AM-TR-NPL-000003

Technical Interface Specifications for Asynchronous Service

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TECHNICAL REFERENCE NOTICE

Section 1 (Technical Interface Specifications for Asynchronous Service over a Northern Telecom, Inc. (NTI) Platform) of this Technical Reference is published by Ameritech to inform the industry of a view of the generic requirements describing the Ameritech Region's Technical Interface Specifications for Asynchronous Service.

Section 2 (Technical Interface Specifications for Asynchronous Service over a Bolt Bernack Newman (BBN) Platform) of this technical reference is published by Michigan Bell Telephone (MBT) to inform the industry of a view of the requirements describing the interface specifications for asynchronous service from the MBT packet-switched network.

Section 2 is meant to parallel the Ameritech Service, Inc. Technical Reference AM TR-NPL-000003 (Issue 1, August 1985), titled "Technical Interface Specifications for Asynchronous Service." That document described the generic requirements for packet-switched network asynchronous service for the Ameritech region.

The organization of Section 2 will follow the organization of the Ameritech document described above. It will also provide additional information about MBT's specific requirements.

Nomenclature for Section 2

The following notation conventions will be used in the command language examples in this manual:

A. Items in UPPERCASE should be entered exactly as shown.

B. Items in lowercase represent arguments that should be replaced with an appropriate value.

C. Items that are **bolded** represent items displayed by the PAD on the terminal.

D. Items in square brackets ([ ]) are optional.

E. Items in ({ }) indicate required arguments.

F. A bar (|) separating items indicates that the item list is the list of optional arguments.

G. Ellipses (. . .) indicate optional additional parameters.

Section 3 is published by Ameritech to inform the industry of Ameritech's Packet Switched Network service offering.

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Section 3 contains generic requirements for X.3, X.28 and X.29 implementation. It has been written specifically for Ameritech Operating Companies.

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This document contains generic requirements for Northern Telecom's Asynchronous Service implementation. It has been written specifically for the Illinois and Ohio Bell Telephone Companies.

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1. Technical Interface Specifications for Asynchronous Service over a Northern Telecom, Inc. (NTI) Platform

1.1. General

1.1.1. Introduction

This practice describes the Northern Telecom SL-10 Interactive Terminal Interface (ITI). The ITI is based on CCITT recommendations X.3, X.28 and X.29, which define a Packet Assembly/Disassembly (PAD) for connecting asynchronous, nonpacket mode terminals (start / stop mode Data Terminal Equipment [DTE] to a public packet switched network. This practice provides brief descriptions of service, network access, service offerings, standardization, capabilities, ITI command language (Table A), ITI parameters and profiles (Table B), parameter definitions (Table C), subscription options and timeouts. The implementation of this interface is subject to BOC business decisions and final tariff approval. For specific implementation details the user should consult with the particular BOC from which service is provided.

The ITI protocol is compatible with CCITT Recommendation X.300. The bilateral closed user group is not supported on SL-10.

1.1.2. Reference Document

1.1.2.1.

The following documents are referenced to in this practice.

List of Definitions for Interchange Circuits Between Data-Terminal Equipment and Data Circuit	CCITT V-24
Terminating Equipment. Packet Assembly/Disassembly (PAD) in a Public Data Network.	CCITT X.3
Interface Between Data Terminal Equipment (DTE) and Data Circuit Terminating Equipment (DCE) for Terminals Operating in the Packet Mode on Public Data Networks.	CCITT X.25
DTE/DCE Interface for a Strat-Stop Mode Data Terminal Equipment Assessing the PAD Facility in a Public Data Network Situated in the Same Country.	CCITT X.28
Procedures for the Exchange of Control Information and User Data Between a Packet Mode DTE and a Packet. Assembly/Disassembly (PAD) Facility.	CCITT X.29
Principles and Procedures for Realization of International User Facilities and Network Utilities in Public Data Networks.	CCITT X.300

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1.1.3. Description of Service(s)

1.1.3.1. Service

The ITI performs the call setup and packetizing functions required to interface directly to the SL-10 network. ITI adapts to a wide range of terminal characteristics by providing each terminal with its own buffers and a database that describes its features.

This database consists of 12 international and 8 national parameters (see Table B) each describing a feature of the terminal. These are initialized to 1 of a set of standard values (profiles) at terminal connection and may be changed at any time by the host computer (packet mode DTE) protocol. The data flow between their terminal and the network is managed entirely by the ITI, so any terminal can talk, through ITI, to any other type of process connected to the SL-10 network, including hosts that support X.25 or X.29 protocol. If the host computer has X.29 software, then it is able to modify the parameter values in the terminal database, and alter the terminal operation to suit the host.

1.1.3.2. Network Access

Network access features are as follows:

Physical Condition	Dial-up or dedicated line.
Electrical Interface	CCITT V.24 compatible.
Dial-up Line	Only terminals operating at 110 bps (11-bit character frame) and 300 bps or 1200 bps (10-bit character frame) may dial into the network.
Dedicated Line	Terminals may subscribe for data rates of 75, 110, 150, 200, 300, 600, or 1200 bps.
Parity Types Supported	Even, odd, mark, space.
Code	International Alphabet No. 5 (ASCII).
NOTE: No character translation is performed by the network.	

1.1.3.3. Service Available

The SL-10 network offers a wide choice of services to meet the specific requirements of subscribers (see Part 3 for a list of options).

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1.1.3.4. Standardization

The ITI protocol is standardized internationally through the use of CCITT recommendations X.3, X.29, and X.25.

1.1.3.5. Capabilities

The ITI can easily be adapted by the user to support his unique terminal. The ITI is driven by a set of parameters (see Table B), modifiable either by the user at the terminal or by the communicating host. The parameters (see Table C) define the operating characteristics of the terminal and the format of the data to be displayed. In addition to the 12 international parameters defined in the CCITT recommendations, additional national parameters are provided by the SL-10 ITI.

Initially, the parameters have values established according to 1 of 6 standard sets known as profiles (see Table B) after physical connection has been established between the terminal and the network. There is also a capability of users to specify their own profiles.

A command language (see Table A) is provided by the network to the terminal user to perform such control functions as establishing a virtual call, modifying the parameters, and clearing a virtual call. It is possible for the user at the terminal to enter commands for the network or for the communicating host.

Procedures are provided for the exchange of control information between the ITI PAD and the host in communication with the terminal. The host can interrogate the ITI PAD for parameter values, request changes to parameter values and invite the network to clear a virtual call (Table A.)

1.1.3.6. ITI Parameters and Terminal Profiles

The ITI has been divided into 20 functions, each of which is controlled by a parameter. These sets of parameters constitute profiles that define the operation of the ITI. Profiles are accessible by using the Profile and Parameter commands in the command language. A list of ITI parameters and terminal profiles as shown in Table 1-B, is an example of profile definitions currently employed by an ITI user. A list of parameter definitions is given in Table 1-C.

1.1.3.7. ITI Multi-Language

The aspect of natural language usage in service signal is not covered in CCITT Recommendations. However, as a user convenience, SL-10 offers a choice of natural languages for ITI service signals. Note that the multi-language feature may not be implemented in all SL-10 installations.

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The user may select from available natural languages for SL-10 service signals (system responses). Service signal test is set up in SL-10 data files. User commands to determine language availability and to change service signal language are described in Table 1-A.

1.1.3.8. Network User Identifier (NUI)

SL-10 supports the Network User Identifier (NUI) feature as per CCITT recommendation 3.2.1.2 (see Table 2-B). The NUI feature allows an ITI user to make locally-charged calls and accept reversed-charged calls from an ITI port by charging the call to the user's NUI number. For security reasons, the NUI has corresponding password which, in turn, is related to a specific account number. Table 1-A describes the commands associated with the NUI feature. Note that NUI may not be implemented on all SL-10 installations.

1.1.3.9. Fast Select

SL-10 supports the Fast Select feature described in CCITT recommendation X.25, section 7.2.4 (see NTP 240-4061-184). For ITI the Fast Select feature is implemented to allow outgoing

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fast select calls of either the restricted or non-restricted type. Table 1-A describes the commands associated with the Fast Select feature.

TABLE A

ITI COMMAND LANGUAGE

A command language is available with the ITI service. This language allows a terminal to control the ITI and to issue reset, interrupt, and clear calls. The SL-10 provides for natural language commands in English, French, and German. Additional information will be supplied upon request.

Command abbreviations are defined at the end of this table.

The commands are as follows:

CALL SETUP COMMANDS

(a) Service Request Signal

Function: To request a service from the SL-10 network.

Format: . <CR> repeated until a herald message is received.

Response: ntwk name: address

Note: The service request signal is the character 'period' (.).

(b) Call Request Command

Function: To establish a virtual connection through the SL-10 network to a destination computer.

Format: [P/ N] [R] [CUG(nnn)] [Transit(<RPOA>)]
dna, user data <CR>

Note: user data is a maximum of 12 characters and must immediately follow the comma. All other items should be separated by a single blank, / indicates alternative.

Response: ntwk name: Call Connected, or failure reason

(c) Call Command (Direct Call Options Only)

Function: To retry an unsuccessful attempt to establish a SVC with Direct Call Option.

Format: CALL <CR>

Response: ntwk name: Call Connected, or failure reason

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TABLE A

ITI COMMAND LANGUAGE

(d) Request Network User Identifier (NUI) Feature

Function: To activate the NUI facility.

Format: NUI nui<CR>
password<CR>

Response: ntwk name: NETWORK USER IDENTIFIER nui ACTIVE or
ntwk name: NETWORK USER IDENTIFIER ERROR or
RE-ENTER PASSWORD

(e) Cancel NUI Feature

Function: To cancel NUI facility (when no calls are in progress).

Format: NUI OFF <CR>

Response: ntwk name: NETWORK USER IDENTIFIER NOT ACTIVE

(f) Query NUI Feature

Function: To determine whether or not a user's NUI is active.

Format: NUI? <CR>

Response: ntwk name: NETWORK USER IDENTIFIER <nui ACTIVE / NOT ACTIVE>

PARAMETER AND PROFILE COMMANDS

Notes:

1. Refer to Table B for additional information on parameters and profiles.

2. Square brackets (i.e., [ ]) identify that the information within them is optional; they should be ignored if they are not applicable.

3. Items enclosed is angle brackets (<>) are character or function mnemonics.

4. Capital letters indicate fixed keywords: lower case indicates variables.

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5. If the reference number in INV, then it indicates that the parameter number is invalid.

TABLE A

ITI COMMAND LANGUAGE

(g) Par Command

Function: To read the specific value of ITI parameters.

Format: PAR ref # [,ref # ..] <CR> (note)
(note, a maximum of 19 characters may be used)

Response: ntwk name: PAR ref #: value, ref #: value.

Function: To read the value of all ITI parameters in the current profile.

Format: PAR

Response: ntwk name: par001: value, par002: value,...

(h) Set Command

Function: To set (SET) the value of ITI parameters or to set and read (SET?) the value of parameters.

Format: SET ref #: value [,ref #: value....] <CR>

SET? ref #: value [,ref #: value....] <CR>

Response: <CR><LF> (to SET Command)
ntwk name: par <ref #>: value (to SET? Command)
ntwk name: par <ref #>: inv (if reference value is invalid)
ntwk name: par inv 000 (if parameter number is invalid).

Note: Value may be a 1- to 3- digit decimal value or a single character within paranthesis, i.e., (A), or a 3-character mnemonic. A maximum of 16 characters may be used in the SET command.

(i) Profile Command

Function: To select a particular terminal profile (profile 2 is the default on dial access lines).

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TABLE A

ITI COMMAND LANGUAGE

Format: PROF n<CR>

where n =

0 - (optional user-defined profile)
1 - (international)
2 - (basic (default))
3 - (transparent)
4 - (internetworking)
5 - (terminal to terminal)
6 - (ITHI profile)

Response: <CR> <LF>.

Note: These profiles (0 to 6) are defined in the ITI Parameter Table:

(j) Query Profile Command

Function: To display the parameter values in a profile.

Format: PROF? prof #<CR>

Response: ntwk name: PROF n ref#1: value 1, ref#2: value 2 etc.

SESSION COMMANDS

(k) Escape Signal

Function: To escape from the data transfer state to the command state. ITI parameters can only be changed in the command state.

Format: "DLE" or "CNTL P", if Parameter #1 = 1
"BREAK", if Parameter #7 = 8.

(1) Reset Command

Function: To reinitialize a virtual circuit.

Note: A reset issued for a SVC does not clear the call.

Format: RESET <CR>.

Response: ntwk name: RESET-LOCAL DIRECTIVE.

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TABLE A

ITI COMMAND LANGUAGE

(m) Status Command

Function: To determine the status (i.e., free or engaged) of a virtual circuit.

Format: STAT or STATUS <CR>

Response: ntwk name: ENGAGED local dna
[([p/n][,][r][,]
[CUG: cug # used])]
<remote dna><CR>
ntwk name: FREE <local dna>
[CUGS: cug #
[IN] [OUT] [PRIVILEDGED]] <CR>

OUTGOING OPTIONS: list of terminal subscription options.

INCOMING OPTIONS: list of terminal subscription options.

(n) Interrupt Command

Function: To send an interrupt package to the destination computer.

Format: INT <CR>

Response: <CR> <LF>

(o) Interrupt and Discard Output Command

Function: To send an interrupt packet to the destination computer and discard output for the terminal.

Format: INTD <CR>.

Response: <CR> <LF>

(p) Clear Request Command

Function: To terminate a call on an existing SVC.

Format: CNTRL -P and CLEAR <CR> or
CNTRL -P and CLR<CR>

Response: ntwk name: CALL CLEARED-LOCAL DIRECTIVE.

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TABLE A

ITI COMMAND LANGUAGE

(q) Halting and Resuming Output

Function: Parameter 12, if set to 1, permits the use XON/XOFF to temporarily stop the outputting of data to the terminal.

Format: <X-OFF>(to halt output, see Note)
<X-ON>(to resume output, see Note)

Note: These are control characters.
X-OFF = ASCII-19
X-ON = ASCII-17

(r) Language Availability Command

Function: To determine which service signal (system response) languages are available.

Format: LANGUAGE? <CR>

Response: ntwk name: LANGUAGES AVAILABLE: lang IN/OUT
: Lang OUT

(s) Language Specifications Command

Function: To specify which language shall be used for system dialogue.

Format: LANGUAGE lang [IN/OUT] <CR>

Response: <CR> <LF>

(t) Exit Command

Function: To return to the data transfer state from the command state.

Format: <CR> on a blank input line

(v) Fast Select Call Request Command

Function: To establish a fast select SVC

Format: a) for restricted fast select call,
[RF / F] [P/N] [R] [CUG(nnn)]
[Transit(<RPOA>)] dna, user data

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TABLE A

ITI COMMAND LANGUAGE

Response:	ntwk name: CALL CLEARED, (user data)
Format:	b) for nonrestricted fast select call, [NF] [P/N] [R] [CUG(nnn)] [Transit(<RPOA>)] dna, user data
Response:	ntwk name: CALL CONNECTED, (user data)

Notes:

1. User data on call request is a maximum of 124 characters and must appear immediately after the comma. User data on the clear and accept can be a maximum of 128 characters.

2. RF=F= (restricted) fast select option.

3. NF=nonrestricted fast select option.

4. RPOA=Registered Private Operating Agency. It may be specified as a four digit DNIC or a mnemonic string which can be a maximum of 10 characters in upper or lower case.

5. P=Priority call option.

6. N=Normal call option.

7. R=Reverse charge option.

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8. dna=Network address (8 to 11 digits).

TABLE B

ITI PARAMETERS AND TERMINAL PROFILES

PARA-METER NO.	VALUES	PROFILE P1	P2	P3	P4	P5	P6	SIGNIFICANCE
PAR1	0 = no <DLE> escape			0			0	No ITI commands possible to the network with <DLE>.
	1 = <DLE> escape	1	1		1	1		ITI commands possible after <DLE>.
PAR2	0 = no echo	0	0	0	0	0	0	No character from the terminal is sent back for verification.
	1 = echo							All characters from the terminal are echoed to the terminal.
PAR3	0 = No data forwarding signal			0			0	None of the characters from the terminal will cause the forwarding of the assembled characters to the host computer; however, a network command or BREAK will do.
	2 = <CR> forwarding		2		2	2		On reception of <CR> the assembled characters are forwarded to the host. Also, a network command or BREAK forwards the data.

