METRIC

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MILITARY STANDARD

INTEGRATED SERVICES DIGITAL NETWORK PROFILE

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FOREWORD

1. This military standard is approved for use by all departments and agencies of the Department of Defense (DOD).

2. Beneficial comments (recommendations, additions, deletions) and any pertinent data that may be of use in improving this standard should be addressed to: DISA, JIEO/TBBG), 11440 Isaac Newton Square, North, Reston, VA, 22090-5006, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document, or by letter.

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

4. An Integrated Services Digital Network (ISDN) (including Narrowband and Broadband) is an end-to-end digital network that takes advantage of the digitization and stored program control of the existing telephone network and new computer-networking technologies. The use of end-to-end digital transmission (for both call control and user data) allows the provision of a wide variety of services over a few standard interfaces. ISDN allows multiple forms of user data including, but not limited to, voice, data, message traffic, fasimile, and video to be exchanged in one integrated network. The use of digital out-of-band signaling also allows more efficient use of the wire pair from the central office to the user. ISDN allows 2 full 64 kbps channels, plus a 16 kbps data channel to be multiplexed onto a single wire pair. This is the Basic Rate Interface. Another interface, the Primary Rate Interface, puts 1.544 Mbps on a 4-wire interface. A third interface, the Broadband Interface, is in the process of being defined. It will initially provide 135 Mbps switched channels over fiber-optic cable. However, broadband-ISDN will not become available until the mid-1990s.

5. This document is a profile of standards pertaining to ISDN products and services. ISO TR10000 defines a profile as "a set of one or more base standards and, where applicable, the identification of chosen classes, subsets, options and parameters of those base standards necessary for accomplishing a particular function." It defines a common set of specifications to facilitate interoperation among products developed by different vendors. Through the use of this profile in the acquisition process, DOD activities can obtain ISDN products and services capable of interoperating across activity, service, and agency boundaries without regard to proprietary limitations. This profile is based on standards developed by the International Telegraph and Telephone Consultative Committee (CCITT) and the American National Standards Institute (ANSI). It is further based on

implementation agreements reached by the ISDN Implementors' Workshop under the North American ISDN Users' Forum (NIUF).

6. This profile will be updated to reflect the continuing evolution in ISDN standards with consideration for backward interoperability. Appendices specify future work items needed to enrich the profile.

CONTENTS

CONTENTS

CONTENTS

CONTENTS

CONTENTS

1. SCOPE

1.1 Purpose. This Integrated Services Digital Network (ISDN) Profile is the standard reference to be used by all Department of Defense (DOD) activities and associated organizations when acquiring ISDN products, systems or services. This profile addresses the interfaces and requirements for ISDN services and equipment for the DOD and for those civilian agencies that choose to use this profile. It is not a complete specification for telecommunications products and services. It provides the additional ISDN language that is necessary beyond the normal requirements for telephony products and services. Through the use of this standard, DOD activities can obtain ISDN products, systems or services capable of interoperating across activity boundaries without regard to proprietary limitations.

1.2 Sources of ISDN standards.

1.2.1 Primary sources. The primary sources are the Stable Implementation Agreements for the Integrated Services Digital Network, developed by the ISDN Implementors' Workshop of the North American ISDN Users' Forum, and the Stable Implementation Agreements for Open Systems Interconnection Protocols, developed by the OSI Implementors' Workshop. They contain implementation specifications that are derived from service and protocol standards issued by the International Telegraph and Telephone Consultative Committee (CCITT) and the American National Standards Institute (ANSI). By primary source it is meant that where this standard specifies a given protocol, it cites that protocol by reference as specified in the above-named workshop agreements. The primary source is used in all instances where the protocol of interest has been specified in the Workshop Agreements. Paragraph 5 of this standard gives conformance statements for each protocol that, in some cases, are augmented from the minimal conformance statements in the Workshop Agreements in order to provide the functionality required for DOD ISDNs.

1.2.2 Secondary sources. The secondary sources include specifications that are standards or advancing to become standards. They are included herein where needed to help satisfy the criterion of completeness. Note that secondary sources exclude protocols, however mature, that are not part of recognized international or national standardization processes. This standard must be complete in that ISDN products and services procured in accordance with it must interoperate and must provide service generally useful for DOD applications. Where the Workshop Agreements do not provide completeness, this standard augments protocol and service specifications from the following sources:

a. ANSI Standards

b. Draft ANSI Standards

c. CCITT Recommendations

d. Draft CCITT Recommendations

Requirements that are based on draft standards and recommendations should be considered as Design Objectives (DO).

1.2.3 Workshops and implementation agreements. In addition to commercial standards bodies that develop standards (e.g., the International Organization for Standardization (ISO), the ANSI Committee T1 (Telecommunications)), workshops have been established wherein participants reach agreement on the ISDN services, functions, and options that will be implemented, thus providing assurance that products from different vendors will be interoperable. Implementation agreements for ANSI ISDN standards are developed by the ISDN Implementors' Workshop under the North American ISDN Users' Forum. Agreements are published in the National Institute of Standards and Technology's (NIST) Special Publication 500-195, Stable Implementation Agreements for Integrated Services Digital Networks, Version 1. Implementation agreements for Open System Interconnection (OSI) protocols are developed by the NIST Workshop for Implementors of Open Systems Interconnection. These agreements are published as NIST Special Publication 500-183, Stable Implementation Agreements for Open Systems Interconnection Protocols, Version 4, Edition 1. Not all standards will have implementation agreements. However, for those standards that do, both the standard and the implementation agreement must be specified in acquisition documents.

1.3 Applicability guidance. This profile applies to all new ISDN services and equipment procured by DoD.

1.4 Future profiles. Future versions will address additional subjects as described in the Foreward to the Appendices.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

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

FEDERAL

FED-STD-1037 - Glossary of Telecommunication Terms

MILITARY

DCAC 370-V175-6 - Defense Switched Network (DSN) System Interface Criteria

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

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

NIST Publications

NIST Special Publication 500-194 - ISDN Conformance Testing

Containing:

NIU/90-002 (NIU Forum/IIW/ICOT-90-40) - Integrated Services Digital Network (ISDN) Layer 1 Conformance Testing S/T Interface

NIU/91-006 (NIU Forum/IIW/ICOT-90-60) - Integrated Services Digital Network (ISDN) Layer 1 Conformance Testing Basic Rate U Interface.

NIST Special Publication 500-195 - North American ISDN Users' Forum Agreements on Integrated Services Digital Network

Containing:

NIU 89-101 Implementation Agreement of the North American ISDN Users' Forum, Basic Access Interface for Use on Metallic Loops for Application on the Network Side of the NT - Layer 1 Specification, 1989

NIU 89-105 Implementation Agreement of the North American ISDN Users' Forum, Basic Access Interface at S and T Reference Points - Layer 1 Specification, 1989

NIU 89-210 Implementation Agreement of the North American ISDN Users' Forum, Data Link Layer Signalling Specification for Application at the User-Network Interface, 1989

NIU 90-301 Layer 3 Signalling Specification for the Minimal Set of Circuit-Switched Bearer Services for the ISDN Basic Rate Interface/Class I

NIU 90-302 Layer 3 Signalling Specification for the Minimal Set of Circuit-Switched Bearer Services for the ISDN Class II Primary Rate Interfaces

NIST Special Publication 823-2 - Integrated Services Digital Network Conformance Testing Layer 1-Physical Layer Part 2-Basic Rate U Interface, User Side

NIUF/400-92 (NIU Forum/IIW/ICOT-91-53) - Integrated Services Digital Network (ISDN) Primary Rate Acess Customer Installation Layer 1 Conformance Testing

(Copies of NIST Special Publications may be requested from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161-2171. NIUF documents may be ordered from the NIUF secretariat: Dawn Hoffman, NIST, Bldg 223 Rm B364, Gaithersburg, MD, 20899, phone (301) 975-2937

2.2 Non-government publications.

2.2.1 ANSI standards.

ANSI T1.110 - American National Standard for Telecommunications - Signalling System Number 7 (SS7) - General Information

ANSI T1.111 - American National Standard for Telecommunications - Signalling System Number 7 (SS7) - Message Transfer Part (MTP)

ANSI T1.112 - American National Standard for Telecommunications - Signalling System Number 7 (SS7) - Signalling Connection Control Part (SCCP)

ANSI T1.113 - American National Standard for Telecommunications - Signalling System Number 7 (SS7) - ISDN User Part (ISUP)

ANSI T1.114 - American National Standard for Telecommunications - Signalling System Number 7 (SS7) - Transaction Capability Part (TCAP)

ANSI T1.115 - American National Standard for Telecommunications - Monitoring and Measurements for Signalling System Number 7 Networks

ANSI T1.116 - American National Standard for Telecommunications - Signalling Number 7 (SS7) - Operations, Maintenance, and Administration Part (OMAP)

ANSI T1.216 - ISDN Management--Basic Rate Physical Layer

ANSI T1.217 - ISDN Management--Primary Rate Physical Layer

ANSI T1.218 - ISDN Management--Data Link and Network Layers

ANSI T1.219 - ISDN Management--Overview and Principles

ANSI T1.408 - Primary Rate Interface-Specification at the Network Side of the NT Layer 1

ANSI T1.504 - Packet-Switched Data Communication Service - Performance Parameters

ANSI T1.507 - Network Performance Parameters for Circuit-Switched Digital Services - Definitions and Measurements

ANSI T1.601 - Telecommunications - Integrated Services Digital Network (ISDN) Basic Access Interface for Use on Metallic Loops for Application at the Network Side of NT (Layer 1 Specification)

ANSI T1.602 - Telecommunications - Integrated Services Digital Network (ISDN) - Data-link Layer Signaling Specification for Application at the User-Network Interface

ANSI T1.603 - Minimal Set of Bearer Services for ISDN Primary Rate Interface

ANSI T1.604 - Minimal Set of Bearer Services for ISDN Basic Rate Interface

ANSI T1.605 - ISDN--Basic Access Interface for S and T Reference Points--Layer 1 Specification

ANSI T1.606 - American National Standard for Telecommunications - Integrated Services Digital Network (ISDN) - Architectural Framework and Service Description for Frame-Relaying Bearer Service

ANSI T1.607 - American National Standard for Telecommunications - Digital Subscriber Signaling System No. 1 - Layer 3 Signaling Specification for Circuit Switched Bearer Service

ANSI T1.608 - American National Standard for Telecommunications - Digital Subscriber Signaling System No. 1 - Signaling Specification for X.25 Packet Switched Bearer Service

ANSI T1.609 - American National Standard for Telecommunications - Interworking Between the ISDN User - Network Interface Protocol and the Signaling System Number 7 ISDN User Part

ANSI T1.610 - Digital Subscriber Signaling System No. 1 - Generic Procedures for the Control of ISDN Supplementary Services

ANSI T1.612 - ISDN Terminal Adaptation Using Statistical Multiplexing

ANSI T1.613 - ISDN Call Waiting Supplementary Service

ANSI T1.614 - American National Standard for Telecommunications- Integrated Services Digital Network (ISDN) - Packet Mode Bearer Service Category Description

ANSI T1.616 - ISDN Call Hold Supplementary Service

ANSI T1.617 - American National Standards Institute Telecommunications Committee ANSI T1S1 DSS1 - Signaling Specification for Frame Relay Bearer Service

ANSI T1.618 - American National Standards Institute Telecommunications Committee ANSI T1S1 DSS1 - Core Aspects of Frame Protocol for Use with Frame Relay Bearer Service

ANSI T1.619 - Multi-Level Precedence and Preemption ISDN Supplementary Service Description

ANSI T1.620 - American National Standards Institute - ISDN Circuit Mode Bearer Service Category Description

ANSI T1.621 - User-to-User Signaling Supplementary Service

(Requests for copies of ANSI standards should be addressed to: ATTN: Sales Dept., American National Standards Institute, 1430 Broadway, New York, NY, 10018-3308 ((212) 642-4900).)

T1M1.2/90-004R1 - User-Network Interface Protocol Profile for Management (advancing to become Q.941)

T1M1.2/90-075 - ISDN Management, Managed Objects

T1M1.2/90-105 - ISDN Management, Service Profile Management/Service Profile Verification

T1M1.2/90-106 - ISDN Management, Local Loopback

T1M1.2/90-107 - ISDN Management, State Change Management

T1S1/LB91-01 - Draft Proposed American National Standard, Digital Subscriber Signaling System No. 1 - Signaling Specification for the User Signaling Bearer Service

T1S1/LB92-01 - Draft Proposed American National Standard, Digital Subscriber Signaling System No. 1 - Signaling Specification for the Calling Line Identification Presentation/Restriction (CLIP/CLIR)

T1S1/92-108 - Working Document: Message Waiting Indicator Control and Notification

T1S1.1/91-453 - Proposed Stage 1 Description for the Conference Calling Service

T1S1.1/92-033 - Completion of Calls to Busy Subscriber (CCBS): Integrated Text

T1S1.1/92-126 - Call Forwarding Integrated Text

T1S1.1/92-188 - Proposed Stage 1 Description for the Line Hunt Service

T1S1.1/92-194 - Normal Call Transfer Integrated Text

T1S1.1/92-199 - Proposed Stage 1 Description for the Preset Conference Calling Service

T1S1.1/92-200 - Hot Line Service Integrated Text

T1 documents (e.g., T1S1.1/91-xxx) and ANSI standards approved, but not yet published, may be ordered from the Exchange Carriers Standards Association Inc. (ECSA), 5430 Grosvenor Lane, Bethesda, MD, 20814-2122.

2.2.2 CCITT Recommendations.

2.2.2.1 CCITT Recommendations from the Blue Book. The following recommendations are in the CCITT Blue Book, IXth Plenary Assembly, November 1988.

E.164 - Numbering Plan for the ISDN Era

E.180 - Technical Characteristics of Tones for the Telephone Service

G.711 - Pulse Code Modulation (PCM) of Voice Frequencies

I.430 - Basic User-Network Interface Layer 1 Specification

Q.920 (I.440) - Digital Subscriber Signalling System No. 1 (DSS1), Data Link Layer

Q.921 (I.441) - ISDN User-Network Interface - Data Link Layer Specification

Q.931 (I.451) - ISDN User-Network Interface - Layer 3 Specifications for Basic Call Control

Q.700 series - Fascicle VI.7, VI.8, and VI.9, Signalling System No. 7.

X.25 - Interface Between Data Terminal Equipment (DTE) and Data Circuit-Terminating Equipment (DCE) for Terminals Operating in the Packet Mode and Connected to Public Data Networks by Dedicated Circuit

X.31 (I.462) - Support of Packet Mode Terminal Equipment by an ISDN

X.75 - Packet-Switched Signalling System Between Public Networks

Providing Data Transmission Services

X.400 - Message Handling System and Service Overview

(Copies of CCITT documents may be requested from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161-2171.)

2.2.2.2 New CCITT Recommendations. The following CCITT Recommendations have been approved and publication is pending. Draft copies are available from the source listed below.

I.251 - Number Identification Supplementary Services

I.252 - Call Offering Supplementary Services

I.253 - Call Completion Supplementary Services

(Copies of CCITT documents may be requested from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161-2171.)

2.2.3 ISO standards.

ISO 8877 - Information Processing-Systems-Interface Connector and Contact Assignments for ISDN Basic Access Interface Located at Reference Points S and T

ISO/IEC/TR 10000 - Information Technology - Framework and Taxonomy of International Standardized Profiles

JTC 1/SC6 WG6 N27 - Layer 3 Protocol for Signalling Between Exchanges of Private Telecommunication Networks for the Control of Circuit-Switched Calls

(Requests for copies of ISO documents should be addressed to: ATTN Sales Dept., American National Standards Institute, 1430 Broadway, New York, NY, 10018-3308 ((212) 642-4900).)

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

3. DEFINITIONS

3.1 Definitions of terms. Definitions of terms used in this standard shall be as specified in FED-STD-1037. Those definitions unique to ISDN and not provided in FED-STD-1037, are provided in this paragraph.

3.2 Additional terms.

3.2.1 Access Unit (AU). A conceptual unit of an ISDN, which provides an interworking function between an ISDN and a Packet-Switched Public Data Network (PSPDN).

3.2.2 Acquisition authority. An individual or team who, under federal law and acquisition regulations, has the authority to enter into, administer, and/or terminate a government contract.

3.2.3 Bearer service. A type of telecommunications service that provides the capability for the transmission of signals between user-network interfaces.

