.5.7)
N.A.	Type of number = national number;	"
N.A.	Numbering plan = ISDN/telephony numbering plan;	"
Called number (3.5.1.5.3 and 3.6.5)	The gateway facility shall map the Called number into the field called *Number digits*; Number digits = the telephone number for the called party.	"
Switch designator (3.5.1.5.4 and 3.6.6)	No action required. Not mapped.	N.A.
Call number (3.5.1.5.5 and 3.6.7)	Map call number to call-reference value. Call number should equal the number provided in the Message number field of the Call-initiate message. If not, the gateway shall abandon the call.	Call reference (4.3)
Miscellaneous information field (3.5.1.5.6 and 3.6.8) See subfields below:	The gateway shall take the following actions:	

Table II. Mapping of the tactical Call-initiate message to the ISDN Setup message (Continued).

TT-A3-9016-0056 Call-initiate message fields/subfields (3.5.1)	→ GATEWAY ACTIONS →	ANSI T1.607 Setup-message information elements (3.1.11)
Call precedence (3.6.8.1)	The Locking-shift information element shall be set to codeset 5. This indicates that the Precedence-level information element will be next.	Locking shift (4.5.3)
	For the Precedence-level information element: Octet 3, bits 7-6: Set Coding standard to National standard; Octet 3, bits 4,3,2,1: Map Call precedence (level) into Precedence level; Octet 4, bits 2-1: Set Look-ahead for busy (LFB) indication to LFB not allowed (LFB not used or mapped); Octet 4a, bit 7-1: Set MLPP service domain to Defense Switched Network (DSN).	Precedence level (see para 6.1, T1.619)
Security status (3.6.8.2)	No action required. Not mapped.	N.A.
Call type (3.6.8.3)	Determine if call is voice. If data, abandon call. Not mapped.	N.A.
Direct access mode (3.6.8.4)	No action required. Not mapped.	N.A.
Call transfer (3.6.8.5)	No action required. Not mapped.	N.A.
S&F indication (3.6.8.6)	No action required. Not mapped.	N.A.

Table II. Mapping of the tactical Call-initiate message to the ISDN Setup message (Continued).

TT-A3-9016-0056 Call-initiate message fields/subfields (3.5.1)	→ GATEWAY ACTIONS →	ANSI T1.607 Setup-message information elements (3.1.11)
Satellite link count (SLC) (3.6.8.7)	The Locking-shift information element shall be set to codeset 6. This indicates that the Satellite Link Count (SLC) information element will be next. The gateway shall add "1" to the SLC, if the gateway link includes a satellite link. Map to SLC information element (see 5.8).	Locking shift (4.5.3)
Transmission type (3.6.8.8)	The gateway shall save the information provided in the Transmission-type subfield for use in the Call-complete message. Not mapped.	N.A.
Transmission restriction (3.6.8.9)	No action required. Not mapped.	N.A.
Routing restriction (3.6.8.10)	No action required. Not mapped.	N.A.
Access code (3.6.8.11)	No action required. Not mapped.	N.A.
Preprogrammed conference (3.6.8.12)	No action required. Not mapped.	N.A.
Path delay or data characteristics field (3.5.1.5.7 and 3.6.9). See subfields below:	The gateway function shall abandon calls identified as data calls. The gateway function shall take the following actions for voice calls:	N.A.
Path delay (two-way path delay) (3.5.1.5.7.1.1 and 3.6.9)	No action required. Not mapped.	N.A.
Two-wire/four-wire (3.5.1.5.7.1.2 and 3.6.9.1.3.1)	No action required. Not mapped.	N.A.
Echo suppressor availability (3.5.1.5.7.1.3 and 3.6.9.1.3.2)	No action required. Not mapped.	N.A.

Table II. Mapping of the tactical Call-initiate message to the ISDN Setup message (Concluded).

TT-A3-9016-0056 Call-initiate message fields/subfields (3.5.1)	→ GATEWAY ACTIONS →	ANSI T1.607 Setup-message information elements (3.1.11)
Call-answer request (3.5.1.5.7.1.4 and 3.6.9.1.3.3)	The gateway facility shall remember if a Call-answer message is requested. If it is, the gateway shall provide the Call-answer message at the appropriate time in the signaling message sequence. Not mapped.	N.A.
Ringback request (3.5.1.5.7.1.5 and 3.6.9.1.3.4)	No action required. Not mapped.	N.A.
Multimode terminal identification (3.5.1.5.7.1.6 and 3.6.9.1.3.5)	No action required. Not mapped.	N.A
Call-variable transfer request (3.5.1.5.7.1.7 and 3.6.9.1.3.6)	No action required. Not mapped.	N.A.
Originating satellite terminal & channel field (3.5.1.5.8)	No action required. Not mapped.	N.A.

Table III. Mapping of the ISDN Alerting message to the tactical Call-complete message.

TT-A3-9016-0056 Call-complete message fields/subfields (3.5.2)	← GATEWAY ACTIONS ←	ANSI T1.607 Alerting-message information elements (3.1.1)
Trunk number (3.5.2.4.2 and 3.6.4)	Map ISDN channel identification number into tactical trunk number.	Channel identification (4.5.12)
Called number (3.5.2.4.3 and 3.6.5)	Insert called number. Called number should be same number inserted in the Call-initiate message using same trunk number.	N.A.
Returned information (3.5.2.4.4 and 3.6.10) See following subfields:	The gateway function shall take the following actions:	
Call answered (3.5.2.4.4.1 and 3.6.10.1)	The gateway facility shall set the Call-answered subfield = No (Call-answer message to follow).	N.A.
Echo suppressor (3.5.2.4.4.2 and 3.6.10.2)	The gateway facility shall set the Echo suppressor subfield = No (default).	N.A.
All-digital path (3.5.2.4.4.3 and 3.6.10.3)	The gateway function shall set the All-digital path subfield = Yes (all-digital path exists to terminating switch).	N.A.
Called terminal security (3.5.2.4.4.4)	The gateway function shall set the Called-terminal-security subfield = nonsecure.	N.A.
Transmission type (3.5.2.4.4.5 and 3.6.10.5)	The gateway shall insert the same information as provided in the transmission-type subfield of the Call-initiate message.	N.A.
Called terminal characteristics (3.5.2.4.4.6)	The gateway function shall set the Called-terminal-characteristics subfield = all-digital 16-kbps CVSD (optionally 32-kbps CVSD).	N.A.
Interswitch transfer (3.5.2.4.4.7)	The gateway function shall set the Interswitch transfer subfield = nonsecure call.	N.A.
N.A.	No action required. Not mapped.	Progress Indicator (4.5.21)
N.A.	No action required. Not mapped.	Display (4.5.15).

Table III. Mapping of the ISDN Alerting message to the tactical Call-complete message (Concluded).