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TABLE C		
PARAMETER DEFINITIONS		
PARAMETER	NAME	DESCRIPTION
1	Escape to Command Mode	Permits terminal user to send commands to the ITI for setting or displaying parameters, resetting or clearing a call, or sending interrupts to the host computer.
2	Echo	Permits ITI to echo input characters from terminal.
3	Data Forwarding Signal	Defines certain characters (e.g., carriage return) top signal the preparation and transmission of a packet to the host.
4	Idle Timer	Another packet forwarding signal which transmits a packet (if not empty) after a fixed interval of line idle; e.g., one second.
5	Auxiliary Device Control	Controls input from an auxiliary device, such as paper tape or magnetic tape reader.
6	Suppress Network Messages	Allows or inhibits the display of interface and network generated messages at the terminal.
7	Procedures on BREAK	Defines action to be taken upon receipt of a BREAK from the terminal.
8	Discard Output	Indicates whether or not output from the remote end is being discarded.

TABLE C		
PARAMETER DEFINITIONS		
PARAMETER	NAME	DESCRIPTION

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9	Padding After CR	Specifies number of padding characters (i.e., NUL) to be inserted by the ITI after a CR is received from the terminal or transmitted to the terminal.
10	Line Folding	Defines the length of a line on the terminal. A CR and LF are automatically sent to the terminal when this line limit is exceeded.
11	Transmission Speed	Indicates the speed of the terminal.
12	Terminal Flow Control	Enables the terminal user to temporarily suspend output.
118*	Character Deletion	Receipt of character from terminal causes deletion of previous character typed in, up to packet boundary.
119*	Line Deletion	Receipt of characters deletes all of current packet.
120*	Line Display	Receipt of character causes all of current packet to be displayed.
121* & 122*	Additional Data Forwarding	Specifies one or two additional characters to be used as data forwarding signals. They are in addition to those specified by parameters 3 and 4.
123*	Parity Treatment	Permits or suppresses parity checking.
125*	Output Pending Timer	Specifies the length of time that terminal output can be blocked by terminal input.
126*	LF Insertion	Specifies when the ITI should insert <LF> after a <CR>.
* Parameters 118, 119, 120, 121, 122, 123, 125 and 126 are National Parameters recognized only by SL-10. All others are defined by CCITT in Recommendation X.3.		

NOTE: Profiles are defined by the network administrating authority at subscription time. Each parameter can be changed while in command mode. Profiles can be changed during a session, but the changed parameters are only in effect for the duration of the current or subsequent call.

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1.2. ITI - - SL-10 Implementation of CCITT Recommendations X.3, X.28, X.29

1.2.1.

The SL-10 implements the standards defined in X.3 and X.28 with the interpretations shown in Tables 2-B and 2-E.

1.2.2.

The SL-10 implements the standards defined in X.29 with only one exception. The extension of the parameter field by using 1111111 (as defined in X.29, 4.4.5.3) is not implemented by SL-10.

1.2.3.

The SL-10 implementation is based upon the 1976 version of the CCITT Recommendations.

TABLE D

SL-10 IMPLEMENTATION OF CCITT RECOMMENDATION X.3

	X.3	SL-10 IMPLEMENTATION
1.	Description of the Basic Functions and User Selectable Functions of the PAD	Implemented as specified, with SL-10 variations detailed as shown below.
1.3	Basic Functions of the PAD	Implemented as specified.
1.4	User selectable Functions which may be Provided by the PAD	Implemented as specified.
1.4.1	PAD Recall by Escaping from the Data Transfer State	Implemented as specified.
1.4.2	Echo	Implemented as specified.
1.4.3	Recognition of Data Forwarding Signals	Implemented as specified.
1.4.4	Selection of Idle Timer Delay	Implemented as specified.
1.4.5	Ancillary Device Control	Implemented as specified.
1.4.6	Suppression of PAD Service Service	Implemented as specified.
1.4.7	Selection of Operation of PAD on Receipt of the Break Signal	Implemented as specified.
1.4.8	Discard Output	Implemented as specified.
1.4.9	Padding after Carriage Return	Implemented as specified.

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1.4.10	Line Folding	Implemented as specified.
1.4.11	Flow Control of the PAD by The start-stop mode DTE	Implemented as specified.

TABLE D		
SL-10 IMPLEMENTATION OF CCITT RECOMMENDATION X.3		
	X.3	SL-10 IMPLEMENTATION
2.4	Description of the Values of PAD Parameters	Implemented as specified.
2.4.1	Initial Values of PAD Parameters	Implemented as specified.
2.4.2	Current Values of PAD Parameters	Implemented as specified.
3.	List of PAD Parameters and Possible Values	Implemented as specified.
3.1	PAD Recall by Escaping from the Data Transfer State	Implemented as specified.
3.2	Echo	Implemented as specified.
3.3	Selection of Data Forwarding Signal	Implemented as specified.
3.4	Selection of Idle Timer Delay The parameter value of 0 to 255 indicating the value of the delay in intervals of 1/20 seconds.	The SL-10 value of delay is 40 ms. (1/25 s)
3.5	Ancillary Device Control	Implemented as specified (1984).
3.6	Suppression of PAD Service Signals	Implemented as specified.
3.7	Selection of Operation of PAD on Receipt of Break Signal from the Start-Stop Mode DTE	Implemented as specified.

TABLE D **SL-10 IMPLEMENTATION OF CCITT RECOMMENDATION X.3**		
	X.3	**SL-10 IMPLEMENTATION**
3.8	Discard Output	Implemented as specified.

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3.9	Padding after Carriage Return Parameter 9 is a value between 0 and 7 indicating the number of padding characters.	In SL-10, Parameter 9 may have any value up to 255.
3.10	Line Folding	Implemented as specified.
3.11	Binary Speed	Parameter 11 has the following values: 0 110 bps 1 134.5 bps 2 300 bps 3 1200 bps* 4 600 bps* 5 75 bps* 6 150 bps* 7 1800 bps* 8 200 bps 9 100 bps 10 50 bps * Additional values supported by SL-10
3.12	Flow Control of the PAD by the Start-Stop Mode DTE	Implemented as specified.

TABLE E		
IMPLEMENTATION OF CCITT RECOMMENDATION X.28		
	X.28	SL-10 IMPLEMENTATION

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1.	Procedures for the Establishment of a National Access Information Path Between a Start-Stop Mode DTE and a PAD	Implemented as specified.
1.1	Access Via a Public Switched Telephone Network or Leased Lines with V Servies Interfaces	Implemented as specified.
1.1.1	DTE/DCE Interface	Implemented as specified.
1.1.2	Electrical Characteristics	Implemented as specified.
1.1.3	Procedure for Setting Up and Disconnecting the Access Information Path	Implemented as specified.
1.1.3.1	Setting Up the Access Information Path by the DTE	Implemented as specified.
1.1.3.2	Disconnecting the Access Information Path by the PAD	Implemented as specified.
1.1.3.3	Setting Up the Access Information PAD by the PAD	Implemented as specified.
1.1.3.4	Disconnecting the Access Information PAD by the PAD	Implemented as specified.
1.2	Access Via Public Switched Data Network or Via Leased Lines with X-Series Interfaces	Implemented as specified.
1.2.1.1	Physical Characteristics	Implemented as specified.

TABLE E

IMPLEMENTATION OF CCITT RECOMMENDATION X.28

	X.28	SL-10 IMPLEMENTATION
1.2.1.2	Procedures for Setting Up and Disconnecting the Access Information Path (Call Control)	Implemented as specified.
1.2.2	DTE/DCE Interface Designed for Operation on Telephone Type Networks (X.20bis)	Implemented as specified.
1.2.2.1	Characteristics	Implemented as specified.
1.2.2.2	Operational Requirements	Implemented as specified.

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1.2.2.3	Operational Requirements for Disconnecting the Access Information Path by the DTE	Implemented as specified.
1.2.2.4	Indication of disconnection by the PAD	Implemented as specified.
1.2.2.5	Setting Up the Access Information Path by the PAD.	Implemented as specified.
1.2.2.6	Operational Constraints for Maintaining the Access Information Path During Information Transfer	Implemented as specified.
2.	Procedures for Character Interchange and Service Initialization Between a Start-Stop Mode DTE and a PAD	Implemented as specified.
2.1	Format of Characters Interchanged	Implemented as specified, with the exception that a service option is available which causes ITI to provide two stop bits for the speeds of 200 bit/s and 300 bit/s.

TABLE E

IMPLEMENTATION OF CCITT RECOMMENDATION X.28

	X.28	SL-10 IMPLEMENTATION
2.2	Procedures for Initialization	Implemented as specified.
2.2.1	Active Link (State 1)	Implemented as specified.
2.2.2	Service Request (State 2)	Implemented as specified.
2.2.3	DTE Waiting (State 3A)	Implemented as specified.
2.2.4	Service Ready (State 4)	Implemented as specified.
2.2.5	Fault Condition	Implemented as specified.
3.	Procedures for the Exchange of Control Information Between a Start-Stop Mode and a DTE	Implemented as specified.
3.1	General	Implemented as specified.
3.1.1	PAD Command Signals and PAD Service Signals	Implemented as specified.
3.1.2	Break Signal	Implemented as specified.
3.2	Procedures for Virtual Call Control	Implemented as specified.

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3.2.1	Call Establishment	Implemented as specified.
3.2.1.1	PAD Waiting (State 5)	Implemented as specified.
3.2.1.2	Network User Identifications (NUI) Some administrations may not implement a NUI signal.	NUI facility granting is condition upon NUI string encrypting to its associated password. NUI is composed of 6, 7 or 8 alphanumeric characters and the password is a fixed-length of 6 alphanumeric characters.
3.2.1.3	PAD Command (State 6)	Implemented as specified.

TABLE E		
IMPLEMENTATION OF CCITT RECOMMENDATION X.28		
	X.28	SL-10 IMPLEMENTATION
3.2.1.4	DTE Waiting (State 3B)	Implemented as specified.
3.2.1.5	Connection in Progress (State 7)	Implemented as specified.
3.2.1.6	PAD Service Signals (State 8)	Implemented as specified.
3.2.1.7	Incoming Calls	If the Incoming Call options match and the link is up, the SL-10 will accept the call and respond with: <Network Name>: call connected.
3.2.2	Clearing	Implemented as specified.
3.2.2.1	Clearing by the Start-Stop Mode DTE	Implemented as specified.
3.2.2.2	PAD Clearing	Implemented as specified.
3.2.3	Unsuccessful Calls A call is cleared if the first character is not entered within a to be determined amount of time, or a complete command has not been entered with 30 seconds.	In SL-10, calls must be established within one minute, or within 10 ITI commands on public dial port.
3.2.3.1	Fault Conditions	Implemented as specified.
3.2.3.2	Failure of the Access Information Path	Implemented as specified.

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3.2.4	Data Transfer	Implemented as specified.
3.3	Procedures for Setting the Values of the PAD Parameters	Implemented as specified.

TABLE E		
IMPLEMENTATION OF CCITT RECOMMENDATION X.28		
	X.28	SL-10 IMPLEMENTATION
3.3.1	Selection of a Standard Profile by the Start-Stop Mode DTE The Transparent and Simple Standard Profiles are defined as Standard Profiles.	The SL-10 supports these profiles and also provides an International Simple Profile and Canadian Internetworking Profile (see Table 1-B).
3.3.2	Procedures for Setting or Changing One or Several Parameters by the Start-Stop Mode DTE	Implemented as specified.
3.4	Procedures for Reading the Values of One or Several Parameters by the Start-Stop Mode DTE	Implemented as specified.
3.5	Formats of PAD Command Signals and PAD Service Signals	In SL-10, space and delete characters are not recognized in the command signal. However, the space character must follow the command signal separating it from the parameter string.
3.5.1	Format of the PAD Command Signal Delimiter The Command Signal delimiter is a CR, or a +.	The Command Signal Delimiter is a CR or it is after 128 characters excluding preceding blanks and control characters.
3.5.2	Format of the Format Effector If parameter 9 is set to 0 and the DTE operates at 110 bps then two padding characters are sent. At 200 or 300 bps, four padding characters will be sent.	When parameter 9 is 0 no padding is done at any speed.

TABLE E		
IMPLEMENTATION OF CCITT RECOMMENDATION X.28		
	X.28	SL-10 IMPLEMENTATION

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3.5.4	Format or Read PAD Command Signal PAR?x,y,...	PAR? X,Y,X,... OR PAR x,y,x...
3.5.5	Format of Standard Profile Selection PAD Command Signal PROFn	PROF n
3.5.6	Format of Set PAD Command Signal and the Set and Read PAD Command Signal SET2:0,3:2,9:4 SET?2:0	SET 2:0,3:2,9:4 SET ? 2:0 or SET? 2:0 Character parameters may be input inparenthesis rather than decimal, e.g., SET 118: (A)
3.5.7	Format of the Reset PAD Service Signal RESET DTE RESET ERR RESET NC	ntwk name: reset - xxx where: xxx = local directive xxx = by destination xxx = temporary network problem xxx = destination not responding xxx = local procedure error xxx = remote procedure error.

TABLE E		
IMPLEMENTATION OF CCITT RECOMMENDATION X.28		
	X.28	SL-10 IMPLEMENTATION

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3.5.8	Format of the Clear Request PAD Command Signal CLR	CLEAR or CLR
3.5.9	Format of the Clear Configuration PAD Service Signal CLR CONF	ntwk name: call cleared - xxx where: xxx = local directive xxx = remote directive xxx = remote request.
3.5.10	Format of the Clear-In-Error PAD Service Signal CLR ERR	ntwk name: call cleared - local procedure error.

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3.5.11	Format of the Status PAD Command Signal STAT	STAT or STATUS
3.5.12	Format of the Status Engaged and status Free PAD Service Signals ENGAGED FREE	ntwk name: Free (local dna) OUTGOING OPTIONS: [CUGS: (cug#[in] [out])...]<CR> [REMOTE CHARGING [-default]<CR>] [LOCAL CHARGING [-default]<CR>] [NORMAL [-default]<CR>] [PRIORITY [-default]<CR>] [NOT ALLOWED <CR] [NONRESTRICTED FAST] [RESTRICTED FAST] (NO PRESELECT RPOA/ PRESELECT=<rpoa>

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TABLE E		
IMPLEMENTATION OF CCITT RECOMMENDATION X.28		
	X.28	SL-10 IMPLEMENTATION
		(NO SELECT RPOS/ SELECT RPOA ALLOWED) INCOMING OPTIONS: [LOCAL CHARGING [-normal&priority] [-all network] <CR>] [-norma] [-priority] [REMOTE CHARAGING <CR>] [NOT ALLOWED <CR>] or ntwk name: ENGAGED (local dna) [P] {,} [R] [nfast/ rfast] [;] [CUG (cug# used)] remote dna <CR> where: dna = data network address cug = closed user group priority, normal = priority, normal call facility

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		P = priority R = remote charging nfast = nonrestricted fast select rfast = restricted fast select

3.5.13	Format of Reset PAD Command Signal	Implemented as specified.
3.5.14	Format of Interrupt PAD Command Signal	Implemented as specified.
3.5.15	Format of the Interrupt and Discard Output PAD Command Signal	Implemented as specified.

TABLE E		
IMPLEMENTATION OF CCITT RECOMMENDATION X.28		
	X.28	SL-10 IMPLEMENTATION
3.5.16	Format of the Parameter Value PAD Service Signal PAR:1,3:2,64:INV	ntwk name: par 2:1, 3:2 ntwk name: par inv:0, 7: inv ntwk name: par 119: DEL The invalid parameter reference and value are flagged separately. Character or mnemonics are used for representation of character parameters.
3.5.17	Format of the Selection PAD Command Signal	Implemented as specified.
3.5.17.1	Format of Facility Request Block A comma (,) is used to separate the facility request codes and a - - is sent after the final facility	A list of facilities is entered with space delimiters and a space after the final facility.

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3.5.17.2	Format of the Address Block A period (.) precedes the abbreviated address. When more than one address, a comma (c) separates teh addresses.	No abbreviated addressing is supported and only one address can be entered. However, it can provide the SL-10 extended addressing capability.
3.5.17.3	Format of Call User Data Field (P) or (D) precedes user data	User data is preceded by a , (comma).