3.2.4 Call completion to a busy subscriber (CCBS). The CCBS feature will allow an authorized user, A, who encounters a busy destination, B, to be notified when the busy destination, B, becomes idle. The network will reinitiate the call to destination B if user A desires. This is a standard commercial feature. Identified but not defined in CCITT Recommendation I.253.

3.2.5 Call forwarding (CF). CF permits a "served user" to have the network send to another number all incoming calls for the served user's ISDN number. (Defined in CCITT Recommendation I.252).

3.2.6 Call forwarding unconditional (CFU). Another term for "Call forwarding".

3.2.7 Call hold (HOLD). A supplementary service which allows a user to interrupt communications on an existing call/connection and then subsequently, if desired, reestablish communications. This is defined in CCITT Recommendation I.253.2.

3.2.8 Call transfer (XFER). A supplementary service which enables a user to transfer an established (i.e., active) call to a third party. This is defined in CCITT Recommendation I.252.1.

3.2.9 Call waiting (WAIT). A supplementary service which permits a subscriber to be notified of an incoming call (as per basic call procedures) with an indication that no interface information channel is available. The user then has the choice of accepting, rejecting or ignoring the waiting call (as per basic call procedures). This is defined in CCITT Recommendation I.253.1.

3.2.10 Calling line identification (CLID). The CLID service is offered to the called party that provides the calling line identification to the called party. This is defined in CCITT Recommendation I.251.3.

3.2.11 Calling line identification restriction (CLIR). CLIR is a supplementary service offered to a calling party that restricts presentation of that party's Calling Line Identification to the called party.

3.2.12 Class I. This is NIUF terminology for terminal equipment which does no switching. This corresponds to the CCITT S reference point.

3.2.13 Class II. This is NIUF terminology for user equipment which does switching(e.g., a PBX). This corresponds to the CCITT T reference point.

3.2.14 Conference call (CONF). This service allows a user to communicate simultaneously with multiple parties, which may also communicate among themselves. This is defined in CCITT Recommendation I.254.1.

3.2.15 Conformance testing. The process of determining whether an implementation complies with the specification of a standard.

3.2.16 Functional testing. The testing of certain basic functions (e.g., a voice call) to see whether these facilities are usable.

3.2.17 Hotline. A service which allows a user to automatically place a call to a preset number when the terminal goes off-hook. The user does not enter any information to place the call. A hotline phone cannot place calls to other numbers or receive calls from other numbers.

3.2.18 HOLD. Call hold (See paragraph 3.2.7)

3.2.19 Interoperability testing. The connection of various pieces of equipment to determine whether they work properly with each other.

3.2.20 ISUP. ISDN user part (Q.761,2,3,4), layer 4 of SS#7

3.2.21 LAPD. Link Access Procedure D, the link layer protocol on the D channel, CCITT Recommendation Q.921

3.2.22 LLSIG. Lower Layer Special Interest Group of the OSI Implementors' Workshop

3.2.23 Multi-Level precedence and preemption (MLPP). This service provides a prioritized call handling service. This service has two parts--precedence and preemption. Precedence involves assigning a priority level to a call. Preemption involves the seizing of resources, which are in use by a call of a lower precedence, by a higher level precedence call in the absence of idle resources.

3.2.24 Performance testing. Perfomance testing is the process of determining the performance of equipment: e.g., how long does a call setup take or how many packets per second can be switched?.

3.2.25 Preset Conference. Preset Conference allows the served user to quickly establish a conference with a predetermined list of conferees that is stored in the network. All of the call attempts are done in parallel.

3.2.26 Profile. Defined by ISO TR10000 as "a set of one or more base standards and, where applicable, the identification of chosen classes, subsets, options and parameters of those base standards necessary for accomplishing a particular function."

3.2.27 PTI. Post, Telephone, and Telegraph (a national telephone company)

3.2.28 SABM. Set Asynchronous Balanced Mode (the command that initializes a LAPB link with modulo 8 sequence numbers).

3.2.29 SABME. Set Asynchronous Balanced Mode Extended (the command that initializes a LAPB link with modulo 128 sequence numbers on a LAPD link).

3.2.30 Supplementary service. Any service provided by the telephone network in addition to the fundamental telephone service. Examples of supplementary services include call waiting, call completion to a busy subscriber, and MLPP.

3.2.31 User-to-user signaling. UUS allows users to exchange information over the signaling channel.

3.3 Acronyms used in this standard. The acronyms used in this standard are defined as follows:

ANS	American National Standard
ANSI	American National Standards Institute
AU	Access Unit
BCIE	Bearer Capability Information Element
BRI	Basic Rate Interface
CCBS	Call completion to a busy subscriber
CCITT	International Telegraph and Telephone Consultative Committee
CFB	Call forwarding busy
CFNR	Call forwarding no reply
CFU	Call forwarding unconditional
CLID	Calling line identification
CLIP	Calling line identification presentation
CLIR	Calling line identification restriction
CLNP	Connectionless Network Protocol

CMD	Circuit-Mode Digital
CONF	Conference call
CONUS	Continental United States
CPE	Customer premises equipment
CRC	Cyclic redundancy check
CS	Circuit switched
CV	Circuit-Mode Speech
CVBD	Circuit-Mode Voiceband Data
DISA	Defense Information Systems Agency
DCS	Defense Communications System
DDN	Defense Data Network
DEFL	Call deflection
DLCI	Data Link Connection Identifier
DO	Design Objective
DOD	Department of Defense
DSN	Defense Switched Network
DSN No. 7	Defense Switched Network Number 7
DSS1	Digital Subscriber Signaling System 1
ECSA	Exchange Carriers Standards Association, Inc.
FCC	Federal Communications Commission
GOSIP	Government Open Systems Interconnection Profile
HLCIE	Higher layer compatibility information element
IE	Information Element
IEC	International Electrotechnical Committee
IIW	ISDN Implementors' Workshop
IP	Internet Protocol
ISDN	Integrated Services Digital Network
ISEG	ISDN Security Experts Group
ISO	International Organization for Standardization
ISUP	ISDN User Part
kbps	Kilobits per second
LAPB	Link Access Procedure Balanced
LAPD	Link Access Procedure D
LH	Line Hunt
Mbps	Megabits per second
MIL-STD	Military Standard
MLPP	Multilevel precedence and preemption
MWICN	Msg Waiting Indication Control Notification
NIUF	North American ISDN Users' Forum

NSA	National Security Agency
NT1	Network Termination 1
NT2	Network Termination 2
OCONUS	Outside continental United States
OIW	OSI Implementors' Workshop
OAM&P	Operations, administration, maintenance and provisioning
OMAP	Operations, maintenance and administration part
OSI	Open Systems Interconnection
PBX	Private Branch Exchange
PISN	Private Integrated Services Network
PRI	Primary Rate Interface
PSPDN	Packet-switched public data network
PSTN	Public switched telephone network
PS	Packet switched
PTT	Post, Telephone, and Telegraph
PVC	Permanent Virtual Circuit
RFP	Request for proposal
SABM	Set Asynchronous Balanced Mode
SABME	Set Asynchronous Balanced Mode Extended
SAPI	Service access point identifier
SCCP	Signaling connection control part
SS No. 7	Signaling System Number 7
TA	Terminal Adaptor
TCAP	Transaction capabilities applications part
TE	Terminal Equipment
TEI	Terminal Equipment Identifier
US	United States
UUS	User-to-user signaling
WAIT	Call waiting
WNDP	Worldwide Numbering and Dialing Plan
XFER	Call transfer

4. GENERAL REQUIREMENTS

4.1 Bearer services. All ISDN switching equipment and network service providers shall support the following bearer services as appropriate.

4.1.1 Mandatory bearer services.

4.1.1.1 Switches and PBXs. The following bearer services are defined in the indicated standards:

a. Circuit-Mode Digital (CMD)(T1.604)

b. Circuit-Mode Speech (CV) (T1.604)

c. Circuit-Mode Voiceband Data (CVBD) (T1.604)

d. Circuit-switched access to a packet-switching node (T1.614)

e. B channel packet-switched access (T1.614)

f. D channel packet-switched access on the Basic Rate Interface (T1.614)

4.1.1.2 Terminals. Terminal equipment shall support one or more of the services listed above in Paragraph 4.1.1.1.

4.1.2 Optional bearer services. The following services are optional for all equipment:

a. Multirate Bearer Service (T1.620)

b. H_0 - 384 kbps (T1.607)

c. H_{10} - 1472 kbps (T1.607)

d. H_{11} - 1536 kbps (T1.607)

e. Multi-use Bearer Service (I.251.9)

f. Frame Relay Service (T1.606)

g. User Signaling Bearer Service (T1S1/LB91-01) (DO)

4.2 Supplementary services. Applicable ANSI documents are referenced for information.

4.2.1 Required supplementary services. Listed below is a subset of required supplementary services for DOD ISDN products and services.

a. Multilevel precedence and preemption (MLPP) (ANSI T1.619)

b. Preset Conference (T1S1.1/92-199) (DO)

c. Hotline (T1S1.1/92-200) (DO)

4.2.2 Optional supplementary services. Listed below is a subset of optional supplementary services for DOD ISDN products and services.

a. Call waiting (WAIT) (T1.613)

b. Call hold (HOLD) (T1.616)

c. Call forwarding (CF) (T1S1.1/92-126) (DO)

d. Call transfer (XFER) (T1S1.1/92-453) (DO)

e. Conference call (CONF) (T1S1.1/91-453) (DO)

f. User-to-User Signaling (T1.621) (DO)

g. Calling line identification (CLID, CLIP/CLIR) (T1S1/LB92-01) (DO)

h. Call completion to a busy subscriber (CCBS) (T1S1.1/92-011) (DO)

i. Message Waiting Indicator Control and Notification (MWICN) (T1S1/92-108) (DO)

j. Line Hunt (LH) (T1S1.1/92-188) (DO)

k. Business Group (BG) (T1S1.1/90-495) (DO)

NOTE

ANSI Subcommittee T1S1 is developing standards for a set of supplementary services. When these standards are completed, the NIUF will develop implementation agreements and conformance test suites for them. When the standards and implementation agreements are completed and approved, they will be referenced herein.

4.3 Testing. The following four types of testing are needed:

a. Conformance

b. Interoperability

c. Performance

d. Functional

4.3.1 Conformance testing. Conformance testing shall be performed with respect to the specifications in Paragraph 5.

NOTE:

Conformance tests and test systems are currently being developed by several testing organizations. Conformance tests that have been completed are listed in Paragraph 2, Applicable Documents, and in applicable paragraphs of Paragraph 5, Detailed Requirements. When these test systems are completed, this standard will be updated to specify the tests, test systems, and test organizations that are accredited to perform conformance testing of ISDN equipment.

In order to ensure DOD recognition of test results, testing centers are accredited by NIST, under the National Voluntary Laboratory Accreditation Program (NVLAP). This program certifies that laboratories have the proper tools, personnel, organization, and procedures to perform conformance testing. This laboratory certification applies to first-party (testing of in-house-developed products) or third party (testing for fee for other developers) testing. Means-of-testing (MOTs) are certified by NIST or its agent. MOTs are the tools used to conduct the conformance testing.

In cases where the development of conformance tests have not been completed, the Acquisition Authority is responsible for determining the test systems and test cases required for certification of conformance and shall determine the minimum acceptable test results for the purpose of procurement.

The Acquisition Authority is also responsible for determining that acceptable test results are available as a prerequisite to the awarding of a final procurement contract.

4.3.2 Interoperability testing. In addition to conforming to the various standards specified in Paragraph 5, equipment shall be tested for interoperability with a selected number of other components.

4.3.2.1 Existing products. The Acquisition Authority shall supply a list of existing products with which proposed products will be evaluated for interoperation.

4.3.2.2 Interoperability testing lists. Each vendor shall include a list of products against which the proposed products have been, or will be, tested for interoperability. The vendor shall list any functional capability of the proposed products, which does not function properly in conjunction with the tested products. The Acquisition Authority shall also be responsible for determining that acceptable test results are available as a prerequisite to awarding a final procurement contract.

4.3.3 Performance testing. The Acquistion Authority shall determine and specify the required performance and related testing of the products or services to be proposed. They may also wish to specify benchmarking criteria as evidence of satisfying performance requirements. The vendor shall indicate the system performance including the conditions under which these measurements have been made.

4.3.4 Functional testing. The Acquisition Authority will determine and specify which functions are required for the particular procurement and, consequently, which functional capabilities should be tested.

4.4 Additional services and interfaces.

4.4.1 Non-ISDN terminal equipment. Where ISDN services are required, an ISDN terminal adaptor function shall be required for non-ISDN terminals.

4.4.2 Interoperability with DDN. A design objective is to have interoperability between terminals using X.25, as supported on ISDN, and terminals using DDN X.25, as used on the current DDN. This would allow the capability for an ISDN switch to serve as a multifunction/consolidated node for the DCS. As such, it could perform as an access point, tandem switch, or node, for circuit-switched voice on the DSN or packet switched data on the DDN.

4.4.3 Private Networking. A design objective is to have PBX networking.

NOTE

Standards for common channel signaling between PBXs are being developed by the ISO. Since the capabilities of CCITT Signaling System No. 7 are not needed for inter-PBX signaling, the approach being taken is to develop a standard based on a symmetric version of the access area signaling protocol, CCITT Recommendation Q.931. In the ISO, the standard is being developed by Joint Technical Committee 1 (JTC1), Information Technology, Subcommittee 6/Working Group 6 (SC6/WG6). Both the United States and Europe have provided contributions to this effort. The U.S. proposes the signaling protocol defined in Annex D and Annex N to ANSI T1.607 and refers to the interface as reference point B. Europeans proposed an ECMA document as a base for the protocol, designated

QSIG, and refer to the interface as reference point Q. The JTC1/SC6/WG6 is defining private integrated services networks (PISNs) and has a working draft, Layer 3 Protocol for Signalling Between Exchanges of PISNs for the Control of Circuit-Switched Calls, revised document WG6 N27. Support for this standard is a design objective.

4.4.4 Interoperation with other networks. An ISDN switch shall interoperate with:

a. Non-ISDN voice switches

b. Non-DOD telephone networks (e.g., FTS2000)

c. Public Switched Telephone Network (PSTN)

d. Packet-Switching Public Data Networks (PSPDNs) using CCITT X.75

e. Other ISDNs using either circuit-switched mode or X.25 packet mode (e.g., National ISDN-1). ISDN switch equipment shall conform to the CCITT Recommendation I.500 series on internetwork interfaces.

5. DETAILED REQUIREMENTS

5.1 Requirements. This paragraph discusses the detailed specifications that apply to acquisition of ISDN products and services. The acquisition authority must select those specifications applicable to a particular procurement, e.g., switching, terminal equipment.

5.2 Interswitch interface. Interswitch functions include common channel signaling, data transmission, interworking with other networks, and management/maintenance functions. Specifications for these functions are provided in the following paragraphs.

5.2.1 Interswitch signaling. There are three possible interfaces for the switch-to-switch interface. The acquisition authority shall decide which of these apply to a specific acquisition. These three options are defined in the following paragraphs.

5.2.1.1 DSN No. 7. This option is the common channel signaling using DSN No. 7. DSN No. 7 is based on the ANSI version of Signaling System No. 7, ANSI standards T1.110 - T1.114, with extensions to meet DOD's special requirements such as MLPP, conferencing, community of interest, management, and transfer of data different from signaling data. The specification of DSN No. 7 is provided in mandatory Appendix B of this document.

NOTE

To ensure the integrity of the DSN signaling network, acquisition authorities of acquisitions that include DSN No. 7, shall coordinate with DISA prior to acquisition.

5.2.1.2 PBX-DSN signaling. This option is for switches that use the DSS1 access protocols to interface to the DSN. Switches using this option will conform to ANSI T1.602, ANSI T1.607 as modified by NIU 90-302, and ANSI T1.608. Signaling for supplementary services shall conform to the standards indicated in paragraph 4.2.

5.2.1.3 PBX-PBX signaling. This option is a design objective. It is based on extensions to DSS1 to allow PBX-to-PBX networking. This work is being done by ISO IEC JTC1/SC6/WG6. See paragraph 4.4.3.

5.2.2 Network data transmission capabilities. ISDN will provide clear channel (i.e., unrestricted) 64 kbps transmission. All switches and service providers shall support unrestricted 64 kbps transmission.

5.2.2.1 Compatibility transfer. Switches and networks shall convey the Low Layer Compatibility and High Layer Compatibility Information Elements, as defined in ANSI T1.607, from one user to the other.