TT-A3-9016-0056 Call-complete message fields/subfields (3.5.2)	← GATEWAY ACTIONS ←	ANSI T1.607 Alerting-message information elements (3.1.1)
N.A.	No action required. Not mapped	Signal (4.5.24)
N.A.	No action required. Not mapped	User-to-user (4.5.26)

c. The gateway facility receives a Connect message, from the ISDN network, when the call is accepted by the ISDN user terminal. (For the purpose of this MIL-STD, the Connect message indicates the ISDN terminal has gone off-hook.) The gateway function shall then create a Call-answer message, which shall be forwarded to the tactical network, and a Connect-acknowledge message, which shall be returned to the ISDN network. The Call-answer message created by the gateway function shall include information mapped (or extracted) from the ISDN Connect message and other information expected by the tactical network. The Call-answer message created by the gateway facility shall comply with Table IV. The Connect-acknowledge message created by the gateway function shall comply with Table V and shall include information extracted from the ISDN Connect message.

d. When the Connect-acknowledge message is sent, the gateway function shall connect the tactical and ISDN trunks through a bit rate adapter or a transcoder. The gateway function shall select the bit rate adapter if it determines that the ISDN and tactical terminals have an interoperable voice-encoding mode. If this is not determined, the gateway function shall connect the trunks to a PCM/CVSD transcoder. The method of determining if tactical and ISDN terminals have an interoperable voice-encoding mode is described in 5.7.

Table IV. Mapping of the ISDN Connect message to the tactical Call-answer message.

TT-A3-9016-0056 Call-answer message fields/subfields (3.5.6)	← GATEWAY ACTIONS ←	ANSI T1.607 Connect-message information elements (3.1.3)
Trunk number (3.5.6.4.2 and 3.6.4)	Map ISDN channel number into tactical trunk number.	Channel identification (4.5.12)

Table IV. Mapping of the ISDN Connect message to the tactical Call-answer message (Concluded).

TT-A3-9016-0056 Call-answer message fields/subfields (3.5.6)	← GATEWAY ACTIONS ←	ANSI T1.607 Connect-message information elements (3.1.3)
N.A.	No action required. Not mapped.	Progress Indicator (4.5.21)
N.A.	No action required. Not mapped.	Display (4.5.15)
N.A.	No action required. Not mapped.	Signal (4.5.24)
N.A.	The gateway function shall examine the User-to-user information element for 16-kbps CVSD (optionally 32-kbps CVSD). If present, the gateway function shall rate-adapt the trunk traffic. If not present, the gateway function shall transcode the trunk traffic.	User-to-user (4.5.26)

Table V. Gateway response to the ISDN Connect message with the ISDN Connect-acknowledge message.

ANSI T1.607 Connect-message information elements (3.1.3 and 5.1.8)	→ GATEWAY ACTIONS →	ANSI T1.607 Connect-acknowledge-message information elements (3.1.4 and 5.1.8)
N.A.	The gateway function shall select the call-reference value. The call-reference flag shall be equal to zero. The call-reference value shall remain fixed for the duration of the call.	Call reference (4.3 and 5.1)
Channel identification (4.5.12)	No action required. Not mapped.	N.A.
Progress indicator (4.5.21)	No action required. Not mapped.	N.A.
Connected number (4.5.13)	No action required. Not mapped.	N.A.

Table V. Gateway response to the ISDN Connect message with the ISDN Connect-acknowledge message (Concluded).

ANSI T1.607 Connect-message information elements (3.1.3 and 5.1.8)	→ GATEWAY ACTIONS →	ANSI T1.607 Connect-acknowledge-message information elements (3.1.4 and 5.1.8)
Connected subaddress (4.5.14)	No action required. Not mapped.	N.A.
Low-layer compatibility (4.5.18)	No action required. Not mapped.	N.A.
User-user (4.5.26)	No action required. Not mapped.	N.A.
N.A.	The Display information element shall be omitted. No action required.	Display (4.5.15)
N.A.	The Signal information element shall be omitted. No action required.	Signal (4.5.24)

5.4.3.2 Call initiated in the ISDN network. (See Figure 6.)

a. When a call is initiated in the ISDN circuit-switched network, the gateway function receives a Setup message from the ISDN circuit-switched network. The gateway function shall then create a Call-initiate message, which shall be forwarded to the tactical network, and a Call-proceeding message, which will be returned to the ISDN network. The Call-initiate message created by the gateway function shall include information mapped (or extracted) from the ISDN Setup message and other information expected by the tactical network. The Call-initiate message shall comply with Table VI. The Call-proceeding message shall comply with Table VII.

Table VI. Mapping of the ISDN Setup message to the tactical Call-initiate message.

Call-initiate message fields/subfields (3.5.1)	← GATEWAY ACTIONS ←	ANSI T1.607 Setup-message information elements (3.1.11 and 5.2)
N.A.	The gateway function shall retain and use the call-reference value for the duration of the call. When used in signaling messages generated by the gateway, the flag shall be set to "1."	Call reference (4.3 and 5.2)
N.A.	No action required. Not mapped.	Repeat indicator (4.5.22)
N.A.	No action required. Not mapped.	Bearer capability (4.5.5)
Trunk number (3.5.1.5.2 and 3.6.4)	The gateway function shall map the ISDN channel number into the tactical-trunk-number field. The gateway will keep track of the ISDN channel number, the ISDN call-reference value, and the tactical-trunk number applicable to each call across the gateway. The gateway facility will discard all other items provided in the Channel-identification information element.	Channel identification (4.5.12)
N.A.	No action required. Not mapped.	Progress indicator (4.5.21)
N.A.	No action required. Not mapped.	Network specific utilities (4.5.19)
N.A.	No action required. Not mapped.	Display (4.5.15)
N.A.	No action required. Not mapped.	Keypad facility (4.5.17)
N.A.	No action required. Not mapped.	Signal (4.5.24)
Switch designator (3.5.1.5.4 and 3.6.6)	The gateway function shall map the area code and the first three digits of the Calling party number into the Switch designator field.	Calling party number (4.5.9)
N.A.	No action required. Not mapped.	Calling party subaddress (4.5.10)

Table VI. Mapping of the ISDN Setup message to the tactical Call-initiate message (Continued).

Call-initiate message fields/subfields (3.5.1)	← GATEWAY ACTIONS ←	ANSI T1.607 Setup-message information elements (3.1.11 and 5.2)
Called number (3.5.1.5.3 and 3.6.5)	The gateway facility shall map the Called-party-number information element into the Called-number field.	Called-party number (4.5.7)
N.A.	No action required. Not mapped.	Called-party subaddress (4.5.8)
N.A.	No action required. Not mapped.	Transit network selection (4.5.25)
N.A.	No action required. Not mapped.	Low-layer compatibility (4.5.18)
N.A.	No action required. Not mapped.	High-layer compatibility (4.5.16)
N.A.	If 16-kbps CVSD (optionally 32-kbps CVSD) is present, the gateway function shall perform rate adaptation during the traffic phase. If 16-kbps CVSD (optionally 32-kbps CVSD) is not present, the gateway function shall perform transcoding during the traffic phase.	User-user (4.5.26)
N.A.	No action required. Not mapped.	Operator system access (4.6.1)
N.A.	The Call-identity information element is optional for MLPP. No action required. Not mapped. (If provided by the ISDN network, the gateway function may use this information element to uniquely identify calls.)	Call identity (Reference 6.1.1 and 6.1.3.6 T1.619.)
Trunk number (3.5.1.5.2 and 3.6.4)	Map the ISDN channel identification number into the tactical trunk number. See channel ID (4.5.12) above.	Channel identification (4.5.12)
Called number (3.5.1.5.3 and 3.6.5)	Map the Called-party number into the tactical Called-number field.	Called-party number (4.5.7)

Table VI. Mapping of the ISDN Setup message to the tactical Call-initiate message (Continued).