TABLE E		
IMPLEMENTATION OF CCITT RECOMMENDATION X.28		
	X.28	SL-10 IMPLEMENTATION
3.5.18	Format of Service Request Signal Not Defined	The service request signal is .<CR> repeated as necessary.
3.5.19	Format of Clear Indication PAD Service Signals	ntwk name: call cleared - xxx where:
3.5.19.1	CLR OCC	xxx = destination busy
3.5.19.2	CLR NC	xxx = temporary network problem
3.5.19.3	CLR INV	xxx = imcompatible call options
3.5.19.4	CLR NA	xxx = access barred
3.5.19.5	CLR ERR	xxx = local procedure error
3.5.19.6	CLR RPE	xxx = remote procedure error
3.5.19.7	CLR NP	xxx = address not in service
3.5.19.8	CLR DER	xxx = destination not responding

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3.5.19.9	CLR PAD	xxx = collect call refused ntwk name: pvc discontinued - xxx where: xxx = temporary network problems xxx = destination not responding xxx = remote request.
3.5.19.21	Format of the Error PAD Service Signal ERR	ntwk name:

TABLE E		
IMPLEMENTATION OF CCITT RECOMMENDATION X.28		
	X.28	SL-10 IMPLEMENTATION
3.5.21 (Cont'd)		Invalid command Command not allowed More than 12 data characters Invalid address.
3.5.22	Format of Padding Characters	Implemented as specified

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3.5.23	Format of the Connected PAD Service Signal COM or (ACK)	Outgoing SVC ntwk name: call connected Incoming SVC ntwk name: called by (<facility>)<address> <logical> channel number> PVC ntwk name: (<facility>)<local address> <logical channel number>
4.	Procedures for the Exchange of User Data Between a Start-Stop Mode DTE and a PAD	Implemented as specified.
4.1	Data Transfer State	Implemented as specified.
4.2	Data from the Start-Stop Mode DTE Received by the PAD	Implemented as specified.
4.3	Delivery of user Data to the Start-Stop Mode DTE Received by the PAD	Implemented as specified.

TABLE E

IMPLEMENTATION OF CCITT RECOMMENDATION X.28

	X.28	SL-10 IMPLEMENTATION
4.4	Packet Forwarding Conditions	Implemented as specified.
4.5	Procedure for the PAD to Indicate to the Start-Stop Mode DTE, by Means of a PAD Service Signal, a Temporary Inability to Accept Additional Information Undefined	A BEL character is sent and if P6 is set to zero, the virtual circuit is reset.

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4.6	Procedure for Ancillary Device Control M is to be defined An XOFF is sent before the interface leaves the data transfer state.	M = 6 An XOFF is not sent in order that commands may be input
4.7	Procedures for Reset	Implemented as specified.
4.7.1	Procedures for Reset	Implemented as specified.
4.7.2	Start-Stop Mode DTE Sending a Reset PAD Command Signal	Implemented as specified.
4.8	Procedures for Indication of Break	Implemented as specified.
4.9	Escape from the Data Transfer State	Implemented as specified.
4.9.1.1	- -	
4.9.1.2	Command Signal delimiters are (+), <CR>	Command signal delimiter is <CR>

TABLE E

IMPLEMENTATION OF CCITT RECOMMENDATION X.28

	X.28	SL-10 IMPLEMENTATION
4.9.1.3	If the complete PAD command signal is not entered within 30 seconds, an error occurs, and a service signal is sent.	Space characters internal to the commands are not ignored, and + is not used as a delimiter. Also there is no time limit for command input.
4.9.2	PAD Command Signals	The SL-10 utilizes all of the PAD command signals plus: INTD PROF Call (auto direct).
4.10	Echo	
4.10.3	In the PAD command state the characters following the character P in the selection command are not echoed.	Not available in SL-10.

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4.11	Selection of the Procedures or Receipt of the Break Signal from the Start-Stop Mode DTE	Implemented as specified.
4.12	Selection of Padding Characters to be Inserted after the Character 0/13<CR>	Implemented as specified.
4.13	Selection of Line Folding	Implemented as specified.
4.14	Selection of Start-Stop DTE Flow Control	Implemented as specified.

Table F

SL-10 ITI Enhancements

- Additional Data Forwarding Signals

National parameters 121 and 122 allow the definition of one or two additional data forwarding signals. These signals are in addition to any that are specified by parameters 3 and 4.

Parameter numbers: 121, 122

Parameter values:

0 = none

1-127 = ASCII code of additional data forwarding signal.

- Parity Treatment

This parameter specifies whether or not the PAD should detect and check parity.

Parameter number: 123

Parameter values:

0 = parity not checked

1= parity detected and checked

- Output Pending Timer

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This parameter specifies the length of time, if any, that terminal output is blocked by terminal input.

Parameter number: 125

Parameter values:

0 = output not to be blocked by input, effectively providing full-duplex transmission

1-255 = value of the delay in seconds.

- Line Feed Insertion

This parameter specifies when the PAD should insert LF upon receipt of carriage return form the terminal or the host. As the parameter value is bit-encoded, any combination of the options is permissible.

Parameter number: 126

Parameter values:

0 = LF not inserted

1 = Insert LF to terminal upon receipt of CR from host

4 = Send LF to terminal upon receipt of CR from terminal

5 = 1 and 4 combined.

- Local Editing Capability

Three national parameters are used to specify local editing (PAD editing) characters. Parameters 118, 119, 120 are used for character deleted, line delete and line display, respectively.

Parameter values:

0 = not specified (no editing)

1-127 = ASCII code of editing character.

Local editing applies to both command and data input and applies to command input unconditionally. The defaults for command input, if parameters 118, 119, or 120 is not specified, are as follows:

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Character delete: 7/15 (DEL)

Line delete: 1/8 (CAN)

Line display: 1/2 (DC2)

- User Defined Profile

This allows the user to specify at subscription time a default profile. The profile is referenced as profile 0 and be recalled with the PROF 0 PAD command. In addition a profile can be displayed using a PAD command signal.

For example:

PROF? 0

or PROF ? 0

ntwk name: prof 0 001:000, 002:001...

- Automatic speed and/or parity detection on entry of the service request signal.
- SVC, auto-direct and private virtual circuit calls.
- Specification of normal and priority classes of traffic.
- Input error service signals:

  ntwk name: re-enter

  ntwk name: parity error

  ntwk name: input error

  ntwk name: input data lost

- On an SL-10 processor if parameter 6 is 0, a character with a parity error is replaced by a (?). Also if input rejection occurs the circuit is rest.

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1.3. Subscription Options

1.3.1.

The subscription options for dedicated and private dial access ports are as follows:

Note: (D) Implies Default Value.

ITEM	OPTION
Code	ASCII (D)
Character Size	7 bits maximim (7 is default).
Parity Type	Mark, Odd, Space, Even. When detected (par 123 set), the parity checked is the value of this option.
Speed (baud) 200 300 600 1200	110
No speed specified (must use Service Request - - see Note 1).	
(Initial) Profile PROF 1 (INTL simple) PROF 2 (Canadian simple) (D) PROF 3 (Transparent) PROF 4 (Internetworking) PROF 5 (Terminal to terminal) PROF 6 (ITHI).	PROF 0 (User Selectable)
Closed User Group	UNIVERSAL (D).
One or more CUG's with options such as:	No outgoing access, no incoming access. Outgoing access. Incoming access (dedicated access only).
Direct Call ON - - one address for one line (dedicated); one address for one port (private dial).	OFF (D).
Virtual Circuit Type	Switched virtual circuit (D). Permanent virtual circuit.

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ITEM	OPTION
Priority (Note 2)	Priority enforced. Normal enforced. Priority nonenforced. Normal nonenforced (D).
Charging (Note 2)	Charge (i.e., normal) nonenforced. Charge enforced (dedicated access only). Reverse enforced.
Outgoing Calls Blocked	OFF(D).
Incoming Calls Blocked	OFF (default dedicated access only) ON (mandatory for dial ports).
ITI Calls Blocked	OFF (D) ON (Refuses any call from another ITI terminal

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Reverse Charge Calls Blocked	Refuses any collect (i.e., reverse charge) calls (D). Accepts normal collect calls within SL-10. Accepts normal + priority collect calls within SL-10. Accepts normal collect calls from all networks. Accepts normal + priority calls from all networks. Other combinations are possible, but will be provided if needs are identified.
Fast Select Calls	Fast Select Restricted - - allow/disallow outgoing restricted fast select call. Fast Select Unrestricted - - allow/disallow outgoing unrestricted fast select call. Fast Select Restricted Only - - allow/disallow only restricted fast select calls.

Notes:

1. If either speed or parity is left undefined, then a Service Request signal shall be issued. Speed specified by subscription options cannot be altered by Service Request. Parity specified by the subscription option is overridden by detected parity in the Service Request.

2. Nonenforced priority and charging options may be overridden at call time by the Selection ITI Command. Enforced priority and charging options cannot be overridden by Selection ITI command.

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1.4. System Timeouts

1.4.1. System timouts are as follows:

DURATION	EVENT WHICH STARTS OR RESTARTS TIMER	EVENT WHICH STOPS TIMER	EVENT WHICH OCCURS ON TIMEOUT
1 minute	Service Ready	Call connected	ITI disconnect of access line.
0-4.5 minutes (Note)	ITI waiting for input ot be complete and output data pending and termianl idle	Input complete	Output data transmitted to termianl.
22 seconds	ITI receipt of call from dial up port	ITI receipt of carrier from termianl	ITI disconnect of access line.
60 seconds	Exchange of READY signals on access line	ITI receipt of Service Request from termial	ITI disconnect of access line.
400 milliseconds	Absence of carrier on access line (except in access link not established state)	Carrier present on access line	Virtual circuit is cleared. ITI disconects access link.
Idle Timer (Note) (Parameter 4)	Receipt of character from terminal (Data Transfer State only)	Expiration of Timer	Transmit packet to host.
NOTE: These events are not coded rigidly into the system. They are controlled by parameters.			

2. Technical Interface Specifications for Asynchronous Service over a Bolt Bernack Newman (BBN) Platform

2.1. General

2.1.1. Introduction

This technical Interface Specification meant as a description of the operation of the Michigan Bell Telephone (MBT) packet assembly / disassembly (PAD) facility. The PAD facility is one of the services offered by the MBT packet-switched network (PSN).

The MBT PAD is based on CCITT Recommendations X.3, X.28 and X.29, which define the functions of a PAD for connecting asynchronous (start-stop mode) Data Terminal Equipment (DTE) to a packet-switched, public data network.

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This reference includes a brief description of a number of topics, among them the MBT network services, network access mechanisms, standardization, capabilities, PAD command language and PAD parameters.

This manual is aimed at a technical audience. Specifically, it is aimed at individuals who will act as network managers, or vendors who will be building equipment that must be compatible with the MBT PSN. Much of the relevant information for these users has been documented in companion manuals, which are referenced in Section 1.2, below.

2.1.2. Reference Documents

The following documents are referenced in this manual and/or provide useful background information for the reader.

CCITT Recommendation V.24: List of Definitions for Interchange Circuits Between Data Terminal Equipment (DTE) and Data Circuit-terminating Equipment (DCE). 1980.

CCITT Recommendation V.35: Data Transmission at 48 Kbps Using 60-108 KHz Group Band Circuits. 1980.

CCITT Recommendation X.3: Packet Assembly/Disassembly (PAD) Facility in a Public Data Network. 1980.

CCITT Recommendation X.25: Interface Between Data Terminal Equipment (DTE) and Data Circuit-terminating Equipment (DCE) for Terminals Operating in a Packet Mode on Public Data Networks. 1980.

CCITT Recommendation X.28: DTE/DCE Interface for a Start-Stop Mode Data Terminal Equipment Accessing the Packet Assembly/Disassembly Facility (PAD) in a Public Data Network Situated in the Same Country. 1980.

CCITT Recommendation X.29: Procedures for the Exchange of Control Information and user Data Between a Packet Assembly/Disassembly Facility (PAD) and a Packet Mode DTE or Another PAD. 1980.

CCITT Recommendation X.300: Principles and Procedures for Realization on International User Facilities and Network Utilities in Public Data Networks. 1980.

NOTE: Although all CCITT Recommendations were updated in 1984, the current MBT PAD facilities are compatible with the 1980 recommendations.

MICHIGAN BELL TELEPHONE Packet-Switched Network Dial-Up Users Guide. November, 1986.

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MICHIGAN BELL TELEPHONE Packet Assembly/Disassembly (PAD) Technical Users Guide. November, 1986.

2.1.3. Description of Service(s)

2.1.3.1. Service

The MBT PAD performs the call setup and packetizing function required for an asynchronous device to interface directly to the PSN. The PAD adapts to a wide range of terminal characteristics by providing each terminal with its own data buffers and a database describing the terminal's features.

The terminal database is comprised of 62 PAD parameters describing different features, characteristics and capabilities of the terminal. These parameters are initialized to some set of values when the terminal port connection is assigned. Terminal parameters may be changed at any time by either the user or host computer. The data flow between the terminal and the network is managed entirely by the PAD, so any terminal may communicate to any other type of process connected to the PSN, including hosts that support the X.25 and X.29 protocols.

If the host computer has X.29 software, it will be able to modify PAD parameter values. The user may alter PAD parameters by using either the X.28 command language or the special MBT PAD Command Language (PCL).

2.1.3.2. Network Access

MBT packet-switched network access features are described below:

PAD connection to PSN:

- Dial-up or direct line.
- Single composite link using the RS-232-C interface at speeds from 2.4 to 19.2 Kbps.
- Dual high-speed link, providing increased reliability and redundancy, using either the RS-232-C or V.35 interface at speeds up to 64 Kbps.

Terminal connection to PAD:

- Dial-up or leased line.
- RS-232-C interface. (Similar to CCITT V.24.)

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- Dial-up speeds supported are 110, 300 and 1200 bps.
- Dedicated line speed may be set automatically using PAD speed hunting. Supported speeds are: 50, 75, 75/1200, 110, 134.5, 150, 200, 300, 600, 1200, 1800, 2400, 4800, 9600 and 19200 bps.

  NOTE: 75/1200 means bps terminal-to-PAD, 1200 bps PAD-to-terminal.

Character format:

- Character codes is International Alphabet No. 5 (ASCII).
- Supported parity options: even, odd, mark, space
- Number of bits per character allowed: 7 or 8
- Number of STOP bits per character: 1, 1.5 or 2

2.1.3.3. Service Available

The MBT PSN offers the PAD user a variety of services to meet specific needs. The available services include:

- Switched virtual circuits (virtual calls)
- Reverse charging
- Packet size of 128 octets
- Window size from 1 to 7 (default = 2)
- X.121 addressing or arbitrary addressing support

Among the services **not** supported are:

- Permanent virtual circuits
- Fast select
- Bilateral closed user groups

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2.1.3.4. Standardization

The MBT PAD supports PAD parameters described in CCITT Recommendation X.3, the command language described in Recommendation X.28, and the CCITT X.25 and X.29 protocols.

In addition, the MBT PAD defines an extended set of PAD parameters and an extended command language, called the PAD Command Language (PCL).

The MBT PAD is also compatible with CCITT Recommendation X.300.

2.1.3.5. Capabilities

The MBT PAD can support most asynchronous terminals. the PAD terminal port is configured by a set of parameters associated with that port. These parameters are modifiable by either the user or host computer. The PAD parameters define the operating environment of the terminal and the format of the data to be displayed.

Initially, the PAD parameters have a value defined by a standard set of values, called a “profile.” Profiles may be created by the MBT network administrator, a local system manager or by the user.

Two command languages are supported by the MBT PAD to allow the user to perform control functions, such as establishing or clearing a virtual call, modifying or examining PAD parameters, or obtaining PAD status information. The user may enter commands directed to either the PAD, the network or the host computer.

When users use the X.28 PAD common language, only 21 of the PAD parameters may be altered. These include 19 of the 20 X.3 parameters plus two of the extended MBT PAD parameters. When users use PCL, 37 of the 62 extended PAD parameters may be altered. (Only the system manager may alter the remaining 25 PAD parameters.)

X.29 procedures are supported to allow the exchange of control information between the MBT PAD and the X.25 host computer that is in communication with the user terminal.

2.1.3.6. MBT PAD Parameters and Terminal Profiles

The MBT PAD is controlled by 62 parameters. The set of values for all parameters constitute a PAD, or user, profile. Profiles may be examined or modified by using the X.28 PROF, PAR?, SET or SET? commands, or by using the PCL PROFILE, PARAMETERS, SET or SET-AND-VERIFY commands.