5.3 User-to-network interface. The user-to-network interface consists of the physical interface, the signaling, and the user information that is carried over it.

5.3.1 Analog access. For mixed systems (containing both ISDN and analog access), the switch shall support a variable mix of analog and ISDN lines. Analog voice data will be encoded with 64 kb/s pulse code modulation with mu-law companding as defined in CCITT Recommendation G.711.

5.3.2 Basic rate physical interface (Layer 1). The line signal at the U reference point shall conform to NIU 89-101 which adopts ANSI T1.601 or (for short wire runs) the line signal at the S/T reference point shall conform to NIU 89-105 which adopts ANSI T1.605. Multiple terminal operation at the S reference point shall comply with ANSI T1.605. Proposed switches shall be capable of terminating both the U and S/T interfaces.

NOTE:
Depending on the distances between terminals and switches, either the short-distance S/T interface or the long-distance U interface may be used. However, some layouts will require long wire runs and the U interface must be available since it may be difficult to predict future requirements. Paragraph 40.2.1 of Appendix A contains more information on this subject.

5.3.2.1 Basic rate test suite. All terminals operating at the Basic Rate Interface at the S/T reference point, shall conform to the ICOT test suite: NIU/90-002 (also designated ICOT/90-40). (This is contained in NIST Special Publication 500-194.) All terminals operating at the Basic Rate Interface at the U reference point, shall conform to the ICOT test suite contained in NIST Spec Pub 823-2.

5.3.2.2 Connector. Terminal equipment operating at the Basic Rate Interface, shall use a connector as defined in ISO standard ISO 8877. The use of this connector shall conform to ANSI T1.601. This connector shall be used at both the S/T and U reference points.

5.3.3 Primary rate physical interface (Layer 1). The PRI physical interface (1.544 Mb/s in North America) shall conform to NIU 91-103R1 which adopts ANSI T1.408. For testing, the ICOT/91-53 test suite applies to PRI terminal equipment.

5.3.4 Link layer signaling (Layer 2). All equipment shall use Link Access Protocol D (LAPD) which conforms to NIU 89-210 which adopts ANSI T1.602.

5.3.5 Circuit-switched control signaling (Layer 3). All equipment shall conform to ANSI T1.607 as modified by either NIU 90-301 for BRI Class I, or NIU 90-302 for PRI Class II, as applicable. See paragraph 3.2 for a definition of Class I and II. The NIU agreements do not support bit rates above 64 kb/s. The implementation of additional bearer services as listed in paragraph 4.1.2 shall conform to ANSI T1.607.

5.3.5.1 High layer compatibility information element. All terminal equipment shall transmit and receive the Higher Layer Compatibility Information Element in a SETUP as defined in ANSI T1.607. Voice terminals shall indicate telephony as a default. Terminals that transmit data shall allow the user to set appropriate values in the fields within this information element.

5.3.6 Packet-switched control signaling. Network equipment and services shall include a packet-switching capacity in conformance with ANSI T1.608. Conditional notification, as defined in T1.608, shall be supported on circuit-switched access connections.

5.3.7 Supplementary service call control. Supplementary service call control shall conform to ANSI T1.610, Appendix B and the applicable standards indicated in paragraph 4.2.

5.3.8 Frame relay packet-switching. Frame Relay services shall conform to ANSI T1.606 (including the addendum to T1.606), ANSI T1.617, and T1.618. In all offerings, data link connection identifiers (DLCI) will have local significance rather than global significance. If Permanent Virtual Connection services are required, they shall conform to Annex B of ANSI T1.617.

5.4 Management and maintenance functions. All maintenance systems shall conform to the following standards, if applicable:

ANSI T1.216	ISDN Management--Basic Rate Physical Layer
ANSI T1.217	ISDN Management--Primary Rate Physical Layer
ANSI T1.218	ISDN Management--Data Link and Network Layers
ANSI T1.219	ISDN Management--Overview and Principles

The following draft standards are design objectives:

T1M1.2/90-004R1	User-Network Interface Protocol Profile for Management (advancing to become Q.941)
T1M1.2/90-075	ISDN Management, Managed Objects
T1M1.2/90-105	ISDN Management, Service Profile Management/Service Profile Verification

T1M1.2/90-106 ISDN Management, Local Loopback

T1M1.2/90-107 ISDN Management, State Change Management

NOTE

Commercial standards for network management are in the formative stages and should be used as preliminary guidance. In the Federal Government, a Federal Information Processing Standard (FIPS), Government Network Management Profile (GNMP) and a military standard, MIL-STD-2045-38000, Network Management for DoD Communications were nearing completion at the time of publication of this ISDN Profile. When published, the provisions of these documents should be considered in ISDN acquistions.

5.5 DSS1 - DSN No. 7 interworking. Interworking between the user-to-network signaling and the switch-to-switch signaling shall conform to ANSI T1.609.

5.6 Human-to-terminal interface. All voice terminal equipment shall conform to CCITT Recommendation E.180.

5.7 Terminal adaptation. For non-secure applications, terminal adaptation shall follow NIU/91-0001, which adopts ANSI T1.612.

5.8 Performance specifications.

5.8.1 Circuit-switching performance. Circuit-switching performance shall be specified in accordance with ANSI T1.507.

5.8.2 Packet-switching performance. Vendors shall specify the performance of the products and shall explain how these values have been derived. Packet-switching performance shall be specified in accordance with T1.504.

NOTE:

One area that should be carefully evaluated is packet-handling performance requirements. Each RFP should contain estimates of packet traffic requirements to serve as a basis for evaluating the capacity of proposed services and products.

5.8.3 Voice transmission performance. The acoustic-to-digital and digital-to-acoustic transmission performance of ISDN terminals shall conform to EIA/TIA Standard 579-1991, Acoustic-to-Digital and Digital-to-Acoustic Transmission Requirements for ISDN Terminals.

5.9 Numbering plan. Equipment shall be able to handle up to a 15 digit numbering plan. The numbering plan shall follow CCITT Recommendation E.164. The DOD ISDN shall use the DSN Worldwide Numbering and Dialing Plan (DSN-WNDP) as defined in DCAC 370-V175-6, Defense Switched Network (DSN) System Interface Criteria for both circuit-switched and packet-switched services.

5.9.1 Numbering plan default. Terminals shall allow the user to set either the North American Numbering Plan or the DSN-WNDP as the default numbering plan for the terminal. The use of the alternative numbering plan shall necessitate only one keystroke to select that plan.

5.9.2 Private numbering plan support. For calls to DSN numbering plan addresses, octet 3 of the called party number information element shall use the type of number: "subscriber number" (100) and the numbering plan: "private numbering plan" (1001). The calling party number information element shall use the same codepoints when appropriate.

6. NOTES.

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

6.1 Intended use. The particular standards or recommendations that are applicable are a function of the equipment or services being procured. Switch-to-switch signaling recommendations (Signaling System No. 7) are not applicable to terminal equipment procurements. On the other hand, the recommendations cited here do apply to switch and service procurements. Testing requirements shall also be evaluated in terms of the individual site requirements.

6.2 Spare capacity. There should be (at least 20 percent) spare capacity (both memory and processing capacity) for enhancements, or a clearly defined and relatively inexpensive method of increasing these capacities.

6.3 Desirable service availability. The scheduled availability of any desirable services that are planned by the vendor, should be indicated in proposals.

6.4 Numbering plan. This paragraph discusses the DOD dialing and numbering plans. The difference between these two plans must be understood. The numbering plan is the address or identity of each terminal. In general, each terminal has one address, independent of where the calling party is. The dialing plan includes everything that a user must dial to make a call. In addition to the number described above, the user might have to dial:

a. A preface to indicate that an unusual class of address is to be transmitted, e.g., 011 to preface an international call or 1 to preface a 10-digit number

b. A precedence digit to indicate the MLPP precedence level

c. A "quality" indicator to obtain routing on special trunks for digital information (This indicator exists on the DSN but has no meaning in an ISDN.)

In ISDN, this information will not be carried within the address but rather will be carried in various information elements. For example, the precedence level will be carried in the MLPP Information Element.

DOD ISDN will use the DSN Worldwide Numbering and Dialing Plan (DSN-WNDP) as defined in the Defense Switched Network (DSN) System Interface Criteria. This will allow users to retain their old phone numbers when a switch is upgraded or replaced. Consequently, ISDN switches will simply use either the old central office codes or new ones depending on the circumstances of the installation.

This numbering plan uses the format of the North American Numbering Plan, which is composed of 10 digits and is organized as follows:

a. 3 digits - Area Code
b. 3 digits - Central Office Code
c. 4 digits - Line Number

6.5 Subject term (key word) listing. The following key words and phrases apply to MIL-STD-188-194:

acquisition
basic call control
basic rate interface
conformance test
customer premises equipment
data link layer
implementation agreements
Integrated Services Digital Network
ISDN
LAPD
network layer
physical layer
primary rate interface
S/T interface
specification
telephone standards
terminal adaptor
terminals
U interface

6.6 Functional tests. Possible functional tests that might be included are:

a. A circuit-switched data call from a terminal to another local terminal or terminals on the public network

b. B and D channel packet calls from sample-procured terminals to terminals on the public network

6.7 Future profiles. Future versions of this profile will address additional subjects as additional standards are approved. Among the areas expected to be refined are: network management, Broadband-ISDN, SONET, interoperability with tactical systems, interoperability with cellular telephones, interoperability with personal telecommunications equipment, and human factors.

6.8 NIU Forum. The stated objectives of the NIU-Forum are to provide an open forum giving users the opportunity to influence the developing ISDNs

to reflect their needs; to identify ISDN applications, develop implementation agreements, and to facilitate their timely and harmonized implentation; and to solicit user, product provider, and service provider participation in this process.

Further information about the NIU-Forum can be obtained by contacting:

Ms. Dawn Hoffman, NIU-Forum Secretariat
National Institute of Standards and Technology
Building 223, Room B-364
Gaithersburg, MD 20899
(301) 975-2937

FOREWARD TO THE APPENDICES

Appendix A is a tutorial providing an overview of the protocols used by ISDN. Mandatory Appendix B is the text of Defense Switched Network (DSN) No. 7, Common Channel Signaling. Additional appendices will be added from time-to-time to provide summaries of protocols planned for inclusion in future versions of this Profile. Each summary will state the requirements for including the protocol in the Profile and a plan of work to meet those requirements.

Criteria covering the areas listed below are candidates for inclusion in a future version of this Profile. Candidates will be included in the basic document if commercial standards have been completed. If not, they will be addressed in an appendix as described above.

a. Supplementary Services
b. Network Management
c. Private Networking (PBX-to-PBX Signaling)
d. Application Software Interfaces
e. Performance
f. Interface with Tactical Systems
g. Security

Appendix A is provided for information. Appendix B is a mandatory part of this standard.

APPENDIX A

OVERVIEW OF ISDN

This appendix contains general information in support of MIL-STD-188-194. Appendix A is not a mandatory part of this standard.

APPENDIX A

10. SCOPE. Tutorial information related to ISDN.

20. APPLICABLE DOCUMENTS. Applicable documents for this appendix are listed in paragraph 2 of the basic standard.

30. DEFINITIONS. Definitions for this appendix are listed in paragraph 3 of the basic standard.

40. GENERAL INFORMATION ON ISDN. This appendix provides an architectural overview of the ISDN protocols. Paragraph 40.1 discusses the OSI model and some extensions to it that were necessitated by ISDN. The remaining paragraphs present an overview of the protocols used by ISDN, the physical layer, the link layer, and the Layer 3 call control.

40.1 ISDN and the OSI model. Many authors refer to the OSI model, but all models and laws are subject to interpretation and the OSI model leaves considerable room for this. For ISDN, considerable extension of the OSI model, both explicit and implicit, has been done. This paragraph describes some of these extensions.

The OSI 7 layer model was derived in the context of computer data communications. For example, from the data communications point of view, everything required to get bits from one end of a line to the other was "Layer 1." This included physical connectors, modems, phone lines, central office switch connections, and all of the equipment used by the phone company. Naturally, when the telephone community applied this model to what they were doing, it was not an easy task; ISDN only complicated matters.

The two key characteristics of ISDN, which make the application of the OSI model difficult, are:

a. The use of out-of-band signaling. One of the assumptions of the OSI model is that the control data for a connection is "mixed in" with the data. In contrast, ISDN control information, for circuit-switched (CS) call control is placed in a separate "D Channel."

b. The consideration of those "Layer 1" objects, which were often overlooked, such as private branch exchanges (PBXs) and switches. It may be argued that this is not an ISDN issue; however, it is ISDN that brings the data and voice issues together.

It has, therefore, become necessary to define several other planes in addition to the user data plane (the "U" plane). CCITT Recommendation I.320, ISDN Protocol Reference Model, defines the Control Plane (the "C" plane) and the Management Plane (the "M" plane). The assignment of layer is sometimes approximate. For example, CCITT Recommendation Q.931 and ISUP (ISDN user part of SS No. 7) carry roughly the same information and are assigned to different

layers. It must be pointed out that when CCITT Recommendation I.320 discusses control information, it is considering the information necessary to control circuits. Further, the CCITT does not usually consider private switching gear; thus, control information for private networks, as well as the upper OSI levels, is considered user information in this context.

40.2 The physical layer (Layer 1). There are two physical interfaces for narrowband ISDN:

1. Basic Rate Interface - This uses 2-wire transmission to provide 2B + D.

2. Primary Rate Interface - This uses the current 4-wire T1 transmission to provide 23B + D (or other configurations) to the user.

40.2.1 Basic Rate Interface. The Basic Rate Interface is the standard network-to-user interface for individual terminal users. It provides 2B + D to the user. There are several important reference points on this interface, the U and the S/T reference points (see Figure 1).

The U reference point on the Basic Rate Interface uses 2 wires and can transmit over relatively long distances (18,000 feet). Signals can be transmitted in both directions simultaneously over this one pair of wires. Echo cancellation is used to separate the incoming signal from the outgoing signal.

In most of the world, the NT1 (the device that handles the actual transmission and reception of bits on the wire) is considered part of the network and is not subject to standardization. In the U.S., the Federal Communications Commission (FCC) ruled that the NT1 is Customer Premises Equipment (CPE) and, therefore, the line side of the NT1, the U reference point, is also subject to standardization. This standard was written by T1D1.3, the current T1E1.4, and is now approved by ANSI as the American National Standard, T1.601.

The S and T reference points exist at the user side of the NT1. The S reference point is defined between the NT1 and a TE. The T reference point is defined between an NT2 (PBX or other switching device) and the network. The distinction between the S and T reference points was created at a time when it appeared that this would be significant. As the standards were developed, the distinction between the S and the T reference points became minor and all of the signaling standards refer to the S/T reference point. In the U.S., this has become the S/T/U reference point since, in some implementations, the S and T points are virtual. This is a consequence of building the TE and the NT1 into one device.

The S/T interface works across relatively short distances (on the order of

APPENDIX A

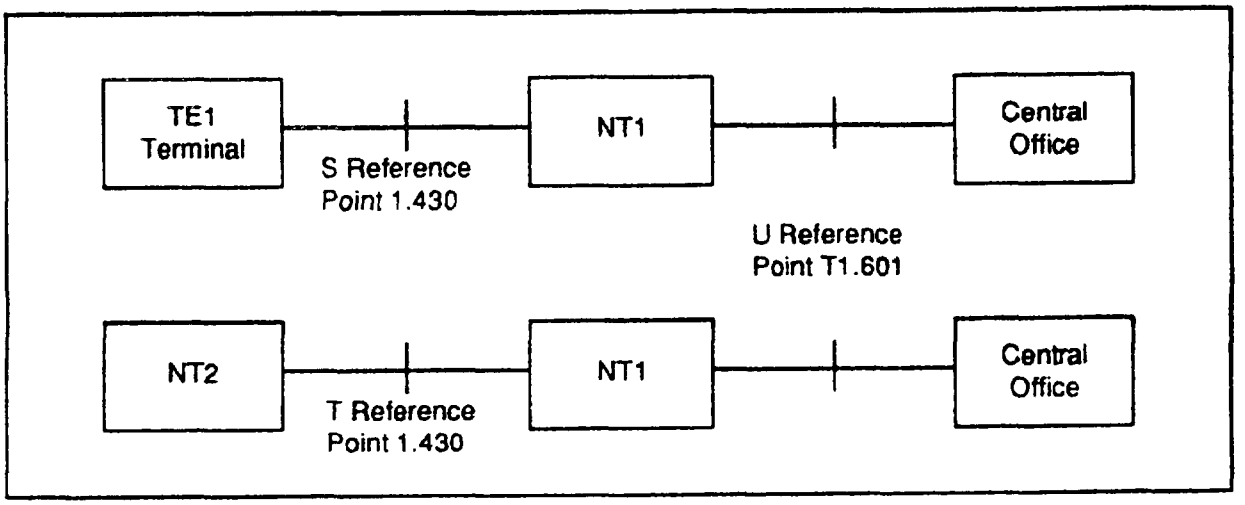

Figure 1. Basic Rate Interface

several hundred feet). This interface is described in CCITT Recommendation I.430. This is an 8-wire interface, in which 2 wires are used to transmit in each direction and the other 4 wires are available to carry power. Because only 4 of the 8 wires are used to actually transmit signals, this interface is commonly referred to as a 4-wire interface. This should not be confused with the true 4-wire Primary Rate Interface (PRI) described in the following paragraph.