Call-initiate message fields/subfields (3.5.1)	← GATEWAY ACTIONS ←	ANSI T1.607 Setup-message information elements (3.1.11 and 5.2)
Switch designator (3.5.1.5.4 and 3.6.6)	The gateway function shall insert the area code and the first three digits of the Calling-party number into the switch designator field.	N.A.
Call number (3.5.1.5.5 and 3.6.7) Message number (3.6.3)	The gateway function shall map the ISDN call-reference value to the Call number field, and set the Message number = the call number.	Call reference (4.3)
Miscellaneous information field (3.5.1.5.6 and 3.6.8) See subfields below:	The gateway function shall take the following actions:	
Call precedence (3.6.8.1)	The gateway shall examine the Locking-shift information element. If it contains codeset 5, the gateway function shall map octet 3, bits 4, 3, 2, and 1 from the Precedence-level information element into the Call-precedence message subfield.	Precedence level (see para 6.1 T1.619)
Security status (3.6.8.2)	No action required. Not mapped.	N.A.
Call type (3.6.8.3)	Call type subfield = voice	N.A.
Direct access mode (3.6.8.4)	Direct access subfield = no	N.A.
Call transfer (3.6.8.5)	Call transfer subfield = no	N.A.
Store and Forward (S&F) indication (3.6.8.6)	S&F subfield = no	N.A.
Satellite link count (SLC) (3.6.8.7)	The gateway shall examine the Locking-shift information element. If it contains codeset 6, the gateway shall add "1" to the SLC if the gateway link includes a satellite link.	Locking-shift (4.5.3) SLC information element
Transmission type (3.6.8.8)	Transmission type subfield = all-digital 16 kbps (optionally 32 kbps).	N.A.
Transmission restriction (3.6.8.9)	Transmission restriction subfield = digital only.	N.A.

Table VI. Mapping of the ISDN Setup message to the tactical Call-initiate message (Concluded).

Call-initiate message fields/subfields (3.5.1)	← GATEWAY ACTIONS ←	ANSI T1.607 Setup-message information elements (3.1.11 and 5.2)
Routing restriction (3.6.8.10)	Routing restriction subfield = no special restrictions.	N.A.
Access code (3.6.8.11)	Access code subfield = full duplex (FDX) traffic mode only.	N.A.
Preprogrammed conference (3.6.8.12)	Preprogrammed conference subfield = no.	N.A
Path delay or data characteristics (3.5.1.5.7 and 3.6.9)	The gateway function shall insert path delay information for a voice call.	N.A.
Path delay (two-way path delay) (3.5.1.5.7.1.1 and 3.6.9)	If the gateway link is a satellite link, enter "40 ms or more." If the SLC is 1 or more, enter "40 ms or more."	SLC
Two-wire/four-wire (3.5.1.5.7.1.2 and 3.6.9.1.3.1)	Two-wire/four-wire = default	N.A.
Echo suppressor availability (3.5.1.5.7.1.3 and 3.6.9.1.3.2)	Echo suppressor = default	N.A.
Call-answer request (3.5.1.5.7.1.4 and 3.6.9.1.3.3)	Call-answer request = Request terminating switch to send Call-answer message.	N.A.
Ringback request (3.5.1.5.7.1.5 and 3.6.9.1.3.4)	Ringback request = Originating switch does not require terminating switch to return a ringback indication in-band.	N.A.
Multimode terminal identification (3.5.1.5.7.1.6 and 3.6.9.1.3.5)	Multimode terminal identification = default.	N.A
Call-variable transfer request (3.5.1.5.7.1.7)	Call-variable transfer request = nonsecure call.	N.A.
Originating satellite terminal & channel field (3.5.1.5.8 and 3.6.14)	Set control bits to "1." Set remaining bits to "0."	N.A.

Table VII. Gateway response to the ISDN Setup message with the ISDN Call-proceeding message.

ANSI T1.607 Call-proceeding-message information elements (3.1.2 and 5.1.5)	← GATEWAY ACTIONS ←	ANSI T1.607 Setup-message information elements (3.1.11 and 5.2.5.1)
Call reference (4.3)	Call-reference value = value received in the Setup message. The flag shall be set to "1."	Call reference (4.3)
N.A.	No action required. Not mapped.	Repeat indicator (4.5.22)
N.A.	No action required. Not mapped.	Bearer capability (4.5.5)
Channel identification (4.5.12)	Channel identification = the contents of the Channel-identification information element in the Setup message.	Channel identification (4.5.12)
Progress indicator (4.5.21)		Progress indicator (4.5.21)
N.A	No action required. Not mapped.	Network-specific utilities (4.5.19)
Display (4.5.15)		Display (4.5.15)
N.A.	No action required. Not mapped.	Keypad facility (4.5.17)
N.A.	No action required. Not mapped.	Signal (4.5.24)
N.A.	No action required. Not mapped.	Calling-party number (4.5.9)
N.A.	No action required. Not mapped.	Calling-party subaddress (4.5.10)
N.A.	No action required. Not mapped.	Called-party number (4.5.7)
N.A.	No action required. Not mapped.	Called-party subaddress (4.5.8)
N.A.	No action required. Not mapped.	Transit network selection (4.5.25)

Table VII. Gateway response to the ISDN Setup message with the ISDN Call-proceeding message (Concluded).

ANSI T1.607 Call-proceeding message information elements (3.1.2 and 5.1.5)	← GATEWAY ACTIONS ←	ANSI T1.607 Setup-message information elements (3.1.11 and 5.2.5.1)
N.A	No action required. Not mapped.	Low-layer compatibility (4.5.18)
N.A	No action required. Not mapped.	High-layer compatibility (4.5.16)
N.A	No action required. Not mapped.	User-user (4.5.26)
N.A	No action required. Not mapped.	Locking shift (4.5.3)
N.A	No action required. Not mapped.	Operator system access (4.6.1)

b. The tactical network acknowledges receipt of the Call-initiate message, indicating that the call has been processed by the tactical network, by sending a Call-complete message. The gateway function shall then create an Alerting message, which will be forwarded to the ISDN network. The Alerting message created by the gateway function shall include information mapped (or extracted) from the tactical Call-complete message. The Alerting message created by the gateway facility shall comply with Table VIII. This will be followed by the Call-answer message. (For the purpose of this MIL-STD, the Call-complete message indicates that the tactical telephone is ringing, and the Call-answer message indicates that the telephone has gone off-hook.) The gateway function shall then create a Connect message, which will be forwarded to the ISDN network. The message created by the gateway function shall include information mapped (or extracted) from the tactical Call-answer message.

The Call-answer message created by the gateway facility shall comply with Table IX.

c. The gateway facility receives a Connect-acknowledge message from the ISDN network, when the call is accepted by the ISDN user terminal. (For the purpose of this MIL-STD, the Connect-acknowledge message indicates the ISDN network has implemented the connection.)

Table VIII. Mapping of the tactical Call-complete message to the ISDN Alerting message.