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A list of the 37 user-accessible MBT PAD extended parameters is provided in Appendix A. The remaining 25 PAD parameters may be modified only by a network administrator, and are described in Appendix B. A list of PCL commands is provided in Appendix C. (PAD parameters and PCL are described in greater detail in the **PAD Technical Users Guide.**)

2.1.3.7. Multi-Language Features

The aspect of natural language usage in service signals is not covered in any CCITT Recommendation. The MBT PAD provides only limited flexibility in this matter.

While using the X.28 command language, command names are comprised of three or four character mnemonics. PAD parameters are referenced by number, and values are assigned by specifying an integer value. Service signals are typically comprised of short abbreviations.

While using PCL, however, command names are comprised of English words. (Although command names in PCL are fairly long, the user only has to specify the first four or five characters of each command; i.e., enough characters to uniquely identify the command.) Parameters are referred to by parameter name, values are assigned by short mnemonic names, and PAD service signals are usually complete sentences.

2.1.3.8. Network User Identification

The MBT PSN supports the Network User Identifier (NUI) feature, as defined in Recommendation X.28 ([3.2.1.2]). The NUI feature allows a PAD user to make locally-charged calls and accept reverse-charged calls form anther PAD port, by charging the call to the NUI associated with the user's port.

The PORT-DEFAULT-NUI Parameter is used to assign an NUI to a PAD port.

2.1.3.9. Fast Select

The MBT PAD does not support the establishment of calls using the Fast Select facility, as described in CCITT Recommendation X.25 ([7.2.4]).

2.2. MBT PAD IMPLEMENTATION OF CCITT RECOMMENDATIONS X.3, X.28 AND X.29

2.2.1. MBT PAD Implementation of X.3

The MBT PAD implements two versions of PAD parameters. The MBT implementation of X.3 parameters is nearly identical to the 1982 CCITT Interim X.3 Recommendation. One of the major differences is with Parameter 11 (Terminal Speed). First, not all of the X.3 terminal speeds

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are available in the MBT PSN. Second, this parameter may not be changed with X.28 commands: it must be changed with PCL.

Some of the MBT extended PAD parameters have slightly different values from their corresponding X.3 parameters. This most notably affects Parameters 9 (Carriage Return Padding) and 14 (Linefeed Padding). The X.3 parameters, assigned values by X.28 commands, may take on any integer value form 0 to 7; the MBT extended version of these parameters, assigned values by PCL commands, may take on any integer value form 0 to 255.

Appendix B of the **MBT PAD Technical Users Guide (TUG)** lists the MBT X.3 parameters and their values. Differences between the MBT implementation and the X.3 recommendation are noted. Appendix A of this document lists the MBT extended parameters and their values.

2.2.2. MBT PAD Implementation of X.28

The MBT PAD implements two versions of the user command language. The MBT implementation of X.28 commands is nearly identical to the 1980 CCITT recommendation. One of the major differences is the definition of a CONNECT command to initiate a virtual call.

MBT also defines an extended command language, called PCL. PCL is a proper superset of the X.28 command language, providing more flexibility and readability than X.28.

Appendix C of the**MBT PAD TUG** lists the MBT implementation of X.28 commands. Appendix C of this document lists the MBT PCL commands.

2.2.3. MBT PAD Implementation of X.29

2.2.3.1. Compatibility to CCITT

The MBT PAD implements the X.29 protocol as specified by the CCITT (1980). This implementation is handled totally by the PAD and is invisible to the user.

The X.29 protocol is described briefly in the sections below.

2.2.3.2. Initiating X.29

Recommendation X.29 provides a mechanism whereby the PAD and the X.25 host DTE can communicate with each other. This communication includes the ability of the DTE to read and/or set PAD parameters, indicate the clearing or resetting of a call, or indicate the occurrence of a BREAK signal.

X.29 is automatically initiated when the PAD user sends an X.28 CONNECT command, or a PCL CALL or CONNECT command. These user commands direct the PAD to generate an

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X.25 CALL REQUEST packet for the X.25 DTE. The Call User Data field in the CALL REQUEST packet indicates the use of X.29 by coding the first four octets of the field as follows:

Octet 1:	0 0 0 0 0 0 0 1
Octet 2:	0 0 0 0 0 0 0 0
Octet 3:	0 0 0 0 0 0 0 0
Octet 4:	0 0 0 0 0 0 0 0

The remaining octets of the Call User Data field may be filled with a 1 to 12 character ASCII string specified by the terminal user. This string is specified with the “P” or “D” argument of the X.28 CONNECT command, or with the “DATA” or “PASSWORD” argument of the PCL CALL/CONNECT command.

2.2.3.3. X.29 Messages

The PAD and X.25 DTE may exchange X.29 messages by sending the messages in X.25 DATA packets, where the Qualified Data bit (Q-bit) is set to 1.

There are eight X.29 commands. They are described in the sections below. Note that:

A. All values are in binary.

B. All octets are shown with the most significant bit (bit 8) on the left.

C. X.29 messages are completely contained in the Information field of X.25 DATA packets.

2.2.3.3.1. Parameter Indication

The Parameter Indication message allows the PAD to indicate one or more PAD parameter value to the X.25 DTE.

The format of the Parameter Indication message is:

Octet 1:	0 0 0 0 0 0 0 0
Octet 2:	parameter #
Octet 3:	parameter value

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where “parameter #” is one of the PAD parameters and “parameter value” is the value of that parameter. Additional pairs of octets containing a parameter number and value may be a part of this message. Non-CCITT PAD parameters may be supported by X.29. If non-CCITT PAD parameters are specified in a parameter list, they will be listed after ’parameter separator”. The parameter separator is two octets, filled with zeros. The parameter separator and non-CCITT parameters, if used, will follow the CCITT parameters.

If the action taken on a parameter is invalid for some reason, the “parameter #” field will contain a 1 in bit 8, and the “parameter value” will take on an error code, per the following table:

Error Type	Parameter Value Field
0 0 0 0 0 0 0 0	No additional information.
0 0 0 0 0 0 0 1	Invalid parameter number.
0 0 0 0 0 0 1 0	Invalid parameter value.
0 0 0 0 0 0 1 1	Parameter value may not be changed.
0 0 0 0 0 1 0 0	Parameter is read-only.
0 0 0 0 0 1 0 1	Parameter follows an invalid parameter separator.

2.2.3.3.2. Invitation to Clear

The Invitation to Clear message may be sent by either the PAD or the X.25 DTE to indicate that this virtual call should be cleared.

The format of this message is:

Octet 1:	0 0 0 0 0 0 0 1

2.2.3.3.3. Set PAD Parameters

The Set PAD Parameters message allows the X.25 DTE to set the value of one or more PAD parameters. If no parameter octets are provided (i.e., if only octet 1 appears), all PAD parameters are reset to their initial value.

The format of this message is:

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Octet 1:	0 0 0 0 0 0 1 0
Octet 2:	parameter #
Octet 3:	parameter value

where “parameter #” and “parameter value” are as described in Section 2.3.3.1., above.

2.2.3.3.4. Indication of BREAK

The Indication of BREAK message is used by the PAD to indicate that a BREAK signal has been transmitted by the user. Note that when the BREAK key is pressed at the terminal, no character is sent; instead, an electrical short is transmitted. This electrical signal cannot be transmitted through the network, thus this message is used.

The format of the Indication of BREAK is:

Octet 1:	0 0 0 0 0 0 1 1
Octet 2*:	0 0 0 0 1 0 0 0
Octet 3*:	0 0 0 0 0 0 0 1

NOTE: Octets 2 and 3 are optional. Both octets will be present or both will be absent.

2.2.3.3.5. Read PAD Parameters

The Read Parameters message allows the X.25 DTE to request to read the value of one or more PAD parameters. The PAD will send the DTE the parameter values by using the Parameter Indication message (Section 2.2.3.3.1). If no parameter octets are provided (i.e., if only octet 1 appears), all PAD parameter values will be displayed.

The format of this message is:

Octet 1:	0 0 0 0 0 1 0 0
Octet 2*:	parameter #
Octet 3*:	0 0 0 0 0 0 0 0

where “parameter #” is as described in Section 2.2.3.3.1., above.

2.2.3.3.6. Error

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The Error message allows the PAD or X.25 DTE to indicate that an error has occurred.

The format of the Error message is:

Octet 1:	0 0 0 0 0 1 0 1
Octet 2*:	Error type
Octet 3*:	Code

The Error Type field is coded per the following table:

Error Type field	Meaning
a. 0 0 0 0 0 0 0 0	Received PAD message contained less than 8 bits.
b. 0 0 0 0 0 0 0 1	Unrecognized message type.
c. 0 0 0 0 0 0 1 0	Parameter field format of received PAD message incorrect or incompatible with message type.
d. 0 0 0 0 0 0 1 1	Received PAD message did not contain an integral number of octets.
e. 0 0 0 0 0 1 0 0	Received an unsolicited Parameter Indication message.
g. 0 0 0 0 0 1 0 1	Received PAD message was too long.

In cases b, c, d, e and f, the Code field will contain the Message Type field (octet 1) of the received PAD message that was in error. In case a, the Code field will be absent.

2.2.3.3.7. Set and Read PAD Parameters

The Set and Read PAD Parameters message allows the X.25 DTE to set, and then read, the value of ore or more PAD parameters. After the parameters have been set to their new value, the PAD will reply with a Parameter Indication message (Section 2.2.3.3.1). If no parameter octets are provided (i.e., if only octet 1 appears), all PAD parameters are reset to their initial value, and then are displayed.

The format of this message is:

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Octet 1:	0 0 0 0 0 1 1 0
Octet 2:	parameter #
Octet 3:	parameter value

where “parameter #” and “parameter value” are as described in Section 2.2.3.3.1, above.

2.2.3.3.8. Reselection

The Reselection message is used by an X.25 DTE to request that the PAD clear the virtual call after the start-stop mode DTE had received all previously transmitted data, and then establish a new virtual call to the reselected DTE. (According to CCITT Recommendation X.29, support of the Reselection message is optional.)

The format of the Reselection message is

Octet 1: 0 0 0 0 0 1 1 1
Octet 2: 0 0 0 0 .ALEN..
Octets 3 - N: ....ADDRESS....
Octets N+1: - ....FLEN.....
Octets N+2 - N+2+FLEN: ...FACILITIES
Octets N+3+FLEN - ??: .CALL USER DATA.

where: ALEN is number of digits in address field, coded in binary (4 bits, value 0-15).

ADDRESS is the DTE address, coded in binary - coded decimal (BCD) (≤8 octets).

FLEN is number of octets in facility field, coded in binary (7 bits, value 0-109).

FACILITIES is the Facilities field (≤109 octets).

CALL USER DATA is the Call User Data field (≤12 octets).

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Appendix A

MBT PAD PARAMETER SUMMARY
(User-Accessible Parameters)

RECALL Parameter - Escape from Data Transfer Mode

NONE	Escape from data transfer mode is not possible.
1 - 127	Escape from data transfer mode by using the ASCII character corresponding to the specified decimal value.
"x"	Any ASCII character, except <NULL>, enclosed in single or double quotes. (default = "p")

ECHO - DATA Parameter - PAD Echo of Input

OFF	No PAD echo
ON	PAD echo

FORWARD-SET Parameter - Data Forwarding Signal

NONE	No data forwarding character
ALL	All characters act as data forwarding characters; thus, each character is indivudually transmitted
ALPHANUMERIC	Any alphanumeric character (A-Z, a-z, 0-9)
CR	CR (^M)
CTRL1	ESC, BEL (^G), ENQ (^E), ACK (^F)
CTRL2	DEL, CAN (^X), DC2 (^R)
CTRL3	EXT (^C), EOT (^D)
CTRL4	HT (^I), LF (^J), VT (^K), FF (^L)
CTRL-OTHER	All control characters, except for those listed in options CRTL1, CRTL2, CRTL3 and CRTL4.

IDLE-DELAY Parameter - Idle Delay Timer

OFF	Idle timer not used
1 - 255	Timeout value, in 1/20th of a second (i.e., 0.05-12.75 seconds).

TERMINAL-FLOW Parameter - Device Flow Control by PAD

OFF	No PAD flow control of device
ON	PAD flow control of device enabled

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MBT PAD PARAMETER SUMMARY
(User-Accessible Parameters)

SERVICE-SIGNALS Parameter - PAD Service Signals

NONE	No service signals allowed
NON-PROMPT	All service signals, except PAD prompt
PROMPT	PAD prompt service signal only
EVERYTHING	All service signals

BREAK-HANDLING Parameter - Procedures on BREAK

NONE	Do nothing
INTERRUPT	Send an X.25 INTERRUPT packet to the host
RESET	Send an X.25 RESET REQUEST packet to the host
SEND-BREAK	Send an X.29 Indication-of-Break message to the host
RECALL	Escape from data transfer state
DISCARD	Discard subsequent output to the terminal
EVERYTHING	Perform all actions specified in the other options, except OFF

DISCARD-OUTPUT Parameter - Discard Output

NORMAL	Normal data delivery
DISCARD	Discard output

RETURN-PADDING Parameter - Carriage Return Padding

NONE	No padding
1 - 255	Number of nonprinting (null) pad characters or time fill units

LINE-LENGTH Parameter - Long Line Folding

NONE	No line folding
1 - 255	Number of characters per line

SPEED Parameter - Terminal Speed

HUNT	50	75	110	134.5	150
200	300	600	75 / 1200	1200	1800
2400	4800	9600	19200		

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MBT PAD PARAMETER SUMMARY
(User-Accessible Parameters)

PAD-FLOW Parameter - PAD Flow Control by Terminal

OFF	No PAD flow control by terminal
ON	PAD flow control by terminal enabled

INSERT-LF Parameter - Linefeed Insertion

OFF	No Linefeed insertion
TO-TERMINAL	Insert LF after each CR sent to the terminal
FROM-TERMINAL	Insert LF after each CR received from the terminal (Note that the LF is included in the data sent to the host)
ECHO-TO-TERMINAL	Insert LF after each CR echoed to the terminal
ALL	All of the above except OFF

LINEFEED-PADDING Parameter - Linefeed Padding

NONE	No linefeed padding
1 - 255	Number of nonprinting (null) padding characters

EDITING Parameter - Editing in Data Transfer Mode

OFF	No editing during data transfer
ON	Editing possible during data transfer

DELETE-CHAR Parameter - Character-delete Character

NONE	No character-delete character
1 - 127	Decimal value of ASCII character to be used as character-delete character
"x"	Any ASCII character, except <NULL>, enclosed in single or double quotes

LINE-DELETE-CHAR Parameter - Line delete Character

NONE	No line-delete character
1 - 127	Decimal value of ASCII character to be used as line-delete character
"x"	Any ASCII character, except <NULL>, enclosed in single or double quotes

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MBT PAD PARAMETER SUMMARY
(User-Accessible Parameters)

REDISPLAY-CHAR Parameter - Line-redisplay Character

NONE	No line-redisplay character
1-127	Decimal value of ASCII character to be used as line-redisplay character
"x"	Any ASCII character, except <NUL>, enclosed in single or double quotes

TERMINAL-TYPE Parameter - Device Type

HARDCOPY	Hardcopy display terminal
CRT	CRT display terminal

ECHO-SET Parameter - Characters to Echo

ALL	All characters are echoed
CR	No echo of CR
LF	No echo of LF
CTRL1	No echo of VT, HT, and FF
CTRL2	No echo of BEL and BS
CTRL3	No echo of ESC and ENQ
CTRL4	No echo of ACK, NAK, STX, SOH, EDT, ETB and ETX
CTRL5	No editing characters (character-delete, line-delete, word-delete and line-redisplay) are echoed
CTRL-OTHER	No ASCII control characters are echoed, except those listed in options CTRL1 through CTRL5, above.