40.2.2 Primary Rate Interface. The PRI uses the current T1-based technology, which follows CCITT Recommendation G.703. I.431 is the CCITT recommendation for the Primary Rate User-Network Interface. This uses 4 wires to provide 1.544 Mbps, which, when overhead is subtracted, becomes 1.536 Mbps of channel structure or 24 times 64 kbps. This may be used as various combinations of B channels, a D channel, and possibly H channels. (e.g., 23 B + D, or 1 H_0 + 17 B + D).

40.3 Link layer - (Layer 2). Link Access Procedure D (LAPD), also designated CCITT Recommendation Q.921 and I.441, is the CCITT recommendation for the Layer 2 protocol on the D channel of ISDN. It is an extension of Link Access Protocol B (LAPB), the Layer 2 protocol of X.25. The main extensions are the following:

a. Address field - The 1-octet address in LAPB is expanded to 2 octets (13 bits are actually used).

b. Window size - While LAPB allowed both 3 and 7 bit windows (the number of unacknowledged frames allowed), the latter was practically never used and 3 bit windowing (modulo 8) was the norm. However, LAPD supports only 7 bit windows (modulo 128).

40.3.1 LAPD addressing. LAPB has a 1 octet address field which is not really used. LAPD uses a 2 octet field. The first octet carries a Terminal Equipment Identifier (TEI) allowing multipoint operation. The second octet carries a Service Access Protocol Identifier (SAPI) allowing separate, independent frame windows for each separate function (e.g., call control versus packet traffic).

40.3.2 LAPD windowing. While X.25 LAPB allowed both 3 and 7 bit windows, there were never any commercial HDLC (High-level Data Link Control) chips that fully supported the larger windows. The "window" is the number of frames or packets that may be outstanding at one time. A 3 bit window means that up to 7 frames can be outstanding. This was found to be adequate for many applications but not for satellite links where the long propagation delay necessitates larger windows. Thus, 7 bit windowing (allowing 127 outstanding frames) was chosen for LAPD.

40.4 Circuit-switched call control (Layer 3). T1.607 is the American

APPENDIX A

National Standard for Layer 3 protocol for circuit-switched call control at the user-to-network interface. It is used for signaling between a user and a switch on the D channel. When signaling information is transported between switches, it is transported by SS No. 7, the Interexchange Signaling Standard (The Q.700 series or T1.110-T1.116).

40.4.1 Call control messages. T1.607 contains a small number of messages. Each of these messages has a specific function (e.g., SETUP is used to initiate a call). The following are some of the messages used in call control:

a. SETUP - This is used to initiate a call. Among the data that may be in the SETUP are: called party address, calling party address, requested bearer service, and type of service expected from the called party.

b. PROGRESS - This message is used to notify the calling party about the progress of the call through the network.

c. ALERTING - This message indicates that the SETUP has been received at the destination. For a voice call, this means that the phone would be ringing.

d. CONNECT - This is used to accept a call and create a connection.

e. RELEASE - This is used to terminate a call.

f. RELEASE COMPLETE - This is the response to RELEASE and is the final message in a call.

A complete list of the messages, and the information elements they can contain, may be found in Paragraph 3 of T1.607.

40.4.2 Information elements. Each message can contain various information elements (IEs). Some IEs are mandatory, others are optional. These are used to convey information, such as called party number and the type of service desired. The number of these IEs is relatively large and open-ended. For example, a SETUP message may contain the following IEs:

a. Called Party Number - to indicate the call destination

b. Calling Party Number - to indicate the call origination

c. Channel Identification - to indicate which channel is to be assigned to the call being set up

d. Bearer Capability - to indicate the service the network should

provide

e. Low Layer Compatibility - to indicate to the destination user the data format, e.g., whether it's packet data or circuit-switched data

f. High Layer Compatibility - to indicate to the destination user the type of application using this connection, e.g., whether it's a voice call, fax, or E-mail.

This is only a partial listing of the possible IEs that can be included in a SETUP message. A complete list of the IEs and their detailed formats may be found in Paragraph 4 of ANSI T1.607 or in CCITT Recommendation Q.931. These messages and information elements constitute the D channel signaling protocol which is used to set up user Layer 1. This protocol is Layer 3 in the control plane and it only exists at the network-to-user interface. Within the network, another signaling protocol, SS No. 7, is used, which may take a completely different route than the user's data.

40.5 X.25 packet-switched call control. ANSI T1.608 is the American National Standard for packet-switched (PS) call control. The technical contents of this standard are based on X.31 (the CCITT recommendation on the use of X.25 terminals on an ISDN), but, editorially, it is more closely patterned on T1.607 so that it is a more independent document and can be read without constant reference to T1.607.

40.5.1 Packet-switching cases. There are a number of different major configurations possible for packet mode. All of the call control in T1.608 is used only to set up part or all of the user Layer 1 connection for an X.25 virtual circuit. Layers 2 and 3 of the user plane are established with X.25 call control, the SABM[1] (or SABME[2]) at Layer 2 and CALL REQUEST for Layer 3. This message flow is depicted in Figure 2. The number of configurations can be confusing, but the ISDN call control (as described in T1.608) is just setting up a connection to a packet handler. The configurations include:

a. Case A - CS access to a Packet-Switched Public Data Network (PSPDN). In this case, the ISDN to which the user is attached (the local network) is providing CS service for this call. The local network is not aware that this is a packet call. Reasons for using this include the possibility that the local network may not provide

[1]Set Asynchronous Balanced Mode - The LAPB command used to initialize a link to be used with 3 bit (modulo 8) windowing.
[2]Set Asynchronous Balanced Mode Extended - The LAPB or LAPD command used to initialize a link to be used with 7 bit (modulo 128) windowing.

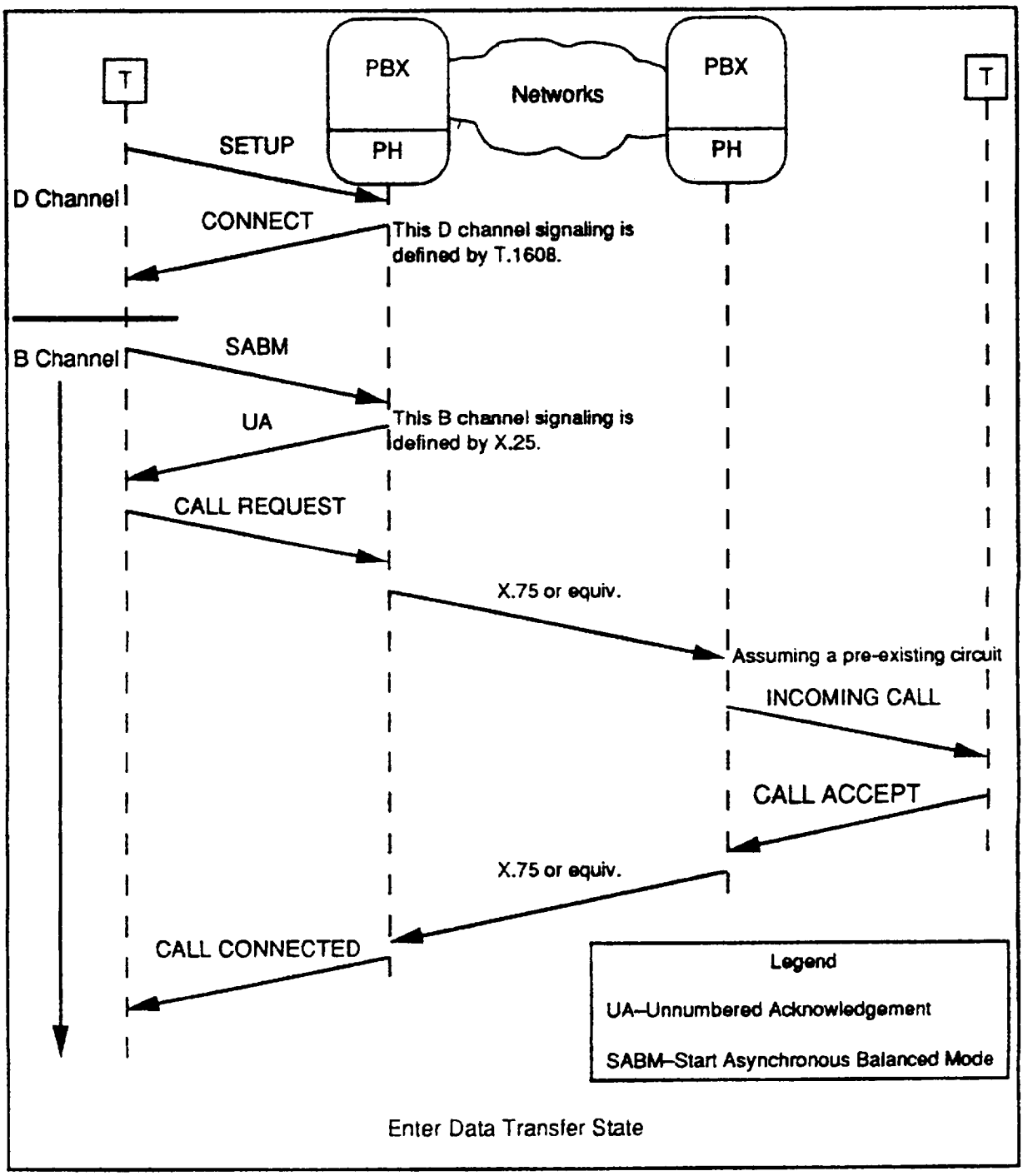

Figure 2. Packet Switched Call Control Signaling
(X.31 Case B, Call Setup of an Outgoing Call on a Demand Access Line)

PS services or another network may provide lower rates. The user must set up a CS call to the PSPDN's Access Unit (AU). Once the CS access exists, multiple virtual circuits may share the access connection.

b. Case B - B channel packet access. This service is provided by the local network. To the user, it appears that the local switch is providing packet services. (The actual implementation of this may be located elsewhere.) The user must set up a PS call to allocate a B channel to the packet access. Once this PS access exists, multiple virtual circuits may share the access connection.

c. Case B - D channel packet access. As in the previous case, this service is provided by the local ISDN. The key difference from the previous case is that the D channel is always set up. Consequently, no ISDN Layer 3 call control is required. The user can start with a Layer 2 SABME (SAPI = 16) on the D channel.

d. Permanent access lines. These unswitched access lines are discussed only briefly in T1.608, since no call control is necessary to set them up. These can be used with either the local service provider or a remote service provider.

Each of these configurations can be used either outgoing or incoming. While this is a large number of cases, the reader should keep in mind that all of these cases are essentially similar--a Layer 1 connection for user data is being set up if the connection does not already exist. Once the Layer 1 connection is established, the normal Layer 2 and Layer 3 information can flow. The following paragraphs discuss these cases in more detail.

40.5.2 Case A - CS access to a PSPDN. This is the case in which the ISDN (to which the terminal is attached) is not providing packet-switching services for the call in question. This was called the "Minimal Integration Scenario" in the 1984 CCITT Red Book recommendations. It assumes that the packet-switching services are supplied by a PSPDN. This PSPDN could be part of a separate ISDN.

For this case, a B channel must be set up as a CS connection to a port of a PSPDN. This is designated as an Access Unit (AU). The call control within the ISDN providing CS access is standard CS call control. The Bearer Services Information Element indicates CS service.

40.5.2.1 Case A - outbound. This is the case of a calling user accessing a PSPDN via CS services from an ISDN. The user issues a SETUP message. Since the ISDN is to provide CS services, the Bearer Capability Information Element (BCIE) would be set to CS. Because there is no end-to-end Q.931/SS7 signaling channel, the Low Layer Compatibility IE will not be used since it could not be transported to the destination user.

The address in the Called Party IE is the address of the AU rather than the address of the destination party. The address of the real destination is used in the CALL REQUEST packet, which is sent after the link to the AU is ready to transfer data. Assuming that the AU accepts the call, a CONNECT would be returned to complete the access connection.

Once the CS access connection is set up, the signaling moves to the B channel. X.25 call establishment is now performed over the access connection. First, the Layer 2 link is initialized with a SABM. Once the Layer 2 link is set up between the user and the AU, the Layer 3 signaling can commence. A CALL REQUEST containing the destination address is now sent. As this progresses through the network, it sets up the packet call.

Additional packet calls may be made on the same access connection. A second CALL REQUEST would initiate another virtual circuit over the same link layer used by the first call.

40.5.2.2 Case A - inbound. The other side of Case A is the inbound side. This is less widely used than the preceding configuration but it is possible. (Since common practice is for terminals to call hosts, called parties are usually at fixed, permanent connections on the packet network.) In this case, the AU of the PSPDN would initiate the access connection to the destination user. The AU would use the data in the CALL REQUEST to assemble the ISDN call control. The called party address would now be the destination, but the calling party address would be that of the AU. Assuming that the conditional notification option had been selected, the reception of additional calls (virtual circuits) would not involve any additional D channel signaling.

40.5.3 Case B - B channel. The second major case of X.25 packet-switching is Case B. This is the case in which the packet service is provided by the ISDN to which the terminal is connected. In the 1984 Red Book, this was designated the "Maximum Integration Scenario." This paragraph discusses the use of Case B on the B channel. The following paragraph discusses Case B for the D channel.

Just as in the previous case, a B (or an H) channel must be set up using call control messages. However, in this case it is between the user and a packet handler within the serving network. A SETUP is issued, but there are some significant differences when compared with Case A. The Bearer Service IE is now set to packet rather than circuit mode since the caller is requesting

packet mode services from the serving ISDN. There is no need for the Called Party Address IE. There is also no need for a Low Layer Compatibility IE. The conveyance of the call by a packet network indicates that it is a packet call.

Once the Layer 1 is established, the X.25 Layer 2 link is initialized with a SABM. Once the Layer 2 link is set up between the user and the packet handler, then the X.25 Layer 3 signaling can commence. An X.25 CALL REQUEST containing the destination address is now sent. As this progresses through the network, it sets up the packet call.

40.5.4 Case B - D Channel. The other part of Case B is packet mode over the D channel. This allows up to 16 kbps of packet data to flow without occupying a B channel. One possible "economy" configuration for ISDN would use two voice terminals (for two separate people), plus two data terminals sharing the D channel, all on one basic rate interface. Most users would be satisfied with that data rate. The protocol implications of D channel packet mode will now be discussed.

Since the D channel always exists (and the switch is assumed to contain the packet function), no ISDN Layer 3 call control is required. A SABME with a SAPI of 16 (packet) is required. This initializes the packet mode window. This would be followed with an X.25 CALL REQUEST. This would contain the destination address and any other necessary control information.

40.5.5 Permanent access. Since these channels are not set up by D channel signaling, there is little discussion of this subject in T1.608. The user notifies the serving network that a permanent-access arrangement is required and it is set up. This could be from the user to the network's packet handler (Case B) or to an Interworking Port of another network (Case A). This is also designated "semipermanent access" in some documents.

40.5.6 Notification. One of the issues on the incoming side of a packet call is notification. Notification involves how a terminal is notified of an incoming call. This may be done with an ISDN message (an incoming SETUP) or only the X.25 message (INCOMING CALL). There are three possible classes of notification:

a. No Notification - No ISDN Layer 3 (Q.931) messages are sent.

b. Conditional Notification - ISDN Layer 3 (Q.931) messages are sent when a circuit is set up or released.

c. Unconditional Notification - An ISDN Layer 3 message is sent for every incoming call even when no additional circuit is required.

These notification classes differ as to whether ISDN Q.931 messages are used.