TT-A3-9016-0056 Call-complete message fields/subfields (3.5.2)	→ GATEWAY ACTIONS →	ANSI T1.607 Alerting-message information elements (3.1.1)
N.A.	The gateway function shall insert the call-reference value used in the Setup message applicable to this call. The call-reference flag shall be equal to zero. The call-reference value shall remain fixed for the duration of the call.	Call reference (4.3 and 5.1)
Trunk number (3.5.2.4.2 and 3.6.4)	Map tactical trunk number into ISDN channel identification number.	Channel identification (4.5.12)
Called number (3.5.2.4.3 and 3.6.5)	Check called number with called number received in the Call-initiate message using same trunk number. Not mapped.	N.A.
Returned information (3.5.2.4.4 and 3.6.10) (See following subfields.)	The gateway functions shall take the following actions:	
Call answered (3.5.2.4.4.1 and 3.6.10.1).	Determine if Call-answer message is to follow. If not, send Connect message to the ISDN network. If yes, no action required. Not mapped.	N.A.
Echo suppressor (3.5.2.4.4.2 and 3.6.10.2)	No action required. Not mapped.	N.A.
All-digital path (3.5.2.4.4.3 and 3.6.10.3)	No action required. Not mapped.	N.A.
Called terminal security (3.5.2.4.4.4)	If security is required, abandon call and send release to ISDN. Not mapped.	N.A.
Transmission type (3.5.2.4.4.5 and 3.6.10.5)	No action required. Not mapped.	N.A.

Table VIII. Mapping of the tactical Call-complete message to the ISDN Alerting message (Concluded).

TT-A3-9016-0056 Call-complete message fields/subfields (3.5.2)	→ GATEWAY ACTIONS →	ANSI T1.607 Alerting-message information elements (3.1.1)
Called terminal characteristics (3.5.2.4.4.6)	No action required. Not mapped.	N.A.
Interswitch transfer (3.5.2.4.4.7)	No action required. Not mapped.	N.A.
N.A.	The gateway function shall insert the following information in the Progress indicator information element: Coding standard = CCITT standardized coding. Location = private network serving the remote user. Progress description = Destination address is non-ISDN.	Progress indicator (4.5.21) " " "
N.A.	The Display information element shall be omitted. No action required.	Display (4.5.15)
N.A.	The Signal information element shall be omitted. No action required.	Signal (4.5.26)
N.A.	The User-user information element shall be omitted. No action required.	User-user (4.5.26)

Table IX. Mapping of the tactical Call-answer message to the ISDN Connect message.

Call-answer message (3.5.6) (TT-A3-9016-0056 references)	→ GATEWAY ACTIONS →	Connect message (3.1.3) (ANSI T1.607 references)
Call reference (4.3)	Call-reference value = value received in the Setup message. The flag shall be set to "1".	Call reference (4.3)
Trunk number (3.5.6.4.2 and 3.6.4)	Map tactical trunk number into ISDN channel number.	Channel identification (4.5.12)
N.A.	The gateway function shall insert the following information in the Progress indicator information element: Coding standard = CCITT standardized coding. Location = private network serving the remote user. Progress description = Destination address is non-ISDN.	Progress Indicator (4.5.21) " " "
N.A.	The Display information element shall be omitted. No action required.	Display (4.5.15)
N.A.	The Signal information element shall be omitted. No action required.	Signal (4.5.24)
N.A.	The gateway facility shall insert 16-kbps CVSD (optionally 32-kbps CVSD), when rate adaptation is selected for the traffic phase.	User-user (4.5.26)

d. When the Connect-acknowledge message is received, the gateway function shall connect the tactical and ISDN trunks through a bit rate adapter or a transcoder. The gateway function shall select the bit rate adapter if it determines that the ISDN and tactical terminals have compatible voice encoders. If this is not determined, the gateway function shall connect the trunks to a PCM/CVSD transcoder.

5.4.4 Call-clearing phase. The time sequence diagram for the call-clearing phase for a Call-release message initiated in the tactical network is shown in Figure 7 and discussed in 5.4.4.1. The time sequence diagram for the call-clearing phase for a

Call-release message initiated in the strategic network is shown in Figure 8 and discussed in 5.4.4.2.

5.4.4.1 Call-clearing initiated in the tactical network. (See Figure 7.)

a. For call clearing initiated in the tactical circuit-switched network, the gateway facility receives a Call-release message from the tactical circuit-switched network. The gateway function shall then create a Disconnect message, which shall be forwarded to the ISDN network. The Disconnect message created by the gateway shall comply with Table X.

b. The ISDN network, in turn, returns a Release message to the gateway function, indicating that the ISDN trunk is available for a new connection.

c. The gateway function shall then make the tactical-trunk-to-ISDN-trunk connection available for another call and create a Release-complete message, which shall be forwarded to the ISDN network. The Release-complete message created by the gateway shall comply with Table XI.

5.4.4.2 Call-clearing initiated in the ISDN network. (See Figure 8.)

a. For call clearing initiated in the ISDN circuit-switched network, the gateway facility receives a Disconnect message from the ISDN circuit-switched network. The gateway function shall then create a Call-release message, which shall be forwarded to the tactical network, and a Release message, which shall be returned to the ISDN network. The Call-release message, created by the gateway, shall comply with Table XII. The Release message created by the gateway shall comply with Table XIII.

b. The gateway function, in turn, receives a Release-complete message from the ISDN network, indicating that the ISDN trunk is available for a new connection.

c. The gateway function shall then make the tactical-trunk-to-ISDN-trunk connection available for another call.

Table X. Mapping of the tactical Call-release message to the ISDN Disconnect message.

TT-A3-9016-0056 Call-release message fields/subfields (3.5.7)	→ GATEWAY ACTIONS →	ANSI T1.607 Disconnect-message information elements (3.1.5 and 5.3.3)
Trunk number (3.5.7.4.2 and 3.6.4)	Disconnect trunk. Map trunk number to call-reference value.	Call reference (4.3)
N.A.	The gateway function shall insert the following information in the Cause information element: Coding standard = CCITT standardized coding. Location = private network serving the remote user. Recommendation = ANSI T1.607. Set Cause value to: 16 for Call release, 45 or 46 for Preempt release (see 6.1.3.3 of T1 6.1.9), 19 for Called party unavailable, 1 for Unassigned loop, 88 for Incompatible connection, 69 for Called DSVT zeroized. Diagnostics (octets 5, 5a, and 5b) shall be omitted.	Cause (4.5.11)
N.A.	The Display information element shall be omitted. No action required.	Display (4.5.15).
N.A.	The Signal information element shall be omitted. No action required.	Signal (4.5.24)
N.A.	The Connected-number information element shall be omitted. No action required.	Connected number (4.5.13)
N.A.	The Connected-subaddress information element shall be omitted. No action required.	Connected subaddress (4.5.14)
N.A.	The User-to-user information element shall be omitted. No action required.	User-user (4.5.26)

Table XI. Gateway response to the ISDN Release message with the ISDN Release-complete message.

ANSI T1.607 Release-message information elements (3.1.9)	→ GATEWAY ACTIONS →	ANSI T1.607 Release-complete-message information elements (3.1.10 and 5.3.3)
Cause (4.5.11)	Insert same information in the Cause field of the Release-complete message.	Cause (4.5.11)
Display (4.5.15)	Insert same information in the Display field of the Release-complete message.	Display (4.5.15)
Signal (4.5.24)	Insert same information in the Signal field of the Release-complete message.	Signal (4.5.24)
Connected number (4.5.13)	Insert same information in the Connected-number field of the Release-complete message.	Connected number (4.5.13)
Connected subaddress (4.5.14)	Insert same information in the Connected-subaddress field of the Release-complete message.	Connected subaddress (4.5.14)
User-user (4.5.26)	The User-to-user information element shall be omitted. No action required.	User-to-user (4.5.26)

Table XII. Mapping of the ISDN Disconnect message to the tactical Call-release message.