COMMAND-MODE Parameter - X.28 or PCL Command Mode

X.28	X.28 command language, X.28, interface, X.3 PAD parameters
PCL	MBT PCL interface and command language, MBT extended PAD parameters

QUOTE-CHAR Parameter - Quote Character

NONE	No quote character
1 - 127	Decimal value of ASCII character to be used as quote character
"x"	Any ASCII character, except <NUL>, enclosed in single or double quotes

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MBT PAD PARAMETER SUMMARY
(User-Accessible Parameters)

WORD-DELETE-CHAR Parameter - Word-delete Character

NONE	No word-delete character
1-127	Decimal value of ASCII character to be used as word-delete character
"x"	Any ASCII character, except <NUL>, enclosed in single or double quotes

COMPLETION-CHAR Parameter - Command Completion Character

NONE	No command-completion character
1-127	Decimal value of ASCII character to be used as command-completion character
"x"	Any ASCII character, except <NUL>, enclosed in single or double quotes (default = ESC)

HELP-CHAR Parameter - PCL Command Help Character

NONE	No help character is used
1-127	The decimal value of the ASCII character to be used as the Help character.
"x"	Any ASCII character, except <NUL>, enclosed by single or double quotes. (default = "?")

BITS-CHAR Parameter - Number of Bits per Character

2	Seven bits per character
3	Eight bits per character

PARITY Parameter - Character Parity Setting

EVEN	Output even-parity characters to the terminal and ignore (discard) terminal input characters with an odd parity.
ODD	Output odd-parity characters to the terminal and ignore (discard) terminal input characters with an even parity.
ON	Output characters to the terminal with the parity bit on (1) and accept input characters of any parity.
OFF	Output characters to the terminal with the parity bit off (0) and accept input characters of any parity.

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MBT PAD PARAMETER SUMMARY
(User-Accessible Parameters)

STOP-BITS Parameter - Number of Stop Bits per Character

1	Append on stop bit after each character
1.5	Append 1-1/2 stop bits after each character
2	Append two stop bits after each character

PAD-FLOW-OFF-CHAR Parameter - PAD Flow Control Character

NONE	No PAD flow-control-off character is used.
1-127	The decimal value of the ASCII character to be used as the PAD flow-control-off character.
"x"	Any ASCII character, except <NUL>, enclosed by single or double quotes.

PAD-FLOW-ON-CHAR Parameter - PAD Flow Control Character

NONE	No PAD flow-control-on character is used.
1-127	The decimal value of the ASCII character to be used as the PAD flow-control-on character.
"x"	Any ASCII character, except <NUL>, enclosed by single or double quotes.

TERMINAL-FLOW-ON-CHAR Parameter - Terminal Flow Control Character

NONE	No terminal flow-control-on character is used.
1-127	The decimal value of the ASCII character to be used as the terminal flow-control-on character.
"x"	Any ASCII character, except <NUL>, enclosed by single or double quotes.

TERMINAL-FLOW-OFF-CHAR Parameter - Terminal Flow Control Character

NONE	No terminal flow-control-off character is used.
1-127	The decimal value of the ASCII character to be used as the terminal flow-control-off character.
"x"	Any ASCII character, except <NUL>, enclosed by single or double quotes.

TERMINAL-OVERFLOW-CHAR Parameter - Input Buffer Overflow Signal

NONE	No terminal overflow character is used.

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MBT PAD PARAMETER SUMMARY
(User-Accessible Parameters)

1-127 The decimal value of the ASCII character to be used as the terminal overflow character.
"x" Any ASCII character, except <NUL>, enclosed by single or double quotes.

ECHO-COMMANDS Parameter - Echoing in PCL Command Mode

ON Echo characters back to the terminal while in PCL command mode
OFF Do not echo characters back to the terminal while in PCL command mode

SERVICE-SIGNAL-PREFIX Parameter - PAD Service Signal Prefix

NONE No prefix character to PAD service signals.
1-127 The decimal value of the ASCII character to be used as the prefix to PAD service signals.
"x" Any ASCII character, except <NUL>, enclosed by single or double quotes.

PROMPT-SUFFIX Parameter - PAD Prompt Suffix

NONE No PAD prompt suffix is used.
1-127 The decimal value of the ASCII character to be used as the PAD prompt suffix.
"x" Any ASCII character, except <NUL>, enclosed by single or double quotes.

CRLF-MAP Parameter - Carriage Return-Linefeed Map

OFF Treat LF characters as normal input data.
ON Discard the first LF following a carriage return and do not echo the LF back to the terminal.

Appendix B

MBT PAD PARAMETER SUMMARY

(Network administration parameters)

The network administration parameters will not be described since they are intended for use by network and system administrators.

Appendix C

MBT PAD COMMAND LANGUAGE

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This table provides a list of the commands in the MBT PAD Command Language (PCL). Both user and supervisory commands are listed. PCL provides a superset of the X.28 command language.

Call Setup Commands

a) Service Request Signal

Function: To request service from the MBT PAD after making a dial-up connection, or after powering up a terminal that is directly connected

Format: <CR> <CR>

Response: **pad>**

b) Call Request Command

Function: To establish a virtual call.

Format: CONNECT {host_number/PSN_number}
{X.121_address}

[DATA:string]
[PASSWORD:string]

[REVERSE-CHARGE]
[PACKET-SIZE:128]
[WINDOW-SIZE:window_size]
[SUB-ADDRESS:host_sub-address]

NOTES:
a) The DATA and PASSWORD parameters may not appear together. Only one, or neither, is allowed.
b) The argument "string" is any ASCII character string, between 1 and 12 characters.
c) The word CALL may be used instead of the word CONNECT in this command.

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Response: **Connection opened.,**

or appropriate error message.

c) ACCEPT-CONNECTIONS Command

Function: Enables user's PAD port to accept incoming calls. Port typically connot accept incoming calls until this command is ussued.

Format: ACCEPT-CONNECTIONS

Parameter Commands

d) PARAMETERS Command

Function: To examine all PAD parameters.

Format: PARAMETERS

Response: **par-name:value**
par-name:value
par-name:value
:
:

(All 37 user accessible parameters listed)

Function: To examine a specified set of parameters.

Format: PARAMETER par_name [,par_name [...]]

Response: **par-name:value**
par-name:value
:
(Only specified parameters listed)

e) SET Command

Function: Set the value of PAD parameters.

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Format: SET par_name:value[+value[...]]
[,par_name:value[+value[...]] [...]]

f) SET-AND-VERIFY Command

Function: Set the value of PAD parameters and examine their value.

Format: SET-AND-VERIFY par_name:value[+value[...]]
[,par_name:value[+value[...]] [...]]

Response: **par name:value**
par name:value
:

(Only specified parameters listed)

g) PROFILE Command

Function: To select a terminal profile.

Format: PROFILE profile_name

where "profile_name" is a file name.

Session Command

h) PAD Recall Character

Function: To escape from data transfer mode to PAD command mode.

Format: <DLE> or <^P> is PCL/X.3 default. PAD Recall character selected by RECALL Parameter.

<BREAK> if BREAK-HANDLING Parameter includes RECALL action.

Response: **pad>**

i) RESET Command

Function: To reset a virtual call.

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Format: RESET

Response: **reset** or appropriate error message.

j) STATUS Command

Function: To determine the communication status of the PAD port.

Format: STATUS

Response: **There is no connection activity.**
Port is accepting connections.
There is an active connection.
There is an initiated connection.

k) INTERRUPT Command

Function: To send an X.25 INTERRUPT packet to the host computer.

Format: INTERRUPT

Response: Appropriate status message.

l) CLEAR Command

Function: To terminate a call.

Format: CLEAR

Response: **Call cleared.** or appropriate error message.

m) Flow Control

Function: Flow control characters are used by the terminal to stop the PAD output to the terminal, or are used by the PAD to stop terminal input.

Format: The TERMINAL-FLOW Parameter indicates if the PAD may flow control the terminal, or not. By default, the XOFF (

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Other characters may be used, as specified by the TERMINAL-FLOW-ON-CHAR and TERMINAL-FLOW-OFF CHAR Parameters.

The PAD-FLOW Parameter indicates if the terminal may flow control the PAD, or not. By default, the XOFF (^S) and XON (^Q) characters are used for PAD flow control. Other characters may be used as specified by the PAD-FLOW-ON-CHAR and PAD-FLOW-OFF-CHAR Parameters.

Information Commands

n) PORT-INFORMATION Command

Function: Display information about the user's PAD port.

Format: PORT-INFORMATION

Response: Port-related information, including:
* PAD port to which terminal is connected
* Current state of port
* User interface (X.28 or PCL)
* Call status of port
* Current state of terminal
* Modem signals asserted on the port
* Call statistics for this port

o) PAD-INFORMATION Command

Function: Display information about the status of the PAD.

Format: PAD-INFORMATION

Response: PAD-related information, including:

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Network Manager Commands

p) LOCAL Command

Function: Used to prefix other PCL commands. Used by network managers. Ignored if used by standard PCL commands and non-privileged users.

Format: LOCAL PCL_command

where "PCL_command" is any PCL command except LOCAL

Supervisory Commands

PCL supports a number of supervisory commands, for use by operations and development personnel. Supervisory commands may be executed only after a LOCAL PRIVILEDGES or REMOTE PRIVILEGES command has been issued. Supervisory commands are briefly described below:

BROADCAST message_string

Sends the string "message_string" to all users currently connected to the PAD. The string must be no more than 72 characters in length.

CALL-HISTORY

Displays the number of incoming and outgoing calls associated with each PAD port, since the last time the PAD was restarted.

CONTROL link_number {EXTERNAL-LOOP} | {HARDWARE-LOOP} |
{SOFTWARE-LOOP} | {LOOPING-OFF}

This command affects the looping of the X.25 port specified by "link_number". EXTERNAL-LOOP indicates that the X.25 port is looped externally. HARDWARE-LOOP indicates the PAD sets the loop-back mode in the USART for the X.25 port. SOFTWARE-LOOP indicates that the Link Layer software of X.25 loops back the output data. LOOPING-OFF is used to nullify a previously issued loop command.

LOCAL PORT port_number DISABLE-PORT
REMOTE PORT port_number DISABLE-PORT

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Used to prevent the PAD from servicing the port in any way. Sets the port into not-accepting-connections state. This mechanism is commonly used to "busy out" a dial-up modem. When the port is disabled, the modem control signals are set to the state specified by the MODEM-DISABLED-OUTPUTS Parameter.

LOCAL PORT port_number ENABLE-PORT
REMOTE PORT port_number ENABLE-PORT

Used to reverse a DISABLE-PORT command, and is valid only for a port that is currently disabled. A newly enabled port is placed in the idle modem state.

END-ALLOC-TRACE

Turns off the tracing of memory allocations and deallocations.

END-LOCAL-PRIVILEGES

After execution of this command, the port no longer has access to the supervisory commands (until another LOCAL PRIVILEGES command is issued).

END-PRIVILEGES

Disables local and remote privileges, if enabled.

END-REMOTE-PROVILEGES

Disables remote commands. Valid only after a REMOTE PRIVILEGES command has been executed.

ENTER-LOADER

Stops execution of the PAD program and starts the loader/dumper program. All open connections are lost.

EXECUTION-PROFILING

THIS COMMAND FOR DEVELOPMENT PRESONNEL ONLY! IT MAY CAUSE THE PAD TO CRASH IF USED BY OTHER USERS!!

GENERATE-TRAFFIC [DURATION: {FOREVER} | {time_in_seconds}]
[MESSAGE-LENGTH: {RANDOM} | {length}]
[PERIOD: {CONTINUOUS} | {time_in_seconds}]
[PATTERN: {RANDOM} | {RIPPLE}]

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Causes the PAD to generate a stream of test traffic. Default argument settings generate a CONTINUOUS stream of 80 character messages, using a RIPLE pattern, where the test is continued FOREVER.

If no open connection exists, the traffic will be generated locally and sent to the terminal. If the user issues the command while a virtual circuit is open, the traffic will be generated locally and sent to the remote end of the connection. The generation of traffic may be haulted by entering a Recall character.

LOCAL PORT port_number command

Used to execute commands on behalf of another port on the same PAD that the user terminal is connected to. Local privileges must be enabled to use this command. "Command" may be one of the following:

ACCEPT-CONNECTIONS	CLEAR
DISABLE-PORT	ENABLE-PORT
MESSAGE	PARAMETERS
PORT-INFORMATION	SET
SET-AND-VERIFY	

LOCAL PRIVILEGES local_privileges_password

Enables access to the supervisory commands and allows the user to execute commands on behalf of other ports. The "password" is a configurable parameter. The "password" argument is not echoed by the PAD when entered.

MESSAGE {LOCAL PORT port_number MESSAGE message_string} |
{REMOTE PORT port_number MESSAGE message _string}

Send a "message_string" of up to 72 characters to the designated PAD port.

PORT-ADDRESS

Prints out all the addresses by which the port in use is known; i.e., one address per configured network link.

PRINT-ALLOC-TRACE

If the PAD has been running an allocation trace, this command will output the accumulated trace information.

ENTER-LOADER

Stops execution of the PAD program and starts the loader/dumper program. All open connections are lost.

EXECUTION-PROFILING

THIS COMMAND FOR DEVELOPMENT PRESONNEL ONLY! IT MAY CAUSE THE PAD TO CRASH IF USED BY OTHER USERS!!

GENERATE-TRAFFIC [DURATION: {FOREVER} | {time in seconds}]

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REMOTE PORT port_number command

Used to execute commands on behalf of a port on a PAD on the remote end of a virtual circuit. This command is valid only when a virtual circuit is open at this prot, the X.25 DTE at the other end of the virtual circuit is an MBT PAD, and remote privileges have been enabled. "Command" may be one of the following:

ACCEPT-CONNECTIONS	CLEAR
DISABLE-PORT	ENABLE-PORT
MESSAGE	PARAMETERS
PORT-INFORMATION	SET
SET-AND-VERIFY	

REMOTE PRIVILETES remote_privileges_password

Enables use of the REMOTE AND REMOTE PORT commands. The REMOTE command allows control over the remote PAD; the REMOTE PORT command allows control over the port at the remote end of a virtual circuit. The "password" is a configurable parameter, and is not echoed by the PAD when entered.

REMOTE command

Used to execute commands for the PAD which is at the remote end of the virtual circuit. It is valid only if there is a virtual circuit open on this port, the X.25 DTE at the other end of the virtual circuit is an MBT PAD and remote privileges have been enabled. "Command" may be one of the following:

BROADCAST	DISABLE-PORT port
ENABLE-PORT port	ENTER-LOADER
PORT-INFORMATION	REBOOT
RESTART	

RESTART

Causes the PAD to reinitialize itself, as if it had just been loaded. The X.25 link is restarted and all terminal ports are reset to their idle states.

START-ALLOC-TRACE

Causes the PAD to start recording information about allocations and deallocations of memory.

TIME [hh[:mm[:ss]]]

This command, without an argument, causes the PAD to display the current time. Since many networks span more than one time zone, the time is kept in Universal Time (UTC), also known as Greenwich Mean Time (GMT).

With an argument, this command may be used to set the time at the PAD.

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3. Technical Interface Specifications for Asynchronous Service over a Siemens Platform

3.1. Introduction

This technical reference describes the interface protocols necessary for asynchronous devices to communicate with packet mode DTEs or other asynchronous DTEs via the Siemens Packet Switched Network (PSN). The asynchronous interface is based on the 1980 and 1984 International Telegraph and Telephone Consultative Committee (CCITT) Recommendation X.28 [1]. The network fully supports 1980 Recommendations and selected 1984[1]. The network fully supports 1980 Recommendations and selected 1984 [1]. The network fully supports 1980 Recommendations and selected 1984 Recommendations. Unless otherwise indicated, specific references to sections of CCITT Recommendations are per the 1980 issue (Yellow Book).

The asynchronous interface defines the protocol between an asynchronous DTE and Public Data Network. The asynchronous DTE/X.25 DTE [4] interface (based on CCITT Recommendation X.29 [2] specifies the protocol between a packet-mode DTE and the Public Data Network. CCITT Recommendation X.3 [3] defines a packet assembly/disassembly (PAD) facility in a Public Data Network.

The asynchronous interface supports originating virtual circuit call service (permits DTE to set up a call) to X.25 or other asynchronous DTEs. The interface also supports terminating virtual circuit call service (allows the DTE to receive incoming calls) from X.25 DTEs and other asynchronous DTEs.

The interface at both ends of a connection between two asynchronous DTEs is identical, whether the remote end DTE is an asynchronous terminal or an asynchronous host computer. This connection supports all capabilities of the asynchronous DTE/X.25 DTE connection. X.29 is supported between respective DCEs.

Sections 2 through 5 of this document provide introductory information on the asynchronous interface. Section 6 presents the Siemens supported version of X.28 and Section 7 describes the Siemens supported version of X.29. Parameter and signal formats have been compiled within the attached tables for convenient reference.