These messages are on the access connection. Each X.25 connection requires an X.25 Call Request to initiate the call.

For semipermanent access, since there is no D channel, no D channel signaling is possible. Since the circuit already exists, such signaling is also superfluous. Thus, No Notification is the only possible option.

For Demand access, the D channel call control is required to allocate circuits. Either Conditional or Unconditional Notification could be used. Since the notification contains no information that is not in the X.25 Incoming Call packet, there is no reason to generate a SETUP when no additional circuit is required. Therefore, the use of Conditional Notification is recommended.

40.6 Frame Relay. Frame Relay is a new packet mode service. It takes advantage of the superior error performance of fiber-optic transmission by eliminating the step-by-step error detection and retransmission of previous protocol systems. While each step does error detection, retransmission is done from the endpoints only, or no retransmission is done at all. This allows the intermediate or transit nodes to forward packets with less processing and less transit delay as compared with X.25 networks.

The standards for this service are T1.606 for the service description, T1.617 (CCITT Q.933) for the signaling to set up a call, and T1.618 (CCITT Q.922 Annex A) for the data transfer state information.

40.6.1 Frame relay services. Frame Relay is based on LAPD. There are several possible versions of this service that may become available. The primary emphasis in the U.S. is on a service in which the network is a nonreliable service. That is, it accepts packets (or frames) at one end and tries to deliver them to the other end, but if the cyclic redundancy check on the frame fails, the frame is discarded and no retransmission is attempted. Send and receive counts in the header (windows) are not used by the network. This type of service is appropriate for packet voice or video where the loss of a few bits of data is not important and the variable delay introduced by retransmission is a problem. If the user wants a reliable data link, the user can use the full Q.922 frame control (two additional octets of windows with the Q.922 procedures).

40.6.2 Frame switching. Another possible service, designated Frame Switching, is closer to today's conventional packet service. It is reliable, i.e., it delivers all packets intact across the network. Any packet that is corrupted by a line error is retransmitted. The windows are rotated by the endpoints of the connection. This service is an X.25 replacement for data services. One layer of protocol provides the equivalent of Layers 2, 3, and 4. This service has been emphasized more in Europe than in the U.S.

APPENDIX B

DSN No. 7 Common Channel Signaling

This information in this appendix is a mandatory part of MIL-STD-188-194.

APPENDIX B

10. SCOPE. This appendix specifies Defense Switched Network (DSN) No. 7 Common Channel Signaling

20. APPLICABLE DOCUMENTS. Applicable documents for this appendix are listed in paragraph 2 of the basic standard.

30. DEFINITIONS. Definitions for this appendix are listed in paragraph 3 of the basic standard.

40. GENERAL INFORMATION ON DSN No 7 . The following DSN No. 7 specification is contained in Paragraph 7.8 of the Defense Switched Network (DSN) Generic Switching Center Requirements (GSCR). The numbering and format from the GSCR have been retained for ease of use.

7.8 Common Channel Signaling-DSN No.7 CCS.

7.8.1 ANSI T1.110.1 - Overview of the Signaling System. The DSN No.7 CCS conforms to the Signaling System Number 7 (SS7) overview provided in ANSI T1.110, Chapter 1. An overview of DSN specific requirements is provided in the following paragraphs, citing the applicable paragraphs of the standard, e.g., 1.0.

a. 1.0 Introduction. The DSN No.7 CCS network shall be compatible with the national signaling networks based on the ANSI T1.100 series of standards and shall be capable of interworking with networks based on SS7, as standardized internationally in the Blue Book (1988) by the International Telephone and Telegraph Consultative Committee (CCITT) (i.e., CCITT SS7).

The DSN No.7 CCS consists of the following American National Standard Institute (ANSI) communications protocols: (1) Message Transfer Part (MTP), (2) Signaling Connection Control Part (SCCP), (3) ISDN-User Part (ISDN-UP), (4) Transaction Capability Application Part (TCAP), (5) Monitoring and Measurements, and (6) Operation and Maintenance Application Part (OMAP). These protocols shall provide the capability necessary to meet DSN requirements for ISDN-based services, circuit-switched call control, and signaling network management.

b. 2.0 Scope, Purpose and Application.

(1) 2.1 Objectives and Fields of Application.

(a) Objectives. The objectives of the CCS No.7 implementation in DSN go beyond basic circuit-switched call control signaling. DSN No.7 CCS emphasizes supporting ISDN advanced capabilities. This support directly applies to the DSN management, administration, and operation applications, and lays the groundwork for the present and future requirements

for information transfer in DSN. The general objective of DSN No.7 CCS system is to provide standardization of CCS No.7 system in the DSN.

The DSN-specific objective is to provide the universal signaling protocol for use throughout the entire DSN; Signaling Gateways within the DSN network between the major geographical areas will not be required.

It is anticipated that interconnections will be made with both public and military networks in the DSN host countries. Signaling Gateways may be required between the DSN and these interconnecting areas. These interface requirements shall be based on the DSN No.7 CCS protocol, DSN User-Networkk Signaling Protocol, and the DSN Interface Criteria.

(b) Applications. In general, the DSN No.7 CCS system meets DSN requirements for call control signaling of telecommunication services (such as telephone and circuit-switched data transmission services). It can also provide a reliable transport system for information transfer between exchanges and specialized centers in the DSN (e.g., for management and maintenance).

The system is optimized for operation over 64 kilobits per second (kb/s) digital channels and is suitable for use on point-to-point and point-to-multipoint terrestrial and satellite links. The DSN No.7 CCS system is intended to be implemented with components developed in commercial applications that follow the ANSI standards for CCS No.7. Specifically, DSN No.7 CCS applies the necessary protocols applicable to services essential for DSN, such as Multi-Level Precedence and Preemption (MLPP), Conferencing (i.e., Preset), Community of Interest, Management, and transfer of data different from signaling data.

(2) 2.2 General Characteristics. Critical characteristics for the DSN are operability and reliability. The DSN No.7 CCS standardizes a number of features contributing to high operability and reliability, such as decentralized distributed architecture, uniform management protocol, error detection and correction, redundancy of signaling links and nodes, and diversion of signaling traffic to alternative paths.

(3) 2.3 Modularity. DSN No.7 CCS is a subset of the modular structure of CCITT SS7. The following specifications represent the set of features standardized for DSN No.7 CCS in the DSN. They are derived from the ANSI standards for the U.S. SS7 system, which is one of a set of national standards based on CCITT. The CCITT SS7 includes a wide range of functions, of which the ANSI SS7 is a subset. The DSN No.7 CCS includes the ANSI SS7 features and extends to meet specific DSN requirements.

c. 3.0 Signaling System Structure.

APPENDIX B

(1) 3.1 Basic Functional Division. The basic composition of functional blocks applicable to DSN No.7 CCS consists of the ANSI specified protocols, a subset of the functional blocks (protocols) found in the CCITT Blue Book (Q.700 series). These blocks are: MTP, ISDN-UP, SCCP, TCAP, OMAP, and Monitoring and Measurements. The fundamental principle of this structure is the division of the functions into the MTP and SCCP, which serve as transport systems for transfer of signaling messages, and the user parts--ISDN-UP, TCAP, OMAP and Monitoring and Measurements--which directly or indirectly utilize the capabilities provided by the MTP.

(2) 3.2 Functional Levels. The protocol needed for DSN No.7 CCS is compatible with the model specified by the ANSI T1.110 standard, and can be related to the seven-layer Open System Interconnect (OSI) Reference Model (RM), as described in the above standard.

d. 4.0 DSN No.7 CCS Specification Guide.

(1) 4.1 Support Information. The DSN No.7 CCS specifications are based on Issue 1 of ANSI SS7 Standards finalized in 1987 and 1988, plus the revisions being developed for Issue 2. The specifications are subdivided as shown in the following paragraphs. Each specification fully incorporates the applicable standard, except where explicitly noted in the subsections of the applicable specification. In these subsections, particular options, procedures, or parameters specific to the DSN are specified.

(2) 4.2 Message Transfer Part (MTP). The MTP of the DSN No.7 CCS shall be as specified in Section 7.8.2. The MTP Specification is subdivided into the following subsections, which correlate to chapters in ANSI T1.111: (1) 7.8.2.1, ANSI T1.111.1- Functional Description of the Signaling System Message Transfer Part (MTP); (2) 7.8.2.2, ANSI T1.111.2-Signaling Data Link; (3) 7.8.2.3, ANSI T1.111.3-Signaling Link (MTP); (4) 7.8.2.4, ANSI T1.111.4-Signaling Network Functions and Messages (MTP); (5) 7.8.2.5, ANSI T1.111.5-DSN Signaling Network Structure (MTP); (6) 7.8.2.6, ANSI T1.111.6-DSN Message Transfer Part Signaling Performance (MTP); (7) 7.8.2.7, ANSI T1.111.7-DSN Testing and Maintenance (MTP); and (8) 7.8.2.8 ANSI T1.111.8-Numbering of Signaling Point Codes (MTP).

(3) 4.3 Signaling Connection Control Part (SCCP). The SCCP of the DSN No.7 CCS shall be as specified in Section 7.8.3. The SCCP Specification is subdivided into the following subsections, which correlate to chapters in ANSI T1.112: (1) 7.8.3.1, ANSI T1.112.1-Functional Description Of The Signaling Connection Control Part (SCCP); (2) 7.8.3.2, ANSI T1.112.2-Definition and Function of SCCP Messages (SCCP); (3) 7.8.3.3, ANSI T1.112.3-SCCP Format and Codes (SCCP); and (4) 7.8.3.4, ANSI T1.112.4-Signaling Connection Control Part Procedures (SCCP).

(4) 4.4 Integrated Services Digital Network (ISDN) User Part

(UP). The ISDN-UP of the DSN No.7 CCS shall be as specified in Section 7.8.4. The ISDN-UP Specification is subdivided into the following subsections, which correlate to chapters in ANSI T1.113: (1) 7.8.4.1, ANSI T1.113.1-Functional Description of ISDN User Part (ISDN-UP); (2) 7.8.4.2, ANSI T1.113.2-General Function Of Messages and Signals; (3) 7.8.4.3, ANSI T1.113.3-Formats and Codes; (4) 7.8.4.4, ANSI T1.113.4- Signaling Procedures; and (5) 7.8.4.5, ANSI T1.113.5-Performance Objectives In The ISDN Application.

(5) 4.5 Transaction Capabilities Application Part (TCAP). The TCAP of the DSN No.7 CCS shall be as specified in Section 7.8.5. The TCAP Specification is subdivided into the following subsections, which correlate to chapters in ANSI T1.114: (1) 7.8.5.1, ANSI T1.114.1-Functional Description and Transaction Capabilities (TCAP); (2) 7.8.5.2, ANSI T1.114.2- Definition and Function Of Transaction Capabilities Messages (TCAP); (3) 7.8.5.3, ANSI T1.114.3-TC Format and Codes (TCAP); and (4) 7.8.5.4, ANSI T1.114.4-Transaction Capability Procedure (TCAP).

(6) 4.6 DSN No.7 System Management. The DSN No.7 CCS Monitoring and Measurements shall be as specified in Section 7.8.6.1, ANSI T1.115-Monitoring and Measurements of SS7. The DSN No.7 CCS Operations, Maintenance and Administration Part (OMAP) shall be as specified in Section 7.8.6.2, ANSI T1.116-Operations, Maintenance and Administration Part (OMAP).

7.8.2 DSN No.7 CCS Message Transfer Part (MTP). The DSN No.7 CCS Message Transfer Part (MTP) shall be as specified in ANSI T1.111-1988, Chapters 1-8. Specific requirements for DSN application are given in the following subsections.

7.8.2.1 ANSI T1.111.1-Functional Description of the Signaling System Message Transfer Part (MTP). The Functional Description of the DSN No.7 CCS Message Transfer Part (MTP) shall be as specified in ANSI T1.111.1. DSN specific requirements are specified in the following paragraphs, citing the applicable sections of the standard, e.g., 2.0.

a. 2.0 Signaling System Structure.

(1) 2.2 Functional Levels.

(a) 2.2.2 Signaling Data Link Functions (Level 1). The Signaling Data Link is a bidirectional digital transmission path comprised of digital signaling links. A maximum of 72 Digital Signaling Links* shall be supported at an individual DSN Signaling Point (SP). Because of its worldwide scope, the DSN No.7 shall support both terrestrial and satellite transmission for the Signaling Data Links at bit rates of 56 or 64 kb/s. These functions are specified in detail in ANSI T1.111.2.

*Note: A future expansion on the number of signaling links supported

by a DSN SP is not prevented by this specification.

(b) 2.2.3 Signaling Link Functions (Level 2). The DSN Signaling Link Functions apply to both terrestrial and satellite transmission. These shall require the implementation of both types of error correction methods specified in Signaling System No.7: the Basic Error Correction method for use on terrestrial Signaling Data Links and the Preventive Cyclic Retransmission method for use on Satellite Signaling Data Links. Detailed requirements are specified in ANSI T1.111.3.

(c) 2.2.4 Signaling Network Functions (Level 3). The DSN Signaling Network Functions include the Signaling Message Handling and Signaling Network Management requirements. The DSN network architecture imposes special requirements on the routing, addressing, and management of the CCS network. A detailed specification of signaling network functions is found in T1.111.4. Network testing information is found in T1.111.7.

b. 3.0 Signaling Network.

(1) 3.1 DSN Basic Concepts and Features.

(a) 3.1.2 Signaling Modes. The DSN Network structure is based on an associated architecture with decentralized STP capability. The signaling network replicates the connectivity of the switched network it serves. Each trunk group in the network is assigned one associated signaling channel. The associated mode of signaling is thus the first choice to establish a signaling relation between adjacent signaling points. The decentralized STP capability provides quasi-associated signaling as a backup to the associated signaling link in case of link failure or other unavailability, or as a second choice to establish adjacent signaling point signaling relations. Signaling relations between non-adjacent signaling points may be established by the Signaling Connection Control Part (SCCP).

One Signaling Data Link is required between any two adjacent signaling points. Backup to this signaling link is provided by utilizing a quasi-associated route until a new direct link is available. When a path for associated signaling fails, a procedure is started to restore the path by activating and switching into service a new circuit to perform as a Signaling Data Link. This concept results in an associated signaling network architecture with quasi-associated capability.

(b) 3.1.3 Signaling Point Modes. The common channel signaling equipment associated with each DSN nodal switch shall provide the functions of a Signaling Point (SP) and Signaling Transfer Point (STP), unless specifically noted otherwise. This is designated as a DSN SP/STP node. The DSN nodes, which do not include the STP function, are designated as DSN SP nodes. A DSN SP/STP node has the ability to originate signaling messages, to receive signaling messages from an origination signaling point (node), and to

transfer signaling messages destined for another signaling point node. A DSN SP node without the STP capability can originate and receive signaling messages only. Messages destined to other signaling points are never routed through a DSN SP-only node.

(c) 3.1.4 Message Labeling. The North American Routing Label, which is utilized in the DSN, is optimized for use with a quasi-associated, paired STP network architecture different from the DSN architecture. Section 7.8.2.4 specifies how the routing label is to be used in the DSN Network.

(2) 3.2 Signaling Message Handling Functions.

(a) 3.2.1 Message Routing. Message routing is based on analysis of the routing label of the message in respect to predetermined routing data at a signaling point. This process provides a selection of succession of signaling links for each message-"message route" and/or succession of link sets- "signaling route." Each signaling message route in the DSN is predetermined and fixed at a given point in time. A message routed toward a specific destination in the DSN is always based on the associated signaling links. If the associated link is not available, quasi-associated routing is used based upon a predetermined selection of signaling links that support the first alternate trunk route. This selection proceeds through the remaining predetermined alternate circuit routes until an available supporting link is found.

DSN routing includes load sharing capability, allowing different portions of the signaling traffic sent to a particular destination to be distributed over two or more signaling links in a link set.

A service indicator included in each message provides the potential to use different routing plans for different user parts.

(b) 3.2.2 Message Distribution. Message Distribution is required at all DSN signaling nodes.

(c) 3.2.3 Message Discrimination. This function is not required at the DSN SP-only node.

(3) 3.3 Signaling Network Management Functions.

(a) 3.3.2 Signaling Link Management. In the DSN, where the signaling links are also routed through the circuit switched channels, signaling link management requires DSN- specific implementation guidance.

(b) 3.3.3 Signaling Route Management. In the DSN this function is used for backup signaling and in cases where the primary

associated signaling routes may present difficulties. Implementation of this function in the DSN No.7 CCS requires DSN-specific implementation guidance.