Call-release message (3.5.7) (TT-A3-9016-0056 references)	← GATEWAY ACTIONS ←	Disconnect message (3.1.5 and 5.3.4) (ANSI T1.607 references)
Trunk number (3.5.7.4.2 and 3.6.4)	The gateway function shall map the Call-reference value to the trunk number and disconnect the trunk.	Call reference (4.3)
	Map the Cause value into one of the following release messages: • Call release • Preempt release • Called party unavailable • Unassigned loop • Incompatible connection	Cause (4.5.11)
N.A.	No action required. Not mapped.	Display (4.5.15)
N.A.	No action required. Not mapped.	Signal (4.5.24)

Table XII. Mapping of the ISDN Disconnect message to the tactical Call-release message (Concluded).

Call-release message (3.5.7) (TT-A3-9016-0056 references)	← GATEWAY ACTIONS ←	Disconnect message (3.1.5 and 5.3.4) (ANSI T1.607 references)
N.A.	No action required. Not mapped.	Connected number (4.5.13)
N.A.	No action required. Not mapped.	Connected subaddress (4.5.14)
N.A.	No action required. Not mapped.	User-to-user (4.5.26)

Table XIII. Gateway response to the ISDN Disconnect message with the ISDN Release message.

ANSI T1.607 Disconnect-message information elements (3.1.5)	→ GATEWAY ACTIONS →	ANSI T1.607 Release-message information elements (3.1.9 and 5.3.4)
Cause (4.5.11)	Insert same information in the Cause field of the Release-complete message.	Cause (4.5.11)
Display (4.5.15)	Insert same information in the Display field of the Release-complete message.	Display (4.5.15)
Signal (4.5.24)	Insert same information in the Signal field of the Release-complete message.	Signal (4.5.24)
Connected number (4.5.13)	Insert same information in the Connected-number field of the Release-complete message.	Connected number (4.5.13)
Connected subaddress (4.5.14)	Insert same information in the Connected-subaddress field of the Release-complete message.	Connected subaddress (4.5.14)
User-to-user (4.5.26)	The User-to-user information element shall be omitted. No action required.	User-to-user (4.5.26)

5.4.5 Glare. Glare (also known as *call collision*) is a condition in which the tactical and ISDN networks simultaneously identify the same trunk to carry calls that have the same precedence level. The gateway function shall detect the glare condition and return a Glare message to the tactical network.

The Glare-message format shall comply with TT-A3-9016-0056, the section titled *Acknowledge messages*. The tactical network shall accept the fact that the message has not been accepted by the ISDN network, and shall send a new Call-initiate message with a new message number and a new trunk number.

5.4.6 Multilevel precedence and preemption. MLPP shall be applicable to calls placed across the gateway.

5.4.6.1 MLPP in ISDN networks. The standards applicable to MLPP in ISDN networks are provided in ANSI T1.610 and T1.619. ANSI T1.610 contains definitions for supplementary-service signaling messages used to support MLPP (see the section titled *Messages for supplementary service control)*. ANSI T1.619 allows MLPP to be a network provider's option. In strategic-ISDN networks, MLPP shall be mandatory, and the MLPP domain shall include all Department of Defense (DOD) subscribers and network resources.

5.4.6.2 MLPP in tactical networks. Two tactical signaling messages apply to MLPP: the Call-initiate message (miscellaneous information field) and the Preempt-release message.

5.4.6.3 MLPP and the gateway function. The gateway function shall map the precedence information in Call-initiate messages received from tactical networks into Setup messages to be sent to ISDN networks and vice versa. Should the gateway function receive a Call-initiate message and a Setup message with the same trunk number, the gateway function shall map the message with the higher precedence level. The gateway shall then send a Preempt-release message to the tactical network when it is the source of the lower-precedence call, or a Release message to the ISDN network when the ISDN network is the source of the lower-precedence call.

5.4.7 Test services for the tactical network. The gateway facility shall provide test services to the tactical network by responding to the test messages described in TT-A3-9016-0056, in the section titled *Test messages.*

5.4.7.1 Test synch. When initializing a tactical trunk group, idle characters are transmitted in the signaling channel. The idle characters are used by the tactical switches and the gateway facility to acquire character synchronization on the signaling channel. After acquisition of character synchronization, the gateway facility and the neighboring tactical switch shall send the Test synch message and shall expect to receive the Acknowledge message. After receipt of the Acknowledge message, the gateway facility shall place the signaling channel into the trunk-signaling service state. The gateway facility shall also send the Test synch message if no message requiring acknowledgment has been sent for three seconds.

5.4.7.2 Loopback trunk. The gateway facility shall loopback trunks when requested in Loopback trunk messages received from the tactical network. The loopback feature shall be used to support tactical trunk-group diagnostics. The frequency, extent, and schedule of the Loopback trunk requests are determined by the tactical network.

5.4.7.3 Loopback complete. After performing the requested loopback process, the gateway facility shall send a Loopback complete message to the tactical network.

5.4.8 Test services for ISDN. The gateway facility shall provide test services to the strategic network by responding to the test messages described in *ANSI T1.408*, the section titled *Loopbacks*, and *T1.217*, the section titled *Testing*.

5.4.8.1 Embedded operations channel. Primary rate interface (PRI) (23B+D) Test messages are transmitted in the data link [also called the embedded operations channel (EOC)] of the 1.544-Mbps signal (DS1) extended super frame (ESF) format. This is the 4-kbps data link (DL) channel shown in Table I. The Loopback command and response messages are formatted as bit-oriented codewords. These codewords consist of 16-bit patterns, which are to be repeated at least 10 times. Bit-oriented codewords are preemptive. When transmitted they shall overwrite other signals on the data link.

5.4.8.2 Gateway loopback testing in the Primary-Rate Access Interface. The ISDN test services herein considered are with respect to loopbacks in the ISDN Primary-Rate Access Interface shown in Figure 10. The gateway access for testing is from the nearest ISDN switch over the EOC. Ia is the 4-wire (2-pair) bidirectional PRI point on the network side of the termination equipment in the gateway.

5.4.8.3 Loopbacks. Loopbacks are initiated by the ISDN switch to which the gateway has access. These loopbacks will provide for fault status and maintenance of the ISDN trunk groups to and from the gateway. The gateway shall respond to line loopbacks at Ia, as described in Table XIV. The loopbacks are controlled by different ESF data-link (EOC) messages, as shown in Table XV.