3.1.1. Reasons for Reissue

This document describes capabilities of the asynchronous DTE interface from the Siemens PSN. Updates to this document may be issued as new capabilities become available. When the document is reissued, the reasons for reissue will be given in this section.

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3.1.2. Terms

This section defines some relevant terms in this technical reference.

- Network interface - the demarcation point between the network communications channel and user provided equipment.
- Data Circuit-Terminating Equipment (DCE) - equipment or functions on the network side of the interface that provide access to the PSN.
- Data Terminal Equipment (DTE) - user equipment that connects to a communications channel as a data source and/or sink. The DTE begins at the communications interface unit on a host computer or terminal equipment.
- Packet Assembler/Disassembler (PAD) - a function of the PSN that performs X.25 operations on behalf of the asynchronous DTE.
- Public Switched Telephone Network (PSTN) - a voice telephone network.
- Public Packet Switched Networks (PPSNs) - A Bell Operating Company maintained and operated public packet switched data network.
- Network refers to the Siemens packet switched network.

Please refer to Appendix A for additional terms and abbreviations.

3.1.3. Companion Documentation

This specification references a number of national and international standards/recommendations. Please refer to Appendix B for a listing and brief description of these references.

3.2. Overview

Figure 1 contains two illustrations which show the way an asynchronous DTE accesses a remote DTE through the PSN and shows the relationships among X.3, X.29 and X.25 protocols.

The first illustration shows haw an asynchronous DTE communicates with a packet mode DTE over the PSN. The asynchronous DTE communicates in a character asynchronous format defined in X.28 while the packet mode DTE communicates with the PSN using X.25 packets. The packetizing and depacketizing of data is performed by the DCE PAD software as defined in X.3. The packet mode DTE uses X.29 procedures to send and receive control information to and from the DCE PAD.

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The second illustration shows how two asynchronous devices communicate over the PSN. Both devices communicate in character asynchronous format via the PSN DCEs that implement the PAD software. The DCE PADs communicate with each other using X.29 procedures.

X.3 defines a set of 22 PAD parameters that can be configured to provide a variety of services to the asynchronous DTE. Each parameter can be set to any of a number of allowed values to provide different features. A combined set of parameter values defines a profile.

X.28 defines the command and service signals that enable the DCE PAD and asynchronous DTE to communicate with each other. These include a variety of commands and procedures that are used for setting PAD parameters, establishing a call, clearing calls, and inquiring about call status.

X.29 defines the formats of the control messages sent between the packet mode DTE and the DCE PAD (or between two PADs). These control messages provide a means for the packet mode DTE to manipulate the PAD parameters. PAD messages are contained in data-qualified packets (Q-bit = 1) at the X.25 packet level. All information transfer between the DCE PAD and packets mode DTE occurs according to procedures specified in X.25.

These PSN interface procedures conform primarily to the 1980 versions of these standards. unless otherwise indicated specific references to sections of CCITT Recommendations are per the 1980 issue (Yellow Book).

A private interface may be operated by a specific customer of the PSN. The service characteristics of the interface (e.g. operating speed, default profile) are determined by that customer during service provisioning by choosing among a variety of service options offered by the PSN. The PSN supports asynchronous direct access arrangements as well as dial-in via the PSTN to private interfaces.

Asynchronous DTE direct access and dial-in interfaces support originating virtual circuit call service (allowing the asynchronous DTE to initiate calls) to packet mode DTEs (X.25) and other asynchronous DTEs. The direct access interface also supports terminating virtual circuit call service (allowing the asynchronous DTE to receive calls) from packet mode DTEs (X.25) and other asynchronous DTEs.

3.3. DCE Functions and PAD Parameters

The PAD service in the DCE performs X.25 functions on behalf of the asynchronous DTE. How these basic functions are accomplished is determined by the user-selectable options available in the PAD parameters.

Service initialization and call establishment procedures are discussed in Section 6.

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3.3.1. DCE Functions

When the asynchronous DTE is physically connected to the DCE PAD, the interface is in one of two modes: data transfer mode or command mode.

In the data transfer mode the DCE PAD does not interpret any data it receives. It takes the data from the asynchronous DTE, one character at a time, and builds X.25 data packets (this is called “packetizing”). The X.25 data packets that arrive at the DCE PAD from the network are disassembled and output, one character at a time, to the asynchronous DTE (called “depacketizing”).

In the command mode all data received by the DCE PAD is interpreted as commands to be responded to according to the procedures defined in X.28 and X.29.

Before the asynchronous DTE can initiate a virtual circuit call to the remote DTE it must connect with the DCE PAD. This is referred to as service initialization. Service initialization procedures dictate what signals must be exchanged between the asynchronous DTE and DCE PAD to establish the initial communication. To facilitate this exchange, the DCE PAD assigns a default profile upon receipt of a valid service request from the asynchronous DTE. After the asynchronous DTE receives the service request acceptance from the DCE PAD, it may then issue commands to the DCE PAD. The interface is now in the command mode. While in this mode, the DCE PAD does not relay data. It interprets any data it receives as a command and responds by taking appropriate action. These commands range from PAD profile selections to virtual circuit call establishment.

A call request may be sent fro the asynchronous DTE to the DCE PAD to initiate call establishment. The DCE PAD takes this information and forms an X.25 call request packet on behalf of the asynchronous DTE. The rest of the call establishment procedures between the DCE PAD and, for example, a packet mode DTE follow the X.25 protocol logic. The DCE PAD sends a call-connected message to the asynchronous DTE after the remote DCE has received the appropriate call-accepted packet from the packet mode DTE. Once the virtual circuit call has been established the DCE PAD enters the data transfer mode. The DCE PAD performs packetizing and depacketizing functions in this mode.

The asynchronous DTE may enter the command mode at any time during the virtual circuit call by sending the escape-to-command character defined in parameter 1. Commands and responses between the remote packet-mode DTE and the local DCE PAD are sent via data qualified X.25 packets (Q bit = 1) and are dictated by X.29 procedures.

To clear a call the DCE PAD must return to the command mode. The asynchronous DTE can clear the call with the X.28 clear command. The packet mode DTE can clear the call either by sending an X.25 clear-request packet or by sending an X.29 qualified-data packet to the DCE

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PAD and instructing it to clear the call. The DCE PAD also handles reset and interrupt procedures.

3.3.2. PAD Parameters

The DCE PAD can perform the previously mentioned functions for a variety of asynchronous DTEs. This flexibility is achieved by providing PAD parameters that can be configured to meet the needs of a particular terminal, host, or application involved in a communications session. Each parameter function is identified by a reference number and is assigned a value used by the DCE PAD to determine actions to take for the particular terminal, host, or application. The DCE PAD maintains a set of parameters and their values for each active asynchronous DTE; this is called a profile. The PSN supports the X.3 parameters and values listed in Table 1. A description of these parameters is given throughout Section 6. Individual parameter values can be examined and/or set at any time during a call by either the asynchronous DTE (using X.28 commands) or the packet mode DTE (using X.29 PAD messages).

3.4. Physical Access

Dial-in and direct access arrangements are supported on the PSN.

3.4.1. Direct Access

Direct access service is offered using private line modems or through DDS access facilities operating from 1200 bps to 9600 bps.

3.4.1.1. Speeds

The asynchronous interface for direct access supports an asynchronous EIA interface to users and can operate at full-duplex speeds of 1.2, 2.4, 4.8 and 9.6 kbps.

3.4.2. Dial-In Access

The PSN supports a dial access port that provides a full-duplex interface.

3.4.2.1. Speeds

The PSN supports a dial-access port that provides a full-duplex interface, at 300 bps or 1200 bps.

3.4.2.2. Compatible Equipment

Please refer to the Siemens exchange termination compatibility specification in Appendix C for a cross reference of modems and data sets which are compatible with the Siemens PSN.

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3.4.2.3. Dial-In Port Types

The DCE supports two types of dial access ports: public dial ports, and private dial ports. The public dial ports require the use of a Network User Identification (NUI) which is signaled by the DTE in an call request packet to provide information to the PSN for billing purposes. NUI (see section 6.2.2.1.1) and auto reverse charging are optional on private dial ports.

3.4.2.4. Establishing the Switched Access Connection

Dial access ports use modem handshaking and an autobaud detection mechanism to detect the data rate of the DTE and set the DCE modem speed. To enable autobaud detection, the user initiates the session by entering a service request as specified in Paragraph 6.1.2.

3.4.2.5. Maintaining the Switched Access Connection

The DCE uses the following carrier disconnect criteria for all asynchronous dial access ports:

- The DCE disconnects an established connection through the PSTN network if the received carrier is interrupted or lost for more that 3.0 seconds. The DCE also ends the session on this port, including the virtual circuit call if one existed on this port.

- The DCE does not disconnect or end the session when the received carrier is interrupted or lost for less than 2.0 seconds.

It is recommended that this procedure also be implemented a the customer's DTE. Implementation of these disconnect criteria prevents the dial access user who subscribes to call waiting service from being prematurely disconnected if call waiting tones are received.

3.4.2.6. Disconnecting the Switched Access Connection

On a dial access port, after a disconnect in the physical level by either the user or the DCE, the DCE prevents connections to this port until after the user's session is cleared. This function prevents a new user from being connected to this port before the previous session is completely cleared.

3.5. Interface Subscription Options

The PAD service in the DCE performs X.25 functions on behalf of the DTE. How these basic functions are accomplished is determined by the user-selectable options available in the PAD parameters. Each parameter is identified by a reference number and is assigned a value used by the DCE to determine actions to take for the particular terminal, application or host. The

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DCE maintains a set of parameters for each active DTE - this is called a profile. This section describes the subscription options available to the asynchronous user on PSN.

3.5.1. Profiles

A profile is a specific combination of parameter values. The asynchronous interface supports user-selectable profiles and a user-default profile that can be defined for each direct access interface.

The user may alter parameters during a session by requesting a different profile or by setting individual parameters with the appropriate X.28 commands. These changes last for the duration of the session only and do not affect the default parameter values.

3.5.1.1. PSN Standard Profile

The CCITT has defined a simple standard profile and a transparent standard profile for general use (these profiles are defined in tables 15 and 16). A default profile has also been defined for Siemen's PSN. This profile, if configured, is equivalent to the CCITT simple standard profile except for a few variations. For instance, parameter 6 is set equal to 5 to allow for user-friendly PSN PAD service signals, and parameter 7 is set equal to 1 to allow for a uniform way of handling receipt of a break signal from the DTE. The Siemens PSN standard profile is described in Table 14.

3.5.1.2. User-Default Profiles

The User Default profile is a default profile defined for each interface port. The default profile on all asynchronous dial access ports is the defined default profile. On direct access interfaces the user default profile will be set at service order time to any combination of parameter values specified by the direct access customer.

3.5.1.3. User-Selectable Profiles

A user-selectable profile is stored in the DCE. This provides a simple means of setting the desired PAD parameters. When a user requests a user-selectable profile (see Section 6.1.3.2) the DCE immediately sets that entire profile. The asynchronous interface supports the simple and transparent standard profiles specified in the CCITT Recommendation X.28 and up to 16 other different profiles which can be defined in one PAD.

3.5.2. Closed User Groups

The closed User Group (CUG) facilities enable users to form groups, with different combinations of access restrictions, from or to users having one or more of these facilities. These are all optional user facilities assigned to the user for an agreed contractual period:

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A. Closed User Group - this facility in the basic form enables a user to belong to one or more CUGs. Users within a CUG may only make or receive outgoing calls to other users belonging to the same CUG.

B. Closed User Group with Outgoing Access - individual members of a CUG may make outgoing calls to the open part of the network or to other users belonging to the same CUGs.

C. Closed User Group with Incoming Access - individual members of a CUG may, if they choose, receive incoming calls either from other CUGs or from other network users.

A wide range of individual user call transmission/reception capabilities and restrictions can be provided by combining the functionality of the closed user group with that of the call barred facility (see sections 5.9 and 5.10.

3.5.2.1. Destination Exchange

At the destination exchange a validation check of the acceptability of the call is made. The call is forwarded only in the cases when the CUG interlock code received matches with the interlock codes stored at the destination exchange for the associated called user, or when a call with outgoing access is to be forwarded to a user which belongs to the open part of the network. In the cases when a call is rejected because of incompatible CUG information, an access barred signal is sent to the calling user.

NOTE: A call may be rejected for other reasons not related to the CUG facilities.)

A user may belong to one or more CUGs. In the case when a user belongs to more that one CUG, one of these is nominated as the preferred CUG of that user (the default). When a user belongs to multiple CUGs and receives a call request, at least one CUG must have the closed user group facility with incoming access or one of the CUG facilities must match that of the incoming call. Outgoing calls must be to another member of the requested CUG or the requested CUG must have outgoing access.

The realization of the CUG facilities is based on various validation checks at call set-up which determine whether or not a requested call is allowed. In particular, a validation check is performed by comparison of a interlock code, which is associated with each user belonging to a CUG.

Facility registration, including allocation of interlock codes, is controlled by the PSN and cannot be controlled by the user.

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3.5.2.2. Originating Exchange During Call Setup Procedure

DTE/DCE protocol actions at the originating exchange during call setup from a user belonging to a CUG, depend on whether the user belongs to one or more CUGs and on the combination of CUG facilities that apply.

3.5.2.3. CUG Selection

For each CUG that a user belongs to, the interlock code assigned to that CUG is stored and associated with the user at the local exchange. In the case when a user belongs to more than one CUG, a selection of the CUG concerned, and thus of the corresponding interlock code, is required at call setup. This selection is made on the following criteria.

In the case when the calling user makes a facility request that includes an index identifying a particular CUG, this is selected by the originating exchange.

In the case when the calling user makes no facility request identifying a particular CUG, the originating exchange selects the preferential (or only) CUG.

Thus no facility request concerning CUG facilities is required by the calling user in the case:

A. When the user belongs to one CUG only,

B. When a user that belongs to more than one CUG makes a call within the preferred CUG,

C. When a user having the closed user group with outgoing access facility makes an outgoing access call.

If a call is made using a NUI, the CUG membership will differ from the CUG membership if no NUI was specified. In this case, the CUG membership will correspond to the NUI. If no NUI is specified, the CUG membership is that of the line being used.

3.5.2.4. Call Setup from a User Having the Closed User Group with Outgoing Access Facility

In this case the call is regarded as an outgoing access call within the preferred (or only) CUG.

The call is set up at the originating exchange. The call request packet forwarded to the next exchange includes the interlock code of the preferred (or only) CUG together with an indication that the call is a CUG call for which outgoing access is allowed.

NOTE: With the above procedure, it is not necessary to distinguish at the originating exchange between a call within a CUG and an outgoing access call.

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3.5.2.5. Calls to a User Having the Closed User Group or the Closed User Group with Outgoing Access Facility

In this case an incoming call is accepted only when it is a CUG call, including the case when outgoing assess is allowed and correspondence is found between the interlock code received and an interlock code associated with the called user. If all the above conditions are not met, the call is rejected.

3.5.2.6. CUG Calls to a User Not Belonging to Any CUG

The incoming call is only accepted for a CUG call for which outgoing access is allowed. An incoming call without CUG facility is always allowed.

3.5.2.7. CUG Calls to a User Having the Closed User Group with Incoming Access Allowed Facility

In this case an incoming CUG call is accepted only when it is a CUG call with outgoing access allowed or correspondence is found between the interlock code received and an interlock code associated with the called user.

3.5.2.8. Calls Without CUG Facility

An incoming call without CUG facility is accepted only when the called user has no CUG facility or incoming access is allowed.

3.5.3. RPOA Selection

The user may specify a preferred first transit network (e.g., inter-LATA carrier) for an interface via the Registered Private Operating Agency (RPOA) Selection facility. The PSN will route any call originated on that interface that requires a transit network (e.g., an inter-LATA call between two PSN subscribers) to the preferred transit network unless the user selects a different transit network during call request via the RPOA selection facility (see Section 6.2.2.1.1).

3.5.4. Calling Card Service

A PSN user may obtain a Calling Card number from Siemens from which virtual circuit calls originating on the PSN ports may be charged. The user may signal the Calling Card number in the network user identification (NUI) facility of a selection PAD command (see Section 6.2.2.1.1).

Private ports can also be configured to allow originating virtual circuit calls to be charged to a Calling Card number. This capability can be established during service provisioning for the port.