(4) 3.4 Testing and Maintenance Functions. Testing and maintenance in the DSN environment is implementation- specific and requires DSN-specific implementation guidance.

(5) 3.5 Use of the Signaling Network.

(a) 3.5.1 The DSN Signaling Network Structure. The DSN No.7 CCS system provision is planned to be based on associated signaling, supplemented by quasi-associated signaling. The DSN No.7 CCS is seen as a common resource that must meet DSN needs that go beyond each signaling relation. These needs will also require the DSN-specific implementation of quasi-associated signaling to allow the full potential of CCS No.7 to support the DSN communication needs.

(b) 3.5.2 Provision of Signaling Facilities. Redundancy is required within the DSN signaling network. The DSN-specific requirements are implementation dependent and shall be a part of the DSN No.7 CCS implementation guidance.

(c) 3.5.3 Application of Signaling Network Functions. These DSN No.7 CCS functions are a subset of the range of functions offered by the ANSI T1.111 standards. They will depend on the specific needs of the DSN subnetworks, which are spread over several geographical regions. The ANSI T1.111 standard provides for the DSN-preferred signaling modes, specific composition of SPs and STPs, and a degree of Level 3 use dictated by different implementations of DSN No.7 CCS.

7.8.2.2 ANSI T1.111.2-Signaling Data Link. The DSN No.7 CCS signaling data link shall be as specified in ANSI T1.111.2. DSN specific requirements are specified in the following paragraphs, citing the applicable sections of the standard, e.g., 1.0.

a. 1.0 General Information. The DSN No.7 CCS Signaling Data Link is derived from Pulse Code Modulation (PCM) multiplexed channels, circuit-switched transmission channels, and the digital streams of data circuits.

b. 4.0 Interface Specification Points.

(1) 4.2 National/International Applications. The DSN Signaling Data Link shall conform to ANSI T1.111.2. A Signaling Data Link located entirely in North America, shall utilize the North American transmission and equipment standards, and require no framing or Law conversions if interfaced with other U.S. networks. A Signaling Data Links required to interwork with the links specified by CCITT will require

conversion to be fully compatible.

(2) 4.4 Interface Requirements-Analog. Analog signaling is not required in the DSN; therefore, no interface requirements are specified.

c. 5.0 Digital Signaling Data Link. The DSN Digital Signaling Data Link is derived from the 1.544 or 2.048 Mb/s digital path. The latter is the case when the CCITT specified signaling link is required.

The DSN Signaling Data Link is derived from one of the trunk group circuits serving each pair of switching nodes. Access to the link in the DSN implementation shall be provided through the switching matrix. Semi-permanent switched connections shall be utilized in establishing the data link access.

A digital signaling data link shall be made up of digital transmission channels and digital switches or their terminating equipment, providing an interface to signaling terminals.

Selection of Digital Time Slots to serve as signaling channels must be coordinated between both ends of the Signaling Data Link. The order for the selection of backup signaling channels must be similarly coordinated.

d. 6.0 Analog Signaling Data Link. Analog signaling is not required in the DSN.

7.8.2.3 ANSI T1.111.3-Signaling Link (MTP). The DSN No.7 CCS Signaling Link functions and procedures shall be as specified in ANSI T1.111.3. DSN specific requirements are specified in the following paragraphs, citing the applicable sections of the standard (e.g., 5.0).

a. 5.0 Basic Error Correction Method. The DSN shall use the Basic Error Correction Method on links composed entirely of terrestrial transmission media, unless the Preventive Cyclic Retransmission (PCR) method is used as described in paragraph "b" below.

b. 6.0 Error Correction by Preventive Cyclic Retransmission (PCR). The DSN shall use the PCR method when a satellite path is used in a combined link. In the DSN regions where a satellite path is used as an alternate route, the specification does not preclude the use of the PCR for all the links in the region, terrestrial and satellite.

7.8.2.4 ANSI T1.111.4-Signaling Network Functions and Messages (MTP). The DSN No.7 CCS signaling network functions and messages shall be as specified in ANSI T1.111.4. DSN specific requirements are specified in the following paragraphs, citing the applicable sections of the standard (e.g., 2.0).

a. 2.0 Signaling Message Handling.

APPENDIX B

(1) 2.2 Routing Label. The DSN uses the U.S. National Routing Label structure (specified in ANSI T1.111.4) for signaling messages between DSN SPs. The Routing Label shall also be used for routing signaling messages to other U.S. networks that comply with the ANSI SS7 Standard. The U.S. Routing Label is adapted for use in the DSN architecture according to the DSN Signaling Point Code Allocation Plan as specified in Section 7.8.2.8. The DSN Routing Label shall comply with the routing label structure for U.S. networks as shown in Figures 3A and 3B/T1.111.4.

The Network Cluster Member Subfield is assigned by the DSN Network Administrator to identify individual SP/STP as the DSN nodes. When used in this manner, the Cluster Member Subfield code 00000000 is reserved for addressing the DSN SP/STPs.

The Cluster Subfield may also be assigned to a selection of DSN SP nodes to be identified as a group. When utilized in this second manner, the Cluster Member Subfield may, for example, identify a cluster of DSN SP only nodes connected to a single DSN SP/STP or identify all signaling points in a particular geographic area or country. These particular instances of assignments do not limit the implementation of the DSN routing label in specific geographic regions.

The Signaling Link Selection (SLS) Field identifies the link set and individual signaling data link to be utilized as a message between two DSN signaling points. Use of the SLS Field in the DSN is affected by the DSN associated Network architecture and is specified in Section 7.8.2.5.

Interconnection between the DSN and non-U.S. signaling network may require use of the international routing label at the point of interconnection. The requirements for this use and the label translation shall be determined on a case-by-case basis as part of the interconnection agreement.

(2) 2.3 Message Routing Function.

(a) 2.3.1 Signaling Link Selection. The message routing function provides rules for selection of a signaling link for an outgoing message. In DSN No.7 CCS, an outgoing link is a part of combined link set that directly connects two DSN signaling nodes. The link set is determined by the Destination Point Code (DPC) in the message routing label; the particular link is determined on the basis of the Signaling Link Selection (SLS) field.

1. DSN Link Set. A link set in the DSN consists of a collection of signaling links that directly connect two DSN signaling nodes. The associated mode architecture of the DSN requires one signaling link set between any two directly- connected DSN switching center nodes. These DSN Link Sets are categorized at each signaling point as either a Normal Link Set, Current Link Set, or Alternative Link Set. Either a combined or a single link

set is implemented between adjacent DSN signaling nodes.

2. Normal Link Set. The Normal Link Set provides the associated link that directly connects two adjacent DSN signaling nodes. This link set is assigned the highest priority and is always chosen by the routing functions when it is available.

3. Alternative Link Sets. Alternative Link Sets are utilized in the DSN to provide backup quasi-associated signaling capability when the associated signaling link (or a higher priority alternative link set) is unavailable. The priority assigned to the selection of alternative signaling links corresponds to the priority of the alternative routing selection in the circuit-switched network routing table. That is, the alternative signaling link set of the first alternative route for a circuit-switched call is assigned next in priority after the Normal Link set. This process of assignment continues until all Alternative Link Set priorities are assigned.

4. Current Link Set. The Current Link Set is the link set currently assigned to convey signaling messages to a particular destination signaling point. This link set should normally correspond to the current highest priority of link set availability.

5. DSN Signaling Links. The associated mode architecture of the DSN requires an active signaling data link between any two directly connected (adjacent) DSN switching center nodes. Backup is provided by inactive signaling data links, redundancy in signaling terminals, and switched access to other circuits normally used for other purposes (e.g., voice circuits). Automatic allocation of signaling terminals and signaling data links according to the Signaling Network Management procedures of ANSI T1.111.4 generally shall be provided.

(b) 2.3.3 Specifics of DSN Signaling Message Routing. Each DSN SP/STP shall have routing tables that determine the Signaling Link Set and a Signaling Link to be used to convey signaling messages for each Destination Point Code. These tables shall indicate the Current Link Set in use to each DSN destination. Use of associated and quasi-associated signaling is mandated by procedures in the MTP that will provide a signaling relation to all signaling points in the network.

A key requirement is to simplify administration of the DSN SP/STP and DSN SP routing functions. The associated architecture of the DSN allows the signaling routing table to replicate the circuit- switched routing table. That is, for circuit-related calls, selection of an outgoing circuit is translated into selection of the current link set serving that destination point code. The signaling link set selected usually will correspond to the Normal (Associated) Link Set for that destination. When the Normal Link Set

is unavailable, the indication is given of the highest Priority Alternative Link Set available.

Signaling for non-circuit-related purposes shall perform the same translation to the Current Link Set based upon the DPC.

A means shall be provided to reconfigure signaling routing changes in response to changes made to the circuit-switched call routing. Such reconfigurations may consist of the addition and deletion of routes, or changes to the priorities of alternate routes. These updates shall be in agreement with local coordination between the DSN Generic Switching Center and its common channel signaling equipment to ensure the transfer of circuit-switched and signaling routing information.

Agreement between the circuit-switched (call) routing and signaling routing tables does not require that the signaling data must follow the circuit-switched call route. This means that the signaling links associated with the adjacent switch's inter- exchange circuits are designated as part of the Normal Link Set (Highest Priority) for that destination. Alternate routes to that destination in the call routing plan are assigned to the Alternative Link Sets, which may be used for signaling to that destination according to their priority. The Current Link Set for signaling is chosen according to the availability of the Normal and the Alternative Link Sets. For example, a call may use a direct trunk circuit between two switches; however, a failure in the Normal Link Set may require use of quasi- associated signaling over an Alternative Link Set.

This procedure is intended to ensure that the prioritization of call routes and signaling routes is identical. The actual routes selected to serve the call and signaling may differ depending upon availability.

The following procedure is used to select a signaling route. As the DPC of the signaling message is determined, a circuit-related call destination is determined by the designation of the outgoing circuit. The DPC is translated into the link set available at the highest priority. An individual signaling link within the Current Link Set is chosen based on the SLS code.

(c) 2.3.5 Handling Messages Under Signaling Time Congestion. Each message is assigned one of four levels of priority, from 0 (the lowest) to 3 (the highest level). Priorities are assigned by the message's generating user part and are taken into consideration by the congestion control to determine whether a message should be discarded under signaling link congestion conditions. The highest priority is assigned to signaling network management messages (priority 3). Priorities are assigned to categories of messages in the DSN; they could be dynamically reassigned under DSN-specific requirements. For example, the priority 2 assigned to the IAM with the precedence Flash and Flash Override and the priority 1 assigned

to the IAM with the Immediate must be recognized under congestion conditions in the DSN and at the boundaries with other networks.

(3) 2.4 Message Discrimination and Distribution Functions. The Message Discrimination function examines the Destination Point Code of a received signaling message to determine whether or not it is destined to the receiving SP. This function is required in every DSN signaling node equipped with an STP. Message Distribution determines to which user of the MTP a received signaling message will be directed. This function is also required in all DSN signaling nodes.

b. 3.0 Signaling Network Management.

(1) 3.6 Signaling Network Congestion (and Priority Levels). Signaling links and signaling link sets determine the network overall operability during network element congestion. Criteria for the determination of DSN signaling congestion status shall be as specified by ANSI T1.111.4, Section 3.6 for U.S. networks. In case of congestion, IAMs carrying FLASH or FLASH OVERRIDE calls shall be assigned Level 2 and IMMEDIATE calls shall be assigned level 1 in the DSN.

c. 6.0 Changeback.

(1) 6.3 Sequence Control Procedure. The Sequence Control Procedure is not used in the DSN.

(2) 6.4 Time-Controlled Diversion Procedure. DSN No.7 CCS uses the Time-Controlled Diversion procedure for changeover since specifics of the DSN No.7 CCS architecture permit communication with the remote signaling point via a signaling link that became available. As sending of the changeback declaration is impossible when changeback is initiated, the changeback initiating signaling point stops the traffic to be diverted and stores it in a "changeback buffer" for a time T3, then reopens the traffic on the signaling link made available.

d. 11.0 DSN Signaling Link Management. There are three signaling link management methods specified in ANSI T1.111.4. The automatic allocation of signaling data links and signaling terminals shall be the method implemented in the DSN.

e. 12.0 DSN Signaling Route Management.

(1) 12.1 General. The Signaling Route Management procedures are required to control signaling routes in the DSN nodes implemented with the SP/STP function. However, both DSN SP and SP/STP nodes shall be capable of responding appropriately to the receipt of Signaling Route Management messages. For example, a DSN SP node may be required to alter its routing

information in response to a Transfer Prohibited, Restricted, or Allowed message.

The DSN use of Transfer Cluster Prohibited, Transfer Cluster Allowed, or Transfer Cluster Restricted procedures may be allowed by the DSN No.7 CCS specifications. Due to the limited initial use of quasi-associated signaling and clustering, these procedures are viewed as a future enhancement that shall not be precluded by the current implementations.

(2) 12.7 Transfer Controlled Procedure. Transfer Controlled is initiated at a DSN SP/STP node to notify one or more originating signaling points that they should no longer send messages to a destination with a give priority or lower. The Transfer Controlled message is sent in response to receipt of a signaling message, the priority of which is less than the current link congestion status. Suggested timer values shall initially be implemented. The DSN Network Administrator shall have control over timer values to accommodate specific DSN application requirements. A means to control timer value settings shall be provided.

f. 13.0 Common Characteristics of Message Unit (MSU) Formats.

(1) 13.2 Service Information Octet. The Service Information Octet of the MSU contains the service indicator and the subservice field. The subservice field is used to distinguish between internationally coded messages and messages coded according to the DSN standard and also contains an indication of the message priority levels.

(a) 13.2.1 Service Indicator. Not all coded users of the MTP are accommodated by DSN No.7. A listing of the service indicator codings and their current DSN implementation status is shown in the following:

D C B A		DSN
0 0 0 0	Signaling network management messages	YES
0 0 0 1	Signaling network testing and maintenance regular messages	YES
0 0 1 0	Signaling network testing and maintenance special messages	YES
0 0 1 1	SCCP	YES
0 1 0 0	Telephone User Part	NO
0 1 0 1	ISDN User Part	YES
0 1 1 0	Data User Part (call and circuit related messages)	NO
0 1 1 1	Data User Part (facility registration and cancellation messages)	NO

1 0 0 0	Spare
1 0 0 1	Spare
1 0 1 0	Spare
1 0 1 1	Spare
1 1 0 0	Spare
1 1 0 1	Reserved for DSN only use
1 1 1 0	Reserved for DSN only use
1 1 1 1	Spare

(b) 13.2.2 Subservice Field. The DSN shall use the network code (10) as specified in ANSI T1.111.4. DSN messages originating and terminating within the DSN or another network conforming to the ANSI standard shall also be coded with the National Network code (10).

DSN interconnections with international networks, via gateways or other methods, are a subject of separate specifications and agreements with the networks and countries concerned. Whether the international or other network indicator is used will be specified as a part of that agreement.

Priority 3 is the highest message priority code and is reserved for network management and other messages critical to the performance of the MTP. Assignment of priority levels to other messages and user parts shall be in accordance with the DSN specific guidelines. The IAM messages that carry the FLASH and FLASH OVERRIDE precedence levels are assigned the priority 2. The IAM messages with the IMMEDIATE are assigned the priority 1. The PRIORITY and ROUTINE precedence levels are at the 0 priority. This priority shall not be changed if a DSN call must cross the network boundaries. However, it is subject to bilateral agreements negotiated with other network providers. The DSN Network Administrator shall have the ability to assign and change priority levels for messages of specific user parts within the DSN and to agree with interconnecting networks for messages that enter and leave the DSN.

g. 14.0 Formats and Codes of DSN Signaling Network Management Messages. The following paragraphs specify DSN requirements for the formats and codes of DSN Signaling Network Management Messages.

(1) The Signal Link Code (SLC), used to identify one of 16 possible signaling links between each pair of adjacent (directly connected) signaling nodes, indicates the identity of a signaling link to which a network management message pertains.

(2) Each adjacent DSN SP pair shall coordinate the assignment of SLCs to ensure compatibility.

(3) The SLC may be used in the DSN to identify the preferred order of signaling data link selection from among the inter-exchange circuits.