5.4.8.3.1 Line loopback activation. Line loopbacks toward the Ia are initiated by the *Line Loopback (Ia) Activate* codeword transmitted in the EOC from the ISDN switch. The gateway shall interpret the codeword, inhibit any signals directed toward the ISDN switch, and send alarm indication signals (AIS) forward as a replacement for the looped signal, whenever a line loopback is activated. (This gateway action is represented by the device L1, for example, in Figure 10.) Line loopbacks shall result in a

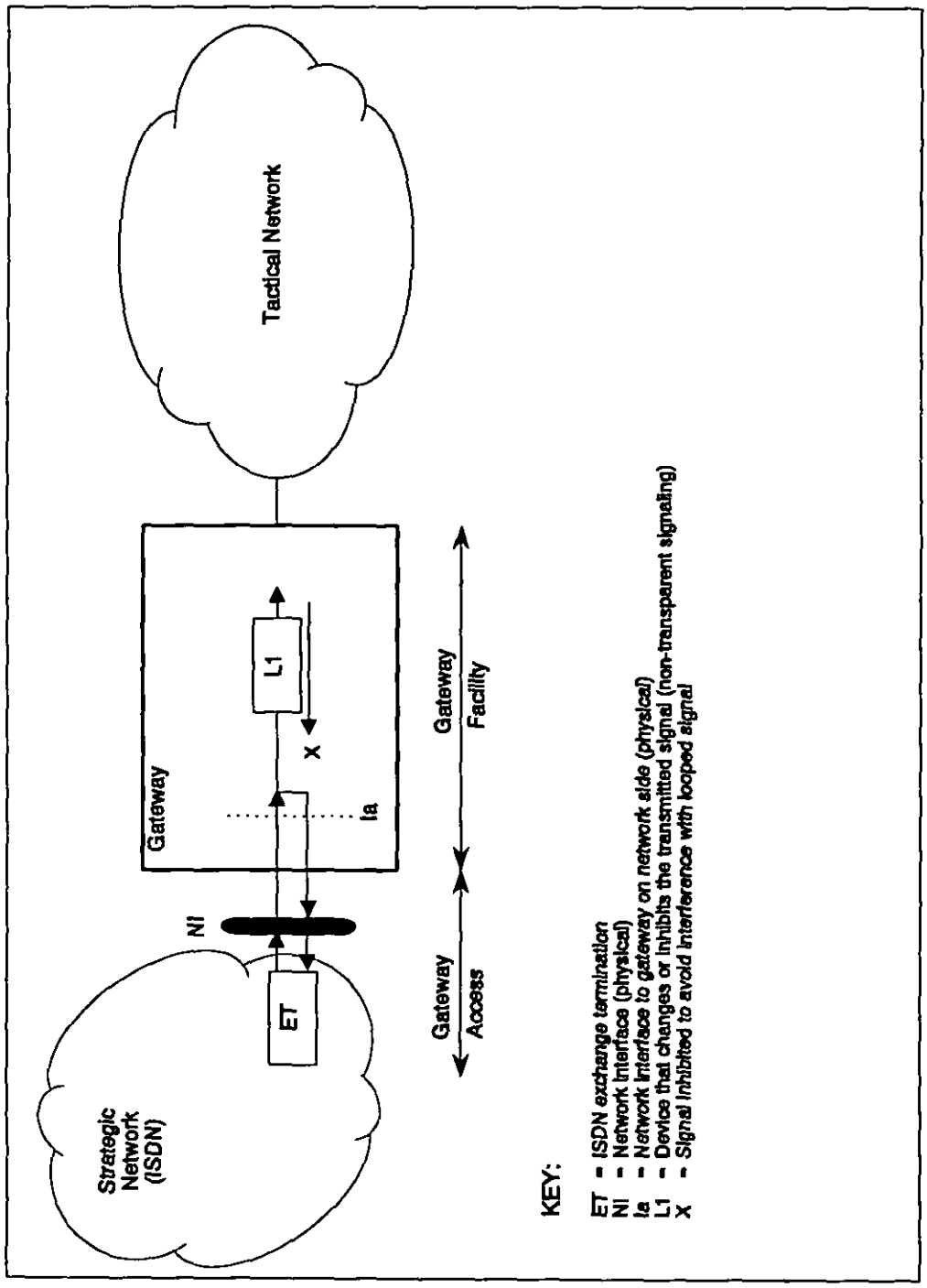

Figure 10. Gateway loopback testing in the Primary-Rate Access Interface.

Table XIV. Description of loopbacks for primary-rate access.

Loopback	Looped Signal	Control Process	Forward Signal (Note 1)	Loopback Direction
Line Loopback Ia	1.544 Mbps	EOC	Non-transparent with AIS (Note 2)	Toward Ia Interface

NOTES:

1. The definition of *forward signals* is only relevant when the line loopback is in equipment that is not at a path termination point.
2. Non-Transparent Loopback: a loopback in which the signal transmitted beyond the loopback point (the forward signal), when the loopback is activated, is not the same as the received signal at the loopback point (see Figure 10). The forward signal may be a defined signal or unspecified.

Table XV. Assigned bit-oriented ESF data-link loopback message.

Function	Codeword
Command and response messages	
Line Loopback (Ia) Activate	0 000111 011111111
Line Loopback (Ia) Deactivate	0 011100 011111111
Universal Loopback (Deactivate)	0 010010 011111111

NOTES:

1. Right-most bit transmitted first.
2. The Line Loopback (Ia) Deactivate codeword is listed here only to be consistent with ANSI T1.403. See 5.8.4.3.2 (in ANSI T1.403) for a discussion on the deactivation of line loopbacks for primary rate access.
3. Command and response codewords shall be repeated at least 10 times.

full 1.544-Mbps loopback (toward the interface) of the received bit stream. Bit sequence integrity shall be maintained.

To ensure that the line loopback activate code (see Table XV) is not sent in the opposite direction, activation of the line loopback shall be a two-step process:

(1) When the line loopback activation code has been detected at Ia, a state is set to prepare for activation.

(2) The line loopback is then activated when the Line Loopback Activate code is no longer detected.

5.4.8.3.2 Line loopback deactivation. Line loopbacks shall be deactivated in two cases:

a. upon receipt of the *Universal Loopback (Deactivate)* codeword (see Table XV), and

b. upon receipt of AIS.

This set of deactivation signals ensures that

a. a formal deactivation signal is defined for inclusion in maintenance procedures, and

b. any inadvertent loopbacks are deactivated by the presence of a normal service signal containing all components of the ESF framing pattern.

Transmission of the Universal Loopback (Deactivate) message in Table XV shall result in the deactivation of any of the above loopbacks. For a particular loopback, deactivation shall occur only from the same side as the loopback activation message was or would have been transmitted.

5.4.9 Restart. The gateway facility shall comply with the ISDN *restart procedure* as described in ANSI T1.607, the section titled *Restart procedure*. Upon receipt of a Restart message, the gateway facility shall (a) return the specified trunks to the idle condition, (b) send Release messages to the tactical network for all trunks identified in the Restart message that are involved in active calls, and (c) send a Restart-acknowledge message to the ISDN network.

5.4.10 Unsuccessful calls. Unsuccessful calls are to be treated as a combination of call-initiation and call-clearing phases. The time sequence diagram for unsuccessful calls initiated in the tactical network is shown in Figure 11 and discussed in 5.4.10.1. The time sequence diagram for unsuccessful calls initiated in the strategic network is shown in Figure 12 and discussed in 5.4.10.2.