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3.5.5. Hunt Group

A group of asynchronous interfaces may be arranged in a hunt group. On asynchronous hunt groups, up to 128 interfaces may share a single address. (Addressing is discussed in Section 6.2.1.) The PSN will distribute virtual circuit calls made to that address over all the interfaces in that hunt group. A call to that hunt group address is completed if there is at least one idle line within the group. All information associated with a particular call is routed over the same line within the group.

Interfaces within a hunt group may be added, activated, deactivated, and removed without affecting service on the other interfaces in the group.

3.5.6. Abbreviated Addressing

A private port may be configured to support abbreviated addressing. Abbreviated addressing allows a limited number of alphanumeric characters to represent a full address. Abbreviated addressing simplifies the calling procedure by eliminating the need for the user to enter, without error, a lengthy address (see Table 2).

3.5.7. Reverse Charging

Reverse charging is an optional user facility that may be requested by the user or a per call basis. This allows a calling user to request that the call should be charged to the called party.

A calling user may request reverse charging by means of a facility request over the DTE/DCE interface.

A. In the case when reverse charging is allowed by the originating exchange, the call control information forwarded to the succeeding exchange will include a reverse charging request indication,

B. In the case when reverse charging is not permitted by the originating exchange, the call is rejected and an invalid facility request call progress signal is sent to the calling user.

3.5.8. Fast Select

Fast Select is an optional user facility which may be requested by a DTE for a given virtual circuit call. The fast select facility allows the user to transmit up to 124 octets of data to the destination in the call request packet. The asynchronous user has one option while using Fast Select:

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- Fast Select with no Restriction on Response - In this mode the connection can enter the data transfer state upon call acceptance.

3.5.9. Incoming Calls Barred

Incoming calls barred is an optional user facility that may be used to limit access so that all the incoming calls to a subscriber are barred. This service is offered by the “one way logical channel outgoing” facility which blocks the incoming calls on all logical channels to that subscriber.

If this service applies to a subscriber, all the incoming calls from the network will be rejected, but it is possible for that subscriber to generate call requests in the network direction. The data transfer can be handled in both directions; this means the logical channels retain their full-duplex capability.

3.5.10. Outgoing Calls Barred

Outgoing calls barred is an optional user facility that may be used to limit access so that all of the outgoing calls from a subscriber are barred. This service is offered by the “one way logical channel outgoing” facility which blocks the outgoing calls on all logical channels from that subscriber.

If this service applies to a subscriber, all of the outgoing calls to the network will be rejected, but it is not possible for this subscriber to receive incoming calls. The data transfer can be handled in both directions; this means the logical channels retain their full-duplex capability.

3.6. X.28 Interface Procedures

The asynchronous DTE interface supports all the procedures specified in X.28 as well as some additional ones. The following sections describe the procedures for:

- a character interchange and service initialization
- exchange of control information
- exchange of user data

between an asynchronous DTE and a DCE PAD. Figures 5 and 6 illustrate these procedures and are recommended as a reference to the material presented in the following sections.

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3.6.1. Character Interchange and Service Initialization

3.6.1.1. Character Formats used in the Exchange of Control Formation Between DTE and DCE

The character formats used to exchange control information follow those indicated in X.28. The ASCII character set specified in ANSI X3.4 is used, as it is compatible with International Alphabet No. 5 described in CCITT Recommendation V.3. The structure of characters is in accordance with CCITT Recommendation X.4 [5]. These character formats apply when the DTE and DCE are exchanging commands and signaling messages. (See Section 6.1.3).

3.6.1.2. Service Initialization

Service initialization is the establishment of a logical link between the terminal and the network. Prior to service initialization, the physical link must be established (e.g., the user on a dial-in connection calls the DCE, waits for the tone, then presses the data button). The physical link is always connected on direct access interfaces. The procedures for service initialization are described below and illustrated using the state diagrams in Figures 2 and 3. Figure 4 provides a guide in the decoding of the state/event symbols used.

After the physical link is set up, both the DCE and DTE transmit binary ones across the interface. The user initiates communication by transmitting a service request (See Table 2 for format) to the DCE. The service request allows the DCE to detect the speed, code and parity of the DTE. This is required for terminals accessing dial-supports so that the binary speed parameter (Parameter 11) of the simple standard profile (default of dial-up) can be set accordingly.

To maintain a standard initialization procedure, a service request is also required of DTEs with direct access (even though a compatible profile, with the appropriate speed, is typically chosen at service order time.

After sending a service request, the DTE transmits binary ones. The DCE responds to a valid service request by sending a PAD-identification PAD-service signal. Typically, this signal welcomes the user to the PSN. An example is illustrated in Table 2. The DCE transmits binary ones after the PAD-identification PAD-service signal is sent.

If service signals are suppressed (Parameter 6 = 0) the interface goes directly into the PAD Waiting State after a valid service request is received. The logical link between the DTE and the network is established when the interface enters the PAD Waiting State.

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3.6.1.3. Exchange of Control Information

The interface goes from the PAD waiting state to the PAD command state at the start of a PAD command signal. Commands and service signals are exchanged between the DTE and DCE while in the PAD command state and PAD service signals state, respectively. The description and format of these signals is given in Tables 2 through 9. Command and service signals provide the following functions:

PAD command signals (DTE to DCE)

- Establish and clear virtual circuit calls
- Allow selection of standard profiles
- Allow selection of individual PAD parameters
- Request current PAD parameter status
- Send interrupt
- Request circuit status
- Reset virtual circuit call

PAD service signals (DCE to DTE)

- Call progress signals
- Acknowledge receipt of PAD command signals
- Transfer PAD operation information

For dial-up connections, if the first character of a PAD command signal is not received within 60 seconds after the interface entered the PAD waiting state, the DCE performs DCE clearing in accordance with Paragraph 6.2.3.4. If, after receiving the first character of a PAD command, a complete PAD command signal is not received within 60 seconds the DCE sends an error PAD service signal and the interface enters the PAD waiting state. The DCE also sends an error PAD-service signal indicates what error has occurred. Its format is illustrated in Table 6. This service signal is only sent when parameter 6 is 1 or 5.

3.6.1.3.1. Prompt PAD-Service Signal

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When an interface enters the PAD waiting state (state 5) or waiting for command state, the DCE PAD may indicate readiness to receive a PAD command by transmitting the prompt PAD-service signal. No PAD commands are accepted until this signal is received.

If parameter 6 is 5, when the interface enters the PAD waiting state or waiting for command state, the DCE indicates readiness to receive a PAD command by transmitting the prompt PAD-service signal. No PAD commands are accepted until this signal is received.

If the value of parameter 6 is 0 or 1, the DCE does not transmit a prompt to the DTE.

3.6.1.3.2. Profile Selection

In addition to the default profile assignment at service order time, the interface also supports DTE selection of profiles. After service initialization is complete, the user can choose one of the user selectable profiles stored in PAD software.

Generally, profile selection is more applicable to dial-access ports because direct-access ports typically provide the most compatible profile as a default when service is installed.

After service initialization, the DTE can request a profile by transmitting the profile-selection PAD command signal. The identifiers for network defined profiles are single or double decimal digits. Profile identifiers for the simple standard profile and the transparent standard profile are 90 and 91, respectively. These two pre-defined profiles are described in tables 15 and 16. If parameter 6 is 1 or 5, the DCE responds to this PAD command signal by sending an acknowledgment PAD service signal. The command and response are illustrated in Table 7.

These procedures do not preclude the DTE setting individual parameters as presented in Paragraph 6.2.4.

3.6.2. Procedures for Virtual circuit Call Control

For dial and direct access ports, the interface supports intra-LATA, inter-LATA, and internetwork calls. Also, an asynchronous subscriber can only place one data call at a time. Signaling procedures for RPOA Selection (on all calls), fast select, CUG (Closed User Group) request and reverse charging request are supported by the PSN. (See Paragraph 6.2.2.1.1). Auto-call service is also supported on dial and direct access ports. If auto-call service is subscribed to , when DTE activation is detected, the PAD automatically transmits a call-request packet containing a presubscribed called address and set of associated facilities to the specified address.

On the auto-reverse charge dial access ports, the interface supports intra-LATA, inter-LATA, and internetwork calls. Signaling procedures for RPOA selection and reverse charging are also supported. DTEs may, but need not , use either or both of these signaling procedures for each

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virtual circuit call. Regardless of whether the DTE uses the reverse charge request, the DCE automatically requests reverse charging on virtual circuit calls originating from these ports.

On ports requiring the use of a NUI, the interface supports intra-LATA, inter-LATA, and internetwork calls. Signaling procedures for RPOA selection, CUG request and reverse charging are supported.

3.6.2.1. Numbering

The PSN numbering plan compiles with CCITT Recommendation X.121 [6] which defines the international numbering plan for public data networks. This recommendation states that an international data number (IDN), which uniquely identifies a particular DTE, consists of a data network identification code (DNIC) followed by a network terminal number (NTN). the DNIC is a 4-digit code that uniquely identifies a network. The NTN is a sequence of 10 digits that is assigned to a particular interface or hunt group.

The PSN NTNs are 10 digits in length and map closely to the existing voice network numbering plan. They are of the form:

NXX + NXX + xxxx (N = 2,...9; X = 0,...9)

The first 3 digits of an NTN are the Data Numbering Plan Area (DNPA) code. The next 3 digits are the data central office code. Together, the codes uniquely identify a particular wire center served by the PSN. The allocation of DNPA and DCO codes will parallel that of the voice network NPA and CO codes notwithstanding future standards changes. The last 4 digits of the NTN, the end point number (EPN), uniquely identify a particular interface or hunt group within a wire center.

Direct access interfaces on the PSN may be addressed by a 10-digit NTN or a full IDN. Consistent with X.121, which allows a prefix to be used to distinguish among different address formats used on a network, the prefix 1 will indicate an address other than a 10 digit PPSN NTN. Thus, a full IDN (DNIC + NTN) is always preceded by the prefix 1.

Dial-in ports are assigned 10 digit NTNs which are used to identify the particular port on which a dial-in call originates to the remote DTE.

3.6.2.2. Call Establishment

Call Set-up is initiated when the DTE sends a selection PAD command signal to the DCE. The format of this command is illustrated in Table 2 and described below.

3.6.2.2.1. Selection PAD Command Signal

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The information content of a selection PAD command signal consists of an optional facility request block, an address block and a user optional call user data field.

3.6.2.2.1.1. Facility Request Block

The facility request block identifies the facilities used to establish the call. The available facilities include NUI, closed used group and reverse charging. Formats for the facility block are given in Table 2. If applicable to the particular access method, any combination of these facilities may be used. Several of the facilities that are supported by the PSN on asynchronous interfaces are:

- Network User Identification (NUI)

Presently, the NUI signal is required only when users must identify themselves for billing purposes. The user sends a selection PAD command signal that includes his login ID in the NUI facility as defined in CCITT Recommendation X.28. If the NUI facility is not selected, the network begins clearing procedures with the reason for clearing given as user failure to specify the NUI facility.

The NUI signal is not used for auto reverse charge ports because it is not required that the user identity be known by the DCE. For direct access to the DCE, user identity is known because of the physical termination on the DCE.

- Closed User Groups

Closed user groups allow members to communicate but precludes Communication with nonmembers. This privacy feature can be used to derive a private subnetwork from the components of the public network. This capability is provided via the CCITT defined closed user group facility (See Recommendation X.25 and X.87). The need to identify users limits the use of this facility to direct access ports and login-required ports.

- Reverse Charging

Reverse charge originating facility is optional on asynchronous interfaces. On direct access and NUI-required interfaces, it allows users to request via signaling procedures for each originating call, that the call be reverse charged. For private dial access, the user can call (via the voice network) interface ports designated as automatic reverse charge. On these ports, the PAD automatically requests reverse charging on all virtual circuit calls.

Formats for the facility block are given in Table 2.

If the DCE receives an invalid facility request, it performs DCE clearing in accordance with Paragraph 6.2.3.4.

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3.6.2.2.1.2. Address Block

A 10-digit PSN NTN or 14-digit full IDN with the prefix 1 may be placed in the address block of the selection PAD command signal when the DTE requests a virtual circuit call setup to another interface or another PPSN. A full IDN with prefix must be used when requesting a call to a DTE on a non-PSN public packet switched data network.

3.6.2.2.1.3. Call User Data Field

The call user data field of a selection PAD command signal is optional and is used to append up to 12 characters (124 characters if fast select) or application-dependent information to a call request. The interface supports the call user data field as a per call option consisting of the characters “P” or “D” followed by up to 12 characters of user data.

The interface interprets the “P” or “D” as a signal for the DCE to not echo or echo, respectively, any characters of user data; this “P” or “D” is not interpreted as user data and therefore is not included in the X.25 Call Request Packet.

3.6.2.3. Call Progress

After the DTE transmits the selection PAD command signal, it transmits binary ones and the interface enters the DTE Waiting State. The interface remains in this state until a valid selection PAD command signal is received by the DCE. Upon receipt of the valid selection PAD command signal, the DCE does the following depending upon whether or not service signals have been suppressed:

- If the value of parameter 6 is 0, the DCE does not send any service signals and the interface enters the connection-in-progress state. It remains in this state until the virtual circuit call is established or cleared.

- If parameter 6 is 1 or 5, on receipt of a valid selection PAD command signal the DCE transmits an acknowledgment PAD service signal (format illustrated in Table 7) followed by binary ones and the interface is put in the connection-in-progress state. To indicate whether the call has been accepted or cleared, the DCE either sends a connected PAD service signal, or a clear-indication PAD service signal, respectively.

The interface enters the PAD service signals state upon initiation of these signals. This state is bypassed if parameter 6 is 0. PAD service signals responding to previously transmitted PAD command signals have priority over PAD service signals arising from vents within the network. No characters are echoed and no PAD commands are accepted while the interface is in state 8 (transmission of service

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signals). If the interface is in state 7 (connection in progress), the only command accepted is a clear request PAD command.

If the virtual circuit call is established, the interface enters the data transfer state after receiving the connected PAD service signal. Data transfer is discussed on Part 6.3

If the virtual circuit call is not accepted, the interface enters the PAD waiting state after receiving the clear-indication PAD service signal. If the interface on a dial-up connection enters the PAD waiting state more than 10 times after receiving a service request signal without a virtual circuit call being set up, the DCE discounts the physical access. This does not apply to direct access connections.

3.6.2.3.1. Incoming Calls

Incoming calls are supported according to procedures defined in X.28. The DCE indicates only the presence of an incoming call to the DTE when the interface is in the PAD waiting state. The DCE does not expect a response from the terminal when an incoming call PAD service signal (See Table 8 for format) is sent. After the terminal receives this signal the interface immediately enters the data transfer state.

3.6.2.3.2. Clearing

Clearing the virtual circuit call can be initiated by either the DTE or DCE.

3.6.2.3.3. DTE Clearing

A DTE can clear a virtual circuit call in one of two ways. The first is to actually disconnect the physical access path (hanging up a dial connection or turning off the terminal). Also, the DTE could clear the call by escaping to the command mode and issuing a clear-request PAD command signal. If a clear request is used, and parameter 6 is set to 1 or 5, the DCE responds with a clear-confirmation PAD service signal. If an invalid clear-request PAD command signal is sent, the DCE includes a local procedural error cause in the clear-indication PAD service signal. The format of these signals is given in Table 3, 4 and 5. After transmitting a clear-indication PAD service signal, the interface is in the PAD waiting state and the DTE is allowed a follow-on call.

If service signals were suppressed (parameter 6 = 0), no follow-on call is allowed and physical access is disconnected when the DCE receives the clear request.

3.6.2.3.4. DCE Clearing

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The DCE initiates virtual circuit call clearing by transmitting a clear-indication PAD service signal to the DTE. After sending the signal, the interface is in the PAD waiting state. The DTE stops sending data when it receives the signal and transmits binary ones. If service signals were suppressed the interface goes directly to the PAD waiting state without the DTE being notified of call clearing. If the call is to a dial-up port, the DCE then clears the dial-up connection.

If physical access is disconnected for any reason, the call attempt or virtual circuit call is cleared by the DCE.

3.6.2.4. Procedures for setting or Changing PAD Parameters

When the interface is in the PAD command state, the DTE may change the values of one or more parameters by sending a set or set-and-read PAD command signal. As illustrated in Table 7, the commands include parameters reference(s) and value(s).