Normally, one associated signaling link between two DSN signaling points will be implemented and designated with an SLC at both ends of 0000. The order of selection of backup signaling data links to be obtained from the inter-exchange circuit group may be pre-coordinated and prioritized at both ends. SLC 0001 is assigned to the circuit normally selected first as a backup signaling link. The remaining SLCs are assigned to inter-exchange circuits in the order of their selection as signaling data links. This order of selection should not be interpreted as prioritizing the signaling links. Any circuit selected to serve as a signaling link remains in service for that purpose until it becomes unavailable (e.g., by failure or management withdrawal, etc.)

(4) This pre-assignment can be overridden when communication between both DSN signaling points over alternative links is possible. In this case, a Signaling Data Link Connection Order message may be utilized to indicate which inter- exchange circuit will be assigned as a signaling data link and which corresponding SLC will be used.

7.8.2.5 ANSI T1.111.5-DSN Signaling Network Structure (MTP). The DSN No.7 CCS Signaling Network Structure shall be as specified in ANSI T1.111.5. DSN specific requirements are specified in the following paragraphs, citing the applicable sections of the standard, e.g., 1.0.

a. 1.0 Scope, Purpose, and Application. The DSN No.7 CCS network shall serve as a totally separate call control and management network that is overlaid on the DSN circuit- switched network. DSN signaling points connected by signaling links shall interface with DSN switch processors to provide the necessary messages and procedures to control voice and data related connections.

The DSN signaling network consists of SPs and SP/STPs colocated with DSN multi-function switches and interconnected by a network of signaling links. The DSN Signaling Network concept is based upon a fully-associated architecture. It consists of origination and destination SPs connected by signaling links which are capable of sharing the load between them. It is supplemented by quasi-associated signaling routes in which the information between origination and destination points may be transferred via a number of STPs. This architecture differs from the examples of a centralized paired-STP architecture shown in ANSI T1.111.5. The DSN architecture is built upon associated signaling links supplemented by a large number of dispersed (decentralized) STPs.

The DSN architecture, while different from commercial architectures based on the quasi-associated principles, is not in violation of ANSI T1.111.5. The major DSN No.7 CCS components are signaling points, signaling transfer points, and signaling links that are in compliance with the ANSI standard. The remainder of this section specifies DSN applications of these components in the signaling network.

APPENDIX B

b. 2.0 Signaling Network Components. This section describes the signaling network structure and individual components: the SP, the SP colocated with an STP, and a network of signaling links arranged in an associated network architecture.

(1) 2.1 Signaling Links. A DSN Signaling Link is a basic component that connects signaling points in a signaling network. The signaling links encompass the "level 2" functions that are specified in ANSI T1.111.3.

A signaling link connecting two signaling points shall correspond to the inter-exchange circuits connecting adjacent DSN switches in the circuit-switched network.

The associated architecture of the DSN requires one directly- connected active signaling link set between any two DSN switching centers. This link is drawn from one of the inter-exchange circuits serving these two switching locations. The remaining inter-exchange circuits (up to 15) may be used as backup signaling links and for the purposes of load sharing. They are considered to be inactive signaling links under normal circumstances and could be made available for a different purpose (e.g., voice transmission).

The signaling links directly connecting two DSN switches in the network constitute a single signaling link set.

Parallel signaling link sets (combined link sets) shall not be precluded by implementations.

(2) 2.2 Signaling Points. The typical signaling component installed at DSN switches shall consist of a SP colocated with an STP (SP/STP), unless specifically stated otherwise. The SP/STP shall serve as signaling message origination, transfer point, and destination point.

The signaling component that has been specifically stated as not requiring the STP function shall consist of an SP only. These DSN SPs shall serve as origination and destination points for signaling messages, but not as transfer points.

Typical locations of DSN SPs without the STP capability will be switches that connect to either a single switch or a very limited number of adjacent DSN switches.

The switches limited to the SP capability do not provide alternate routing for another switch served by common channel signaling. Upgrade of a DSN SP to a DSN SP/STP should not be precluded by the SP implementation.

APPENDIX B

As a minimum, a single signaling link shall exist between every adjacent switch in the DSN backbone network. Up to 16 inter- exchange circuits to the adjacent switches are available in DSN No.7 CCS.

All of the DSN backbone switches are considered to be network SPs. Each SP and SP/STP shall be assigned a unique signaling point code for addressing signaling messages.

SPs and SP/STPs shall interface directly to the DSN switch processor. The DSN SP only nodes shall provide at least two of the level 3 functions: 1) the message distribution function, which delivers a received message to the appropriate user part or to the local MTP levels of the home SP; and 2) the routing function, which makes a choice of an outgoing signaling link that routes a message to a destination SP.

The DSN network concept is based on the decentralization and dispersion of STP capability throughout the signaling network. This concept requires STPs to be colocated with most DSN switch signaling points.

As described above, an SP/STP is used for quasi-associated backup of an unavailable associated route. Under the DSN concept, a quasi-associated link cannot be used for backup of another quasi- associated unavailable route.

The STP capability in the DSN requires at least two of the level 3 functions to be present: message discrimination function and message routing function. The discrimination function allows the DSN to determine that a message is destined to another STP. It initiates the routing function which selects an outgoing signaling link.

Figure 3, Typical DSN SP/STP Location shows a typical network configuration with primary and alternate signaling routes for setting up calls from A to B. The nodes represent both circuit switches and signaling nodes. A and B are adjacent switches connected by associated signal links that form the normal or primary route. Most calls under normal conditions will flow over this route. When all trunks/links on the normal route are busy, calls from A to B are set up over the alternate nodes.

The failure of any signal link shall be backed up with the DSN quasi-associated capability. For example, quasi-associated signaling route (shown in Figure 3, Typical DSN SP/STP Location) provides a backup capability for the failed associated signaling link between A and B. Calls will be set up over the A to B trunk circuits. For this to work, the node at C must have the STP capability, where a call from A to B may be set up via the C signaling node without being routed through switch C.

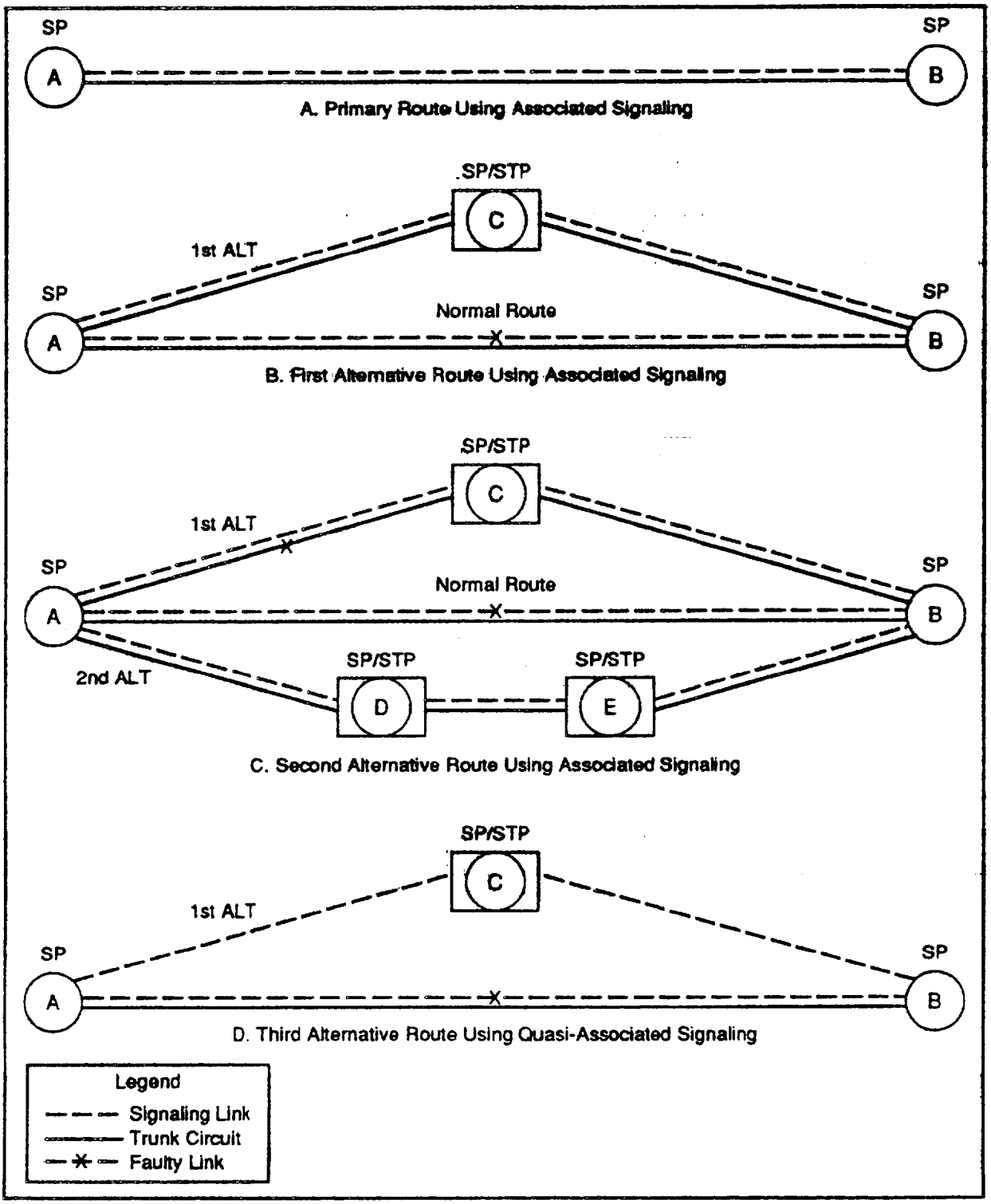

Figure 3. Typical DSN SP/STP Location

APPENDIX B

Any DSN signaling point that is a part of a backup signaling route for two adjacent DSN signaling points must be an SP/STP. In order to allow future upgrading of the DSN network, all DSN SPs shall have the potential to be upgraded to a DSN SP/STP.

c. 3.0 Structural Division of DSN Signaling Network (National and International Requirements). The worldwide signaling network outside the DSN network consists of two functionally independent levels: the international level and the national level. The overall DSN structure reflected by the signaling network management and the numbering plans of signaling points provides the network with the capability to function on both the national and the international levels. A DSN SP/STP shall be assigned to one of two categories:

(1) A node that functions as an ANSI specified (T1.111.5) national signaling point (signaling transfer point). This type belongs to the DSN signaling network only and is identified by a signaling point code [Originating Point Code (OPC) or DPC] according to the DSN numbering plan of signaling points

(2) A node that functions both as an international signaling point (signaling transfer point), and a DSN signaling point (signaling transfer point), and therefore belongs to both the DSN and the international signaling network, and is identified by a specific signaling point code (OPC or DPC) in each of the signaling networks accordingly.

d. 4.0 Considerations Common to Both International and National Signaling Networks.

(1) 4.4 Number of Signaling Links Used in Load Sharing. Load sharing among parallel link sets is not precluded by this specification if the parallel sets (combined link sets) are implemented in DSN No.7 CCS. If implemented, the number of signaling links used in load sharing is implementation dependent, and shall be part of the DSN No.7 implementation guidance.

(2) 4.5 Satellite Link Use. The DSN circuit switched backbone shall encompass satellite routes. Calls traversing different calling areas could encounter several satellite circuits. The DSN Satellite Link Use is for futher Study.

e. 6.A Signaling Network for Internetwork Traffic.

(1) 6A.1 General. The traffic between DSN SP/STPs requires extended protocol capabilities (to be defined) to provide for appropriate monitoring and measurements. Unlike the national networks specified in the corresponding section of the ANSI Standard, the DSN network employs associated

signaling with quasi-associated capabilities. Based on this architecture, the internetwork traffic requirements for the DSN network are different. The internetwork traffic requirements are specified in the following paragraphs.

(2) 6A.2 Integrated Numbering of National Signaling Networks. Signaling Gateways are not required within the DSN because DSN No.7 CCS operates under a uniform protocol throughout all DSN areas. Gateways may become a requirement to interconnect the DSN with other international CCITT No.7 networks. This can only be determined by agreement with each interconnecting network.

(3) 6A.5 Routing in the Absence of Failures. The SLC bit rotation procedure used for load sharing in the U.S. national networks shall be implemented in the DSN network only for load sharing within the link set.

f. 7.0 DSN Signaling Network Framework. The DSN network shall employ "F" links to connect every SP and SP/STP together. These "F" links shall provide the associated architecture of the DSN. That is, every pair of directly connected (adjacent) DSN switches shall be connected by an "F" type of associated signaling link (Figure 4, F-links).

These signaling links may also carry signaling traffic that is characteristic of other types of signaling links. For example, when quasi-associated backup signaling is employed, the "F" signaling link will logically appear to be an "A" link providing access from a SP to a STP. Similarly, an "F" between two DSN SP/STPs could in some cases carry quasi-associated signaling between the two STPs and appear as a logical "B" link. Similar examples can be stated where the DSN "F" link carries traffic that will provide the logical appearance of "D" and "E" type links. Because the DSN SP/STPs do not operate in mated pairs, no "C" link implementations will occur in the DSN.

7.8.2.6 ANSI T1.111.6-DSN Message Transfer Part Signaling Performance (MTP). The DSN No.7 CCS requirements and guidelines for the MTP signaling performance shall be as specified in ANSI T1.111.6.

7.8.2.7 ANSI T1.111.7-DSN Testing and Maintenance (MTP). The DSN No.7 CCS Testing and Maintenance requirements shall be as specified in ANSI T1.111.7.

7.8.2.8 ANSI T1.111.8-Numbering of Signaling Point Codes (MTP). The DSN No.7 Numbering of Signaling Point Codes shall be as specified in ANSI T1.111.8. The DSN meets the ANSI requirements for a large network and has been granted a network code value of 241. ANSI T1.111.8, Table B1, shows the current list of assigned large network codes. Signaling point codes in the DSN are assigned by the Network Administrator in accordance with ANSI guidelines.

APPENDIX B

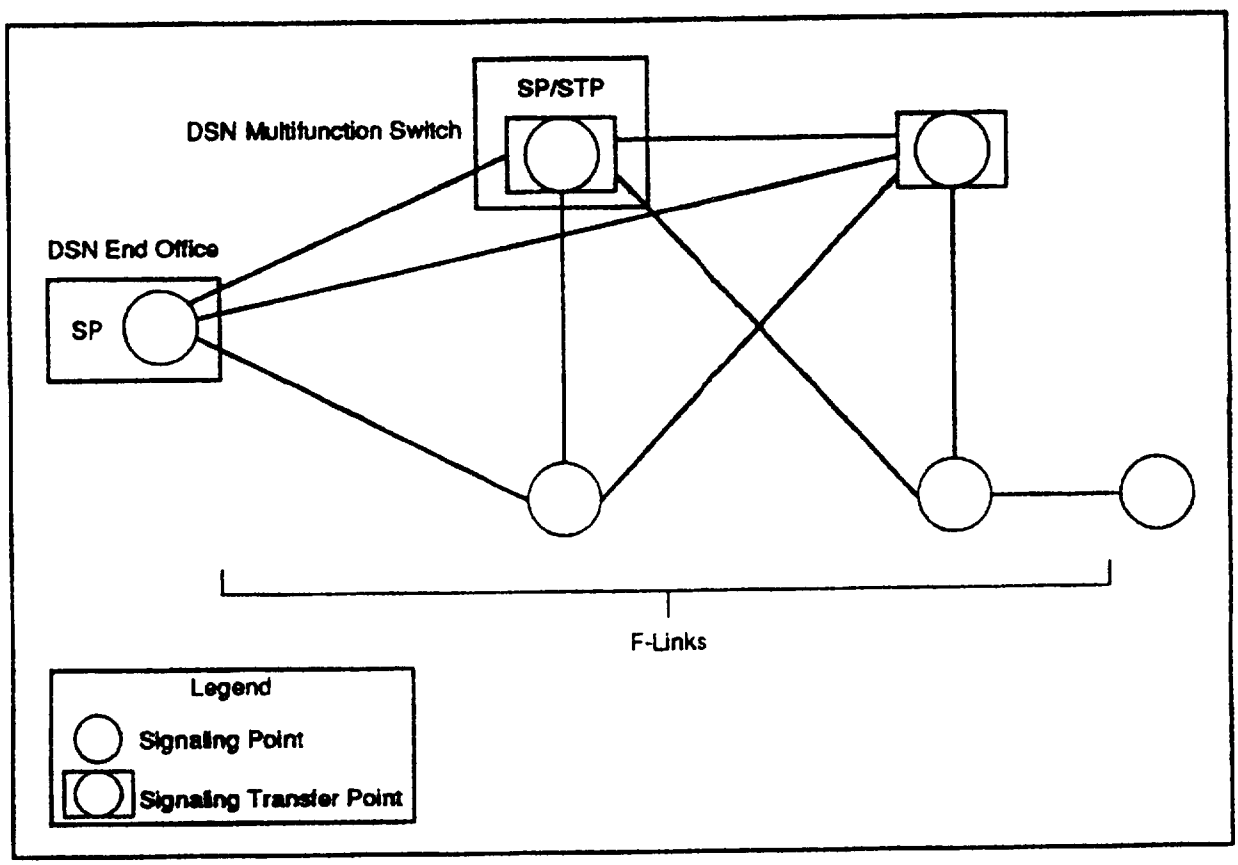

Figure 4. F-Links

7.8.3 Signaling Connection Control Part (SCCP). The DSN No.7 CCS SCCP shall be as specified in ANSI T1.112-1988, Chapters 1-4. Specific requirements for DSN application are given in the following subsections.