5.4.10.1 Unsuccessful calls initiated in the tactical network. Call initiation from the tactical network follows the same process as described in 5.4.3.1a for call initiation in the tactical network: the gateway receives a Call-initiate message from the tactical circuit switch and maps this onto an ISDN Setup message, which it forwards to the ISDN circuit switch. For a variety of reasons, which will be indicated in the Cause information element of the Disconnect message, such as "User busy," "No circuit or channel available," or "Preemption" (ANSI T1.607, section 4.5.11, titled *Cause*), the ISDN switch sends a Disconnect message to the gateway. The gateway will then create

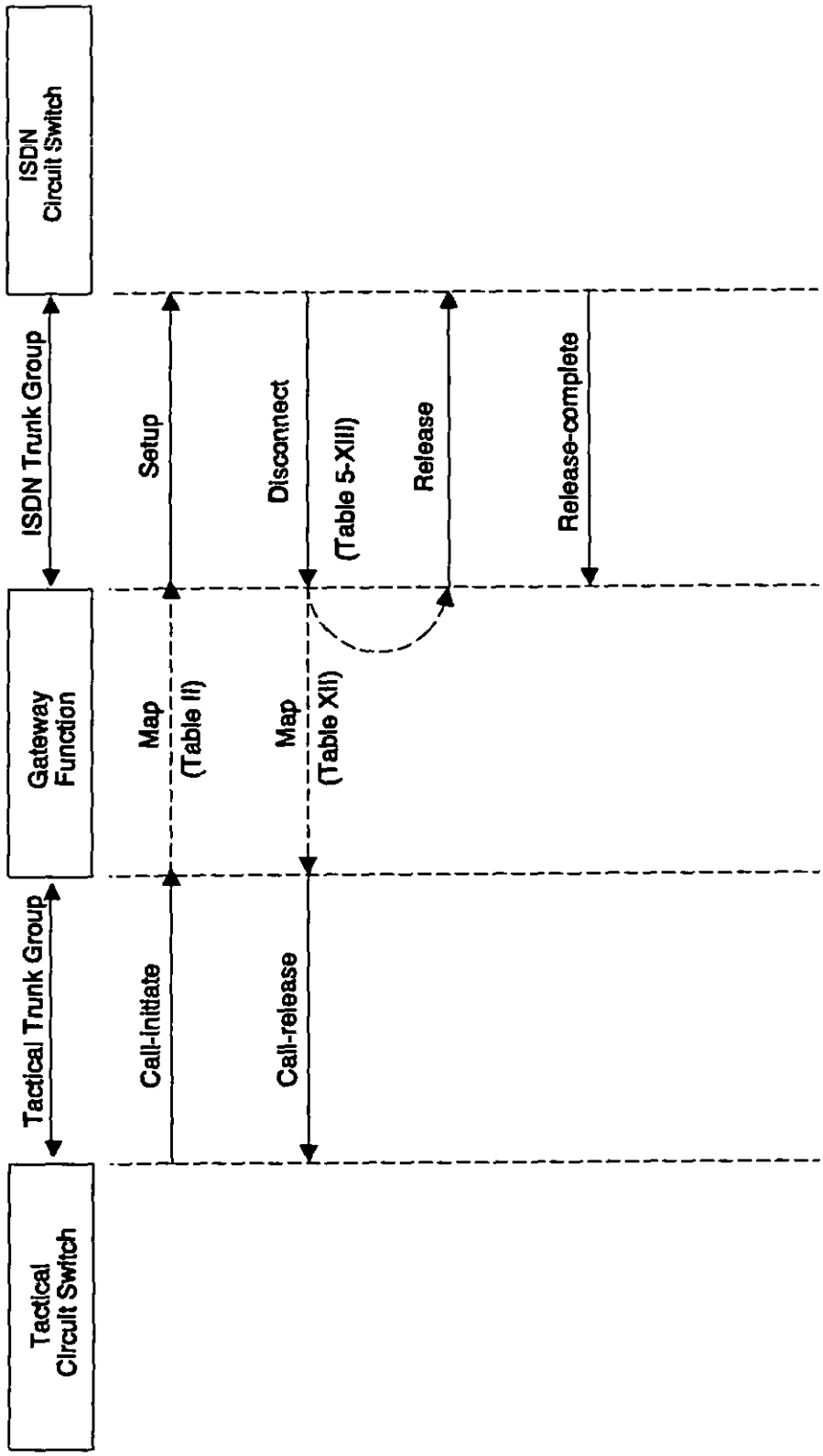

Figure 11. Time sequence diagram for unsuccessful call setup, call initiated in the tactical circuit-switched network.

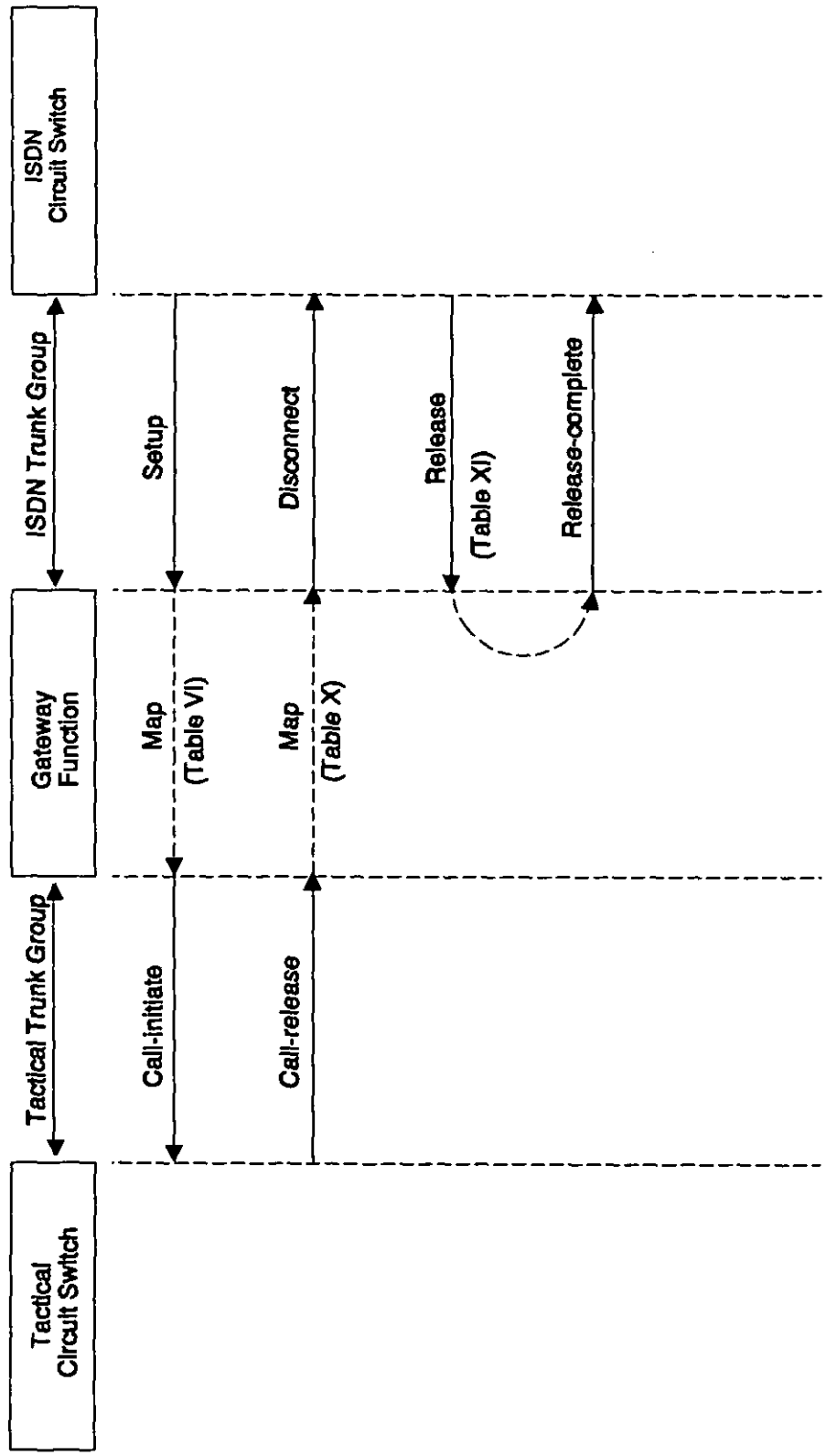

Figure 12. Time sequence diagram for unsuccessful call: call initiated in the ISDN circuit-switched network.

a Call-release message, which will be forwarded to the tactical network, and a Release message, which will be returned to the ISDN, in accordance with section 5.4.4.2a for call clearing initiated in the ISDN network. The ISDN will, in turn, return a Release-complete message to the gateway, in accordance with 5.4.4.2b. This indicates the ISDN trunk is available for a new connection.