If parameter 6 is 1 or 5, the DCE responds to a valid set-and-read PAD command by sending a parameter value PAD service signal. This signal indicates the newly set parameters and also indicates any invalid PAD parameters that were requested (invalid parameters are not invoked). The DCE responds to a valid set PAD command signal by transmitting an acknowledgment PAD signal. Both service signals are shown in Table 7.

When parameter 6 is 0, the DCE accepts and invokes valid parameters without advising the DTE of any invalid parameters or parameter values.

3.6.2.5. Procedures for Reading PAD Parameters

A DTE may inquire about the current values of one or more parameters by transmitting a read PAD command signal (See Table 7). The DCE responds with a parameter value PAD service signal as described in the previous section. If service signals are suppressed the read command is ignored.

3.6.2.6. Parameter Priority

This section describes the procedures to resolve a situation where different parameters use the same character as a parameter value (e.g., if both the line delete character and line display character (parameters 17 and 18) are designated as ASCII Character No. 24, CONTROL X).

The asynchronous terminal interface does not check for character duplication, even if duplication occurs while changing parameters. If this situation occurs, the DCE performs the function of the parameter with the highest priority among those parameters whose values are duplicated. Priority assignment to parameters that may be duplicated is illustrated below:

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(Highest) 1. PAD recall character (parameter 1)

2. PAD command signal delimiter

3. X.ON, X.OFF (parameter 12)

4. Character delete (parameter 16)

5. Line display (parameter 18)

6. Data forwarding character (parameter 3)

(Lowest) 7. Line delete (parameter 17)

3.6.2.7. Procedure Regarding the Current Value of PAD Parameters

The following conditions apply when a call is cleared without being physically disconnected:

- Upon receipt of a clear packet either before or after call set-up, the DCE resets the parameters to the values specified in the default profile.

3.6.3. Procedures for the Exchange of User Data

3.6.3.1. Data Transfer State

The interface enters the data transfer state when the DTE receives the connected PAD service signal. It remains in this state until either an escape to command mode character is sent by the DTE or the virtual circuit call is cleared.

Any character sequence, except functional characters specified in the parameters, can be sent from DTE to remote DTE while in the data transfer state. Procedures for sending the 1/0 (DLE) character (when parameter 1 is set to 1) are described in the beginning of section 6.3.5.

3.6.3.2. Data Exchange

The treatment of parity during data transfer follows the same procedures specified in Section 6.1.2. The DCE delivers data to the DTE by inserting start and stop bits according to CCITT Recommendation X.4.

3.6.3.3. Packet Forwarding Conditions

A packet is forwarded from the DCE to the remote DTE when enough data to fill a packet has been received. Packet forwarding also occurs upon expiration of the maximum assembly timer

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delay period. This timer begins when the first character to be assembled into the packet is received by the DCE. The value of the timeout is less than or equal to 12.75 minutes.

The DTE can also impose packet forwarding conditions by performing one of the following:

- Allowing the idle timer delay period to elapse. The idle timer is restarted each time a character is received by the DCE. If a character is not received within the specified delay period (set in parameter 4) the packet is forwarded. If the packet cannot be forwarded because of flow control constraints, characters continue being added to the packet until either flow control permits forwarding or the packet is full. This forwarding condition does not apply if parameter 15 is 1.
- Sending a data forwarding character (set in parameter 3).
- Transmitting a break signal (when parameter 7 is not 0).
- Sending a PAD command signal.

3.6.3.4. Reset Procedures

3.6.3.4.1. DTE Sending Reset PAD Command Signal

The DTE resets a virtual circuit call by escaping from the data transfer state and transmitting a reset PAD command signal to the DCE. The format of this signal is given in Table 9. The DCE interprets a break signal as a reset PAD command signal if parameter 7 is 2. The DCE acknowledges the reset, if parameter 6 is 1 or 5 by sending an acknowledgment PAD service signal.

3.6.3.4.2. DCE Sending Reset PAD Service Signal

If the remote DTE or the network resets the virtual circuit call, the DCE sends a reset PAD service signal to the DTE when parameter 6 is 1 or 5. This signal indicates whether the reset was caused by the remote DTE, a local procedural error, or network congestion. The format for the restart PAD service signal is illustrated in Table 9. If parameter 6 is 0 the DCE does not inform the DTE of a reset.

3.6.3.5. Escape from Data Transfer

The DTE can escape from data transfer by sending either an escape character (set in parameter 1) or a break signal (if parameter 7 is 8) to the DCE. If parameter 6 is 5, the DCE responds by sending a prompt PAD service signal. Upon receipt of the escape signal, the interface enters the waiting for command state.

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All data destined for the DTE is delayed until the interface returns to the data transfer state. The next character sent by the DTE is interpreted as follows:

- If the character is 1/0 (DLE), the interface returns to the data transfer state and this character is treated as user data.
- If the character is the PAD command delimiter (+ or CR), the DCE does not transfer it and the interface returns to the data transfer state.
- If the character is the first letter of a PAD command, the interface enters the PAD command state. This is a packet forwarding condition.

If the complete PAD command is not received within 60 seconds or an invalid command is sent, the DCE responds with a PAD service signal (if service signals are not suppressed) indicating the error. The interface then returns to the data transfer state.

Following the transmissions a valid PAD command, the interface goes from the service signals state (bypassed if service signals are suppressed) to either the data transfer state, connection in progress, or the PAD waiting state, whichever is appropriate (i.e., a valid selection PAD command leads to the connection in progress state).

3.6.3.5.1. PAD Commands and Procedures Allowed After Escape from Data Transfer

Upon escape from data transfer, the DTE can use any of the following procedures or PAD commands:

- Procedures described in section 3.6.2.3.3 to clear a virtual circuit call.
- Procedures described in section 3.6.3.4.1 to reset a virtual circuit call.
- If parameter 6 is 1 or 5, the DTE can check to see if a virtual circuit call exists by sending a status PAD command signal. The DCE responds by sending either a call-established or a call-idle PAD service signal. The format of these signals is illustrated in Table 6.
- A request that an interrupt packet be sent to the remote DTE by transmitting an interrupt PAD command signal (see Table 6) to the DCE. If parameter 6 is not 0, the DCE responds with an acknowledgment PAD service signal.
- The profile selection, set, set-and-read, and read PAD command signals.

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3.6.3.6. Flow Control

3.6.3.6.1. Ancillary Device Control

If parameter 5 is 1, DCE can flow control the data input from the DTE. When the DCE can no longer accept characters from the DTE, it transmits an X-OFF character. These characters are those which in International Alphabet No. 5 IA are used to switch a transmitting device on and off. When it can receive another character, the DCE transmits the X-ON character. The network can continue to accept a maximum of another 32 characters after the X-OFF has been sent. For this parameter to have any effect, the DTE must recognize standard X-ON and X-OFF characters and respond to them (i.e., stop input on X-OFF, resume input on X-ON.

3.6.3.6.2. Flow Control of the DCE by the DTE

If the interface is in the data transfer state and parameter 12 is 1, the DTE can flow control the DCE by using X-ON and X-OFF characters.

3.6.3.7. Echo

The value of parameter 2 dictates whether characters are echoed by the PAD. Typically, they are echoed by the PAD (parameter 2 = 1) because when this function is performed by the remote DTE the packet count may be more than doubled and delay is usually experienced. For some applications (e.g., editing), the remote DTE may want to assume the function of echoing. In the data transfer mode, characters to be echoed have priority over data characters waiting to be delivered. Characters that cannot be accepted by the DCE, because of flow restrictions, are not echoed.

3.6.3.8. Procedure on Break

When a break is entered from the DTE, it results in a physical break on the communications line. This physical occurrence cannot be transmitted over a packet switched network so another means of notifying the remote DTE that a break has occurred is required. The settings for parameter 7 define ways for accomplishing this (see Table 1). The setting relies on the remote DTE knowing what to do with the information indicating that a break has occurred.

Parameter 8 is used in conjunction with the setting of parameter 7 to 21. It indicates whether data destined for the DTE is being flushed by the DCE or is being delivered.

3.6.3.9. Other Terminal-Dependent Parameters

3.6.3.9.1. Carriage Return Padding

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The DTE can specify, by means of parameter 9, the number of padding characters to be inserted after each carriage return transmitted or echoed to it. Padding ensures that characters are not printed when the mechanical device (carriage) is being returned to the left margin of the user's display device. The value of parameter 9 indicates how much padding, either a nonpregnant character (NULL) or time fill, is required. This value also specifies the padding inserted after the line feed (ELF) character of the form effector.

3.6.3.9.2. Line Folding

Through parameter 10, the DTE can select a line folding option and specify the maximum number of characters that the DCE can send to it as a single line. After K2 characters (value of K2 set in parameter 10) in an output line the DCE inserts a format effector and provides appropriate format effector padding (parameter 9).

3.6.3.9.3. Line Feed Insertion

Parameter 13 allows the DTE to specify the action taken by the DCE, with respect to line insertion when it deals with a carriage return during data transfer.

3.6.3.9.4. Line Feed Padding

Parameter 14 specifies whether or not padding is done after a line feed is transmitted to the DTE.

3.6.3.10. Editing

The DCE provides editing functions for the DTE so it can edit character input to the DCE before it is processed. The editing buffer can be up to 128 characters but is not larger than the assigned packet size.

Editing is always available in the command mode. The three functions provided are character delete, line delete, and line display. The characters used to perform these functions are determined by the settings of parameters 16, 17 and 18 or may be network default characters. Any default character may be overridden by the setting of a parameter.

Editing during the data transfer mode is selectable by setting parameter 15. If editing is selected, the value of the idle timer (parameter 4) is ignored during data transfer.

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3.7. X.29 Interface Procedures for Support of Asynchronous DTEs

3.7.1. Procedures for the Exchange of User Data and Control Information

This section describes the protocol required in the X.25 Interface Specifications to provide interconnection with asynchronous terminals. This protocol is compatible with CCITT Recommendation X.29. For the following description, the asynchronous device is the “local DTE” and the X.25 device is the “remote DTE”.

3.7.1.1. Call Establishment

When the local DCE receives a selection PAD command signal from the local DTE (refer to Section 6.2) it maps the information contained in the signal into a call request packet and sends this packet to the remote DCE. The remote DCE in turn sends an incoming call packet to the remote DTE. (For packet formats refer to Recommendation X.25.)

The call user data field of an incoming call and a call request packet is divided into a protocol identifier field and a call field. The format of the protocol identifier field is illustrated in Figure 7. The call data field contains any user data that was sent by the local DTE in the selection PAD command signal.

A call request may also be initiated by the remote DTE. In this instance, the call user data field is optional and the DCE still accepts the call if none is provided.

3.7.1.2. Data Transfer

After the call has been established, the DCE and remote DTE can exchange the complete repertory of packet types. The user data fields of data packets are used to carry PAD messages and user data. The Qualifier bit (Q-bit) distinguishes user data transfer from PAD messages. Data packets that contain user data have the Q-bit set to 0 indicating the data is intended for the local DTE or has originated from the local DTE. Data packets that contain a PAD message have the Q-bit set to 1, indicating the data is intended for the DCE or has originated from the DCE.

The DCE sets the D bit to 0 in all transmitted data packets containing user data. The DCE takes the following actions when receiving data packets containing user data. If the D bit is set to 1, the DCE acknowledges the packet when the data is transmitted to the local DTE.

The significance of the acknowledgment is that the data has been transmitted to the local DTE, but there is not acknowledgment by the local DTE. The DCE need not withhold the acknowledgment if the data packet has the D bit set to 0.

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3.7.1.3. PAD Messages

PAD messages allow the remote DTE to set parameters, read parameters, and initiate call clearing from the DCE. PAD messages allow the DCE to indicate the value of parameters (in response to a read from the remote DTE), indicate that the terminal sent a break, and indicate a remote DTE PAD message in error.

All PAD messages contain a control identifier field and a message code field (refer to Figure 8). Some PAD messages also include a parameter field. The control identifier field (bits 8 through 5 of the first byte) contains all zeros. The message code field (bits 4 through 1 of the first byte) indicates the message type (see Table 11).

Successive bytes (this does not apply to message types 1 and 5) are interpreted in pairs where the first byte indicates the PAD parameter reference number and the second byte indicates the value of the parameter. The DCE supports PAD message length of at least 61 octets. This allows for one octet containing the control identifier field and message code, followed by up to 30 parameter fields. If a parameter reference appears more than once in a PAD message, only the last appearance is taken into account.

The DCE does not set the D bit to 1 when transmitting data packets containing PAD messages.

The DCE takes the following actions when receiving data packets containing PAD messages. If the D bit is 1, the DCE acknowledges the packet when the command contained in the PAD message has been carried out. The significance of this acknowledgment is that the DCE has completed the actions specified by the PAD message (command). The DCE need not withhold the acknowledgment if the data packet has the D bit set to 0.

3.7.1.3.1. Procedures for Setting and /or Reading PAD Parameters

When the DCE receives a set, read or set-and-read PAD message, any data destined to the local DTE is delivered before action is taken in response to the message. Receipt of this PAD message is also a data forwarding condition. The occurrence of a packet forwarding condition does not cause the DCE to transmit empty data packets.

The DCE responds to a valid read or set-and-read PAD message by making the appropriate parameter modifications and then sending a parameter-indication PAD message. The parameter-indication PAD message contains the specified parameter reference numbers and their current values (after modification, if any). A parameter-indication PAD message is not sent in response to a set PAD message. Table 10 specifies the DCEs response to set, read, and set-and-read PAD messages.

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3.7.1.3.1.1. Parameter Field for set, Read, Set-and Read, and Parameter Indication PAD Messages

The parameter field, when present, of these PAD messages consists of successive parts of reference fields and value fields, each one octet long (see Figure 8).

Parameter reference numbers are binary coded in bits 7 to 1 or the reference field. The DCE ignores bit 8 in all PAD messages it receives and only interprets bits 7 to 1. If bits 7 to 1 contain an invalid reference (see Section 3.7.1.3.5) the DCE sets bit 8 to 1 in the parameter-indication PAD message to inform the remote DTE of an error.

Parameter values are coded in bits 8 to 1 of the parameter value field. The value fields in read PAD messages contain the value 0. In set and set-and-read PAD messages, the value fields contain the requested parameter values. If the preceding reference field has 8 set to 1, the value field indicates the reason for error as given in Table 12.

3.7.1.3.2. Procedures for Inviting the PAD to Clear

The remote DTE can request that the DCE clear a virtual circuit call by sending it an invitation-to-clear PAD message. Upon receipt of this message, the DCE sends all previously transmitted data to the local DTE. The DCE then sends a clear indication packet to the remote DTE with the clearing cause field of this packet set to “DTE clearing”.

The invitation to clear PAD message consists of only one octet (control identifier field and message code). This is illustrated in Figure 10.

3.7.1.3.3. Interrupt and Discard Procedures

The following procedures apply when the local DTE transmits a break and parameter 7 is 21. The DCE sends an interrupt packet with the user data field set to 0 followed by an indication-of-break PAD message (refer to Figure 11). The parameter field of this message indicates that parameter 8 is set to 1 (discard output).

The remote DTE must send a set or set-and-read PAD message changing the value of parameter 8 to 0 (normal data delivery) before data transmission to the DCE can resume. If the DCE receives an indication-of-break PAD message from the remote DTE with no parameter field, it transmits a break signal to the local DTE.

If the local DTE sends an interrupt PAD command or break signal to the DCE and parameter 7 is set to 1, the DCE responds by transmitting an interrupt packet with the user data field coded as 00000001.

3.7.1.3.4. Procedures for Reset

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Procedures for reset are described in CCITT Recommendation X.25. A reset results in parameter 8 being set to 0 (normal data delivery). All other parameters maintain their current values.

3.7.1.3.5. Error Handling Procedures by the DCE PAD

If an error occurs in one of the reference/value sets of the parameter field in a set, read, or set-and-read PAD message, the DCE indicates it in the parameter-indication PAD message by setting bit 8 in the reference field to 1. Possible errors include: referencing a parameter that does not exist, trying to set a read-only parameter and requesting an invalid parameter value. These errors do not affect the processing of any other valid references to PAD parameters.

When the DCE receives an invalid PAD message, it responds by sending an error PAD message. The error PAD message (see Figure 9) indicates what type of error has occurred (see Table 13) and also contains the message code of the invalid PAD message.

FIGURE 1

ASYNCHRONOUS TERMINAL INTERFACES