7.8.3.1 ANSI T1.112.1-Functional Description of the Signaling Connection Control Part. The DSN No.7 CCS SCCP functional description shall be as specified in ANSI T1.112.1. DSN specific requirements are specified in the following paragraphs, citing the applicable sections of the standard, e.g., 2.0.

a. 2.0 Services Provided by the SCCP. The SCCP provides additional functions to the MTP to provide both connectionless as well as connection oriented network services to transfer circuit related and noncircuit-related signaling information and other types of information between exchanges. The connectionless services requires a function which maps the called address to Signaling Point Codes of the MTP-Service. This function shall be provided within each DSN No.7 CCS node. (See ANSI T1.112.1 Section 2.2).

7.8.3.2 ANSI T1.112.2-Definition and Function of SCCP Messages. The definition and function of DSN No.7 CCS SCCP messages shall be as specified in ANSI T1.112.2.

7.8.3.3 ANSI T1.112.3-SCCP Format and Codes. The DSN No.7 CCS SCCP formats and codes shall be as specified in ANSI T1.112.3.

7.8.3.4 ANSI T1.112.4-Signaling Connection Control Part Procedure. The DSN No.7 CCS SCCP procedures shall be as specified in ANSI T1.112.4. DSN specific requirements are specified in the following paragraphs, citing the applicable sections of the standard, e.g., 2.0.

a. 2.0 Addressing and Routing.

(1) SCCP Routing Principles. The SCCP Routing Control (SCRC) shall be required to translate a calling party address from PC + SSN to GT.

b. 5.0 SCCP Management Procedures. SCCP management procedures defines how replicated nodes or subsystems may relate. Within DSN, nodes/subsystems shall operate in the dominate role, which is consistent with the philosophy of main-associated and backup-quasi-associated signaling.

7.8.4 DSN No.7 CCS Integrated Services Digital Network User Part (ISDN-UP). The DSN No.7 CCS ISDN-UP shall be as specified in ANSI T1.113-1990, Chapters 1-5. Specific requirements for DSN application are given in the following subsections.

APPENDIX B

7.8.4.1 ANSI T1.113.1-Functional Descriptions of ISDN User Part (ISDN-UP). The DSN No.7 CCS ISDN-UP functional description shall be as specified in ANSI T1.113.1-1990. DSN specific requirements are specified in the following paragraphs, citing the applicable sections of the standard, e.g., 1.0.

a. 1.0 Scope, Purpose, and Application. The ISDN-UP specifies the signaling functions, codes, messages, and procedures needed to provide services for circuit-switched voice and data services in the DSN. The ISDN-UP serves analog, digital, mixed analog/digital, and ISDN Networks. The broad applicational base of the ISDN-UP provides accommodation for the evolution of the DSN from an analog to an all digital network.

b. 2.0 Services Supported By The ISDN User Part. In addition to the basic service and the non-ISDN supplementary services specified in the standard, the Multi-Level Precedence and Preemption service, as specified in T1.619, is mandatory.

c. 4.0 End-To-End Signaling. End-to-end signaling transports signaling information between the end points of a circuit-switched connection or between any two points in the signaling network. Both end-to-end signaling methods (i.e., pass along and SCCP) shall be supported in DSN No.7 CCS.

7.8.4.2 ANSI T1.113.2-General Function of Messages and Signals. The DSN No.7 CCS ISDN-UP general functional of messages and signals shall be as specified in ANSI T1.113.2-1990. DSN specific requirements are specified in the following paragraphs, citing the applicable sections of the standard, e.g., 1.0.

a. 1.0 Signaling Messages. The signaling messages available for DSN No.7 are specified in ANSI T1.113.2-1990. Table 2/T1.113.2 lists the ISDN-UP messages and their acronyms. These messages could be divided into several categories with respect to their functional content pertinent to connection setup, operations, supervision, tests, and maintenance.

b. 2.0 Signaling Information. Signaling information is identified in subsections 2.1 through 2.77. The following has specific DSN comments:

(1) 2.41 End-to-End Method Indicator. In the DSN both the SCCP and the Pass Along methods shall be available.

7.8.4.3 ANSI T1.113.3-Formats and Codes. The DSN No.7 CCS ISDN- UP Formats and Codes shall be as specified in ANSI T1.113.3-1990. DSN specific requirements are specified in the following paragraphs, citing the applicable sections of the standard, e.g., 3.0.

APPENDIX B

a. 3.0 ISDN-UP Parameters. The format of the various ISDN-UP parameters are given in subsections 3.1 through 3.33 of the ANSI standard, all of which are applicable to the DSN. The following has specific DSN comments:

(1) Precedence Parameter. In the DSN No.7 System, a Precedence parameter of one octet in length shall be used in the Initial Address Message to indicate the precedence level, service domain, and LFB status of each call. Table I provides the DSN No.7 CCS system coding for each subfield.

Table I Precedence Parameter

PRECEDENCE PARAMETER

SUBFIELDS	DSN NO.7 CODING
PRECEDENCE LEVEL	BITS 3-1
FLASH OVERIDE (0)	0 0 0
FLASH (1)	0 0 1
IMMEDIATE (2)	0 1 0
PRIORITY (3)	0 1 1
ROUTINE (4)	1 0 0
	*
MLPP SERVICE DOMAINS	BITS 6-4
DSN	0 0 0
	*
LFB STATUS	BITS 7-8
LFB ALLOWED	0 0
LFB NOT ALLOWED	1 0
PATH RESERVED	0 1

* all other values are spare

7.8.4.4 ANSI T1.113.4-Signaling Procedures. The DSN No.7 CCS ISDN-UP Signaling Procedures shall be as specified in ANSI T1.113.4-1990. DSN specific requirements are specified in the following paragraphs, citing the applicable sections of the standard, e.g., 2.0.

a. 2.0 Basic Call Control and Signaling Procedures.

(1) 2.1.1.1 Actions Required at Originating Exchange. Routing information in the DSN shall be supplied by the originating exchange. However, the design shall not preclude requests to a remote database for routing information.

b. Multilevel Precedence and Preemption. Multi-level Precedence and Preemption (MLPP) Service provides a set of optional call handling procedures for use in an ISDN network. These procedures are applicable to any network that provides the MLPP capability. Utilization of MLPP procedures provides essentially nonblocking service to very high priority users. This ensures the ability to communicate during network congestion periods. The ISDN-UP signaling procedures for the MLPP Service are covered in T1.619.

7.8.4.5 ANSI T1.113.5-Performance Objectives in the ISDN Application. The DSN No.7 CCS performance requirements for an ISDN application shall be as specified in ANSI T1.113.5.

7.8.5 Transaction Capability Application Part (TCAP). The DSN No.7 CCS TCAP shall be as specified in ANSI T1.114-1990, Chapters 1-5. Specific requirements for DSN application are given in the following subsections.

7.8.5.1 ANSI T1.114.1-Functional Description and Transaction Capabilities. The DSN No.7 CCS Transaction Capabilities shall be as specified in ANSI T1.114.1-1990.

7.8.5.2 ANSI T1.114.2-Definition and Functions of Transaction Capabilities Messages. The elements and functions of DSN No.7 CCS TCAP messages shall be as specified in ANSI T1.114.2-1990.

7.8.5.3 ANSI T1.114.3-TC Format and Codes. The DSN No.7 CCS formats and encodings for TCAP messages shall be as specified in ANSI T1.114.3-1990.

7.8.5.4 ANSI T1.114.4-Transaction Capability Procedure. The DSN No.7 CCS TCAP procedures shall be as specified in ANSI T1.114.4- 1990.

7.8.5.5 ANSI T1.114.5-Definitions of Operations, Parameters and Error Codes. The DSN No.7 CCS functions and encoding for the Operation, Parameter and Error Code elements used by the TCAP protocol shall be as specified in ANSI T1.114.5-1990. DSN specific requirements not covered by the standards are specified in the following paragraphs, citing the applicable sections of the

standard, e.g., 2.0.

a. 2.0 Operations)

(1) 2.1.1 Parameter Family Identifier - 0000001. This indicates that the following operations on Parameters is to be performed. In DSN No.7 CCS the Parameter - Provide Value Specifier - 00000001, is used in the MLPP service for the Look- ahead for busy option that will determine if circuits are available before action is taken to preempt the call. The operation of this parameter is used to indicate that the values in the Parameters identified in the Parameter Set are to be provided. In the case of MLPP service, this operation specifies the following mandatory parameters:

(a) The Look-ahead For Busy Response*

(b) Bearer Capability Supported*

(c) The Service Key which encompasses the following:

-- The Called Party number
-- The Calling Party number
-- The Circuit Identification Code*
-- The Bearer Capability Requested
-- The Precedence*
-- The Call Reference.*

When the operation is performed successfully, a Return Result with the following parameters are returned:
-- The Look-ahead for Busy Response*
-- The Bearer Capability Supported*

If the operation cannot be performed, the Return Error cause may be one of the following:

-- Unexpected Data Value-if the argument of the operation is not as expected
-- Data Unavailable-if the data identified was not available
-- Task Refused-if the entity is unable to do the task at this time.
* These paramaters are either not in T1.114.5 or must be modified. See paragraph 7.8.5.5 (b) for details.

b. 4.0 Parameters Several Parameters needed to support the MLPP Service are not yet fully defined in T1.114.5-1990. The DSN-specific Parameters are specified in the following paragraphs, citing the applicable sections in the standard if they exist:

(1) 4.19 Bearer Capability Requested - 10010010 The Bearer Capability Requested parameter is used to indicate the Bearer Capability requested by the

calling party. It is coded contextual (in the context of the Parameter Set) and has a primitive form. The format and contents of the Bearer Capability Requested parameter is provided in T1.114.5

(2) 4.20 Bearer Capability Supported - 10010011. This parameter indicates whether or not a requested bearer capability is supported and is used to indicate the reason a bearer capability requested was not available. The format of the Bearer Capability Supported parameter is illustrated in Figure 3/T1.114.5. The contents of this Parameter are defined and coded as follows:
(a) 00000001 - Bearer Capability is not supported
(b) 00000010 - Bearer Capability is supported
(c) 00000011 - Bearer Capability is not authorized
(d) 00000100 - Bearer Capability is not presently available
(e) 00000101 - Bearer Capability is not implemented

(3) Look-ahead for Busy Response - XXXXXXXX. The Look- ahead For Busy Response Parameter is used to indicate whether the preemptable resources were found. The parameter is coded contextual. It is 1 octet long and is of type OCTET STRING. Its format is illustrated in Figure 5. The contents of are defined and coded as follows:

(a) Location. Bits DCBA indicate the location which initiated the response and are defined and coded as follows:
0000 - User
0001 - Private network serving the local user
0010 - Public network serving the local user
0011 - Transit network
0100 - Public network serving the remote user
0101 - Private network serving the remote user
0110 - Local interface controlled by this signaling link
0111 - International network
1010 - Beyond an interworking point
All other values are spare.

(b) Acknowledgement Type. Bits HG indicate the acknowledgement type. This indicates whether the request for search and reservation of circuits was accepted. Bits HG are defined and coded as follows:
00 - Path reservation is denied
01 - Negative acknowledgement
10 - Positive acknowledgement
11 - Spare.

(4) Circuit Identification Code - XXXXXXXX. The Circuit Identification Code Parameter is used to identify the physical path between two exchanges. The parameter is coded contextual, is 2 octets in length and is of type OCTET STRING. The format and coding is as described in T1.113.3 Section 1.2.

APPENDIX B

	H	G	F	E	D	C	B	A
Look-ahead For Busy Response	X	X	Spare		X	X	X	X

The Look-ahead for busy response length is one octet.

The location field is coded as follows:

Location	D	C	B	A
User	0	0	0	0
Private Network Serving the Local User	0	0	0	1
Public Network Serving the Local User	0	0	1	0
Transit Network	0	0	1	1
Public Network Serving the Remote User	0	1	0	0
Private Network Serving the Remote User	0	1	0	1
Local Interface Controlled by this Signaling Link	0	1	1	0
International Network	0	1	1	1
Beyond an Interworking Point	1	0	1	0
All other values are reserved				

The Acknowledgement Type field is coded as follows:

Acknowledgement Type	H	G
Path Reservation Denied	0	0
Negative Acknowledgement	0	1
Positive Acknowledgement	1	0
Spare	1	1

Figure 5. Look-ahead For Busy Response

(5) Precedence - XXXXXXXX. The Precedence Parameter is used to identify the MLPP call in terms of priority treatment and MLPP Service Domain. It is of variable length and is of the type OCTET STRING. The format is illustrated in Figure 6 and the contents are coded as follows:

First octet - Bits DCBA indicate the Precedence Level and are coded as follows:
(a) 0 0 0 0 - FLASH OVERRIDE(0)
(b) 0 0 0 1 - FLASH(1)
(c) 0 0 1 0 - IMMEDIATE(2)
(d) 0 0 1 1 - PRIORITY(3)
(e) 0 1 0 0 - ROUTINE(4).
Bits GFE are spare
Bit H is extension indicator

Second octet - Bits GFEDCBA indicate an identity of the MLPP service domain and are coded as follows:
(a) 0 0 0 0 0 0 0 - Defense Switched Network
All other values are spare.
Bit H is extension bit

(6) Call Reference - XXXXXXXX. The Call Reference Parameter is used to identify a particular MLPP call within an exchange independent of the physical circuits. The parameter is 6 octets in length and is of type OCTET STRING. The format contents are as specified in Section 3.5 and Figure 7 in T1.113.3.

7.8.6 DSN No.7 CCS Management. The DSN No.7 Management specifications shall be as specified in Sections 7.8.6.1 and 7.8.6.2.

7.8.6.1 ANSI T1.115-Monitoring and Measurements of SS7. DSN No.7 CCS Monitoring and Measurements shall be as specified in ANSI T1.115.

7.8.6.2 ANSI T1.116-Operations, Maintenance and Administration Part (OMAP). The DSN No.7 CCS Operations, Maintenance and Administration Part shall be as specified in ANSI T1.116. DSN specific requirements are specified in the following paragraphs, citing the applicable sections of the standard, e.g., 2.0.

a. 2.0 Operations and Maintenance Procedures for the Signaling Network.

(1) 2.3.2 Screening. Both options of screening shall be available in the DSN.

(2) 2.5.4.2.3 Duplex Translation. This option is not supported in the DSN.

APPENDIX B

	H	G	F	E	D	C	B	A
Precedence	ext	Spare			X	X	X	X
Domain	ext	X	X	X	X	X	X	X

The precedence parameter length is 2 octet.

The precedence octet is coded as follows:

Location	D	C	B	A
Flash Override (0)	0	0	0	0
Flash (1)	0	0	0	1
Immediate (2)	0	0	1	0
Priority (3)	0	0	1	1
Routine (4)	0	1	0	0

The MLPP Service Domain octet is coded as follows:

MLPP Service Domain	G	F	E	D	C	B	A
Defense Switched Network	0	0	0	0	0	0	0
	0	0	0	0	0	0	1
Spare				To			
	1	1	1	1	1	1	1

Figure 6. Precedence Format

Custodians:
Army - SC
Navy - EC
Air Force - 90
DISA - DC

Review Activities:
Army - CR
Navy - OM, NOSC, MC
Air Force - 02
NSA - NS

User Activities:

Other Interest:
JCS
NCS

Preparing Activity:
DISA - TBBG

(Project SLHC - 1940)

INDEX

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INTEGRATED SERVICES DIGITAL NETWORK PROFILE

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

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