5.4.10.2 Unsuccessful calls initiated in the strategic network. Call initiation from the ISDN network follows the same process as described in 5.4.3.2a for call initiation in the ISDN network: the gateway receives a Setup message from the ISDN circuit switch and maps this onto a tactical Call-initiate message, which it forwards to the tactical circuit switch. For a variety of reasons, such as "Called party unavailable," "Unassigned loop," "All-trunks busy," or "Invalid route," the tactical switch sends a Call-release message to the gateway. The gateway will then create a Disconnect message, which will be forwarded to the ISDN network, in accordance with section 5.4.3.2b for call-clearing initiated in the tactical network. The ISDN will, in turn, return a Release message to the gateway, in accordance with 5.4.4.1b. This indicates the ISDN trunk is available for a new connection. The gateway will then send the ISDN a Release-complete message, in accordance with 5.4.4.1c.

5.5 Transcoding. The gateway shall perform transcoding for voice calls that do not have common voice-encoding techniques. Transcoding shall provide digital translation of 16-kbps (optionally 32-kbps) CVSD to and from 64-kbps mu-law PCM. Transcoding includes two processes: translation of the digital encoding methods, and conversion of the sampling rates. The translation of the digital encoding methods shall be digital, that is, no intermediate analog stage shall be used. This approach eliminates the accumulation of quantization noise generated by analog-to-digital conversion. The sampling rates of 16-kbps (optionally 32-kbps) shall be converted to and from the 8-kbps samples used with 64-kbps mu-law PCM. The complete translation process shall occur in real-time, with the only inherent measurable delay attributable to the hysteresis effect of CVSD, which uses three previous bits to determine the current state. The effectiveness of the transcoding process shall be quantified by using standard TRI-TAC and PCM-encoded test-tone patterns, and measuring the distortion incurred through the translation process. TRI-TAC CVSD test-tone patterns are described in TT-C1-7205-0102 Specification NSA No. 79-20. Mu-law PCM test-tone patterns are described in CCITT G.711 and Table 6/G.711. The gateway shall be designed to minimize the amount of distortion.

5.6 Rate adaptation. For those calls between terminals using common voice-encoding, the gateway function shall provide

bit-rate adaptation. 16-kbps and the optional 32-kbps tactical bit streams shall be rate-adapted in accordance with the following procedure, as documented in CCITT I.460 and CCITT V.110, the section titled *Rate adaptation of 8-, 16-, and 32-kbps streams*.

a. The 16-kbps stream received on incoming tactical trunks shall be mapped to bit positions 1 and 2 of the corresponding outgoing 64-kbps ISDN trunks. (See Figure 3.)

b. The optional 32-kbps stream shall be mapped to bit positions 1, 2, 3, and 4.

c. Unused bit positions shall be set to "1."

d. The order of bit transmission of the subrate stream shall be identical before and after rate adaptation.

e. Bit positions 1 and 2 of the incoming ISDN trunk shall be mapped to the corresponding outgoing 16-kbps tactical trunk. (Bit 1 shall precede bit 2 in the 16-kbps stream).

5.7 Voice encoding. This section defines the types of voice-encoding signals generated by subscriber terminal equipment (or terminal adapters) connected at reference point A in ISDN and tactical networks.

5.7.1 Pulse-code modulation. ISDN terminals use 64-kbps PCM voice encoding with mu-law companding, as described in MIL-STD-188-113, paragraph 5.1, titled *Eight-bit pulse-code modulation (PCM)*.

5.7.2 Continuously variable slope delta. Tactical terminals use CVSD voice encoding as described in MIL-STD-188-113, paragraph 5.2, titled *Continuously variable slope delta (CVSD) modulation.*

5.8 Satellite link count. The purpose of the satellite-link-count (SLC) information element is to indicate the number of satellite links traversed between Defense Information Systems Network (DISN) users. SLC will be used in the DISN, in conjunction with MLPP, to preempt low-priority calls on congested satellite links when alternate satellite link routing would result in transmitting calls with an unacceptable grade-of-service.

An SLC information element is present in Signaling System 7 (SS7) but is absent in DSS1. Since DSS1 is used in DISN subnetworks to interface with other DISN subnetworks that use SS7, it is necessary to introduce an SLC information element into

DSS1. This is accomplished by using the Locking-shift procedure described in ANSI T1. 607-1990, the section titled *Locking-shift procedure*.

5.8.1 Locking-shift procedure. The Locking-shift procedure is based on the introduction of a Locking-shift information element into a DSS1 message to shift to a new active codeset. The new codeset is valid only within the message that contains the Locking-shift information element.

The Locking-shift information element consists of a single octet and has the following format:

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

It shall contain the *New codeset identification* field (bits 1-3) set to codeset 6 ("110"). When the gateway sees this, it shall shift out of the original codeset to codeset 6. The SLC information element, as specified in 5.8.2, shall follow this Locking-shift information element.

Since networks other than DISN might use codeset 6 for information elements different from those used by DISN, the MLPP Precedence-level information element must also appear in the SETUP message. Octet 4a, bits 1-7 ("0000000"), of this information element identifies the private network as "Defense Switched Network." The MLPP information element is shown as a gateway action for the SETUP message in Table II of this MIL-STD. Thus, codeset 6 is made unique to the DISN.

5.8.2 Satellite-link-count information element. The SLC information element in codeset 6 has the format and coding as indicated in Figure 13:

8	7	6	5	4	3	2	1
Spare							*SLC*

(1) The following codes are used for the SLC indicator:

Bits 2 1	
0 0	No satellite link present
0 1	One satellite link present
1 0	Two satellite links present
1 1	Three or more satellite links present

(2) Bits 3-8 are spare.

Figure 13. Satellite-link-count information element.

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6. NOTES

6.1 Key-word listing. The following key words, phrases, and acronyms apply to MIL-STD-188-105:

- Circuit-switched networks
- Digital Subscriber Signaling System Number 1 (DSS1)
- End-to-end security
- Integrated Services Digital Network (ISDN)
- Multilevel precedence and preemption (MLPP)
- Rate adaptation
- Tactical-to-strategic interface
- Transcoding

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NSA - NS
DISA - DC
DLA - DH
DMA - MP
ECAC - --
DOT - OST
DJA - DIA

User Activities:

Army - SC
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3. DOCUMENT TITLE: **Interoperability and Performance Standard for the All-Digital Tactical-to-Strategic Gateway**

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

5. REASON FOR RECOMMENDATION

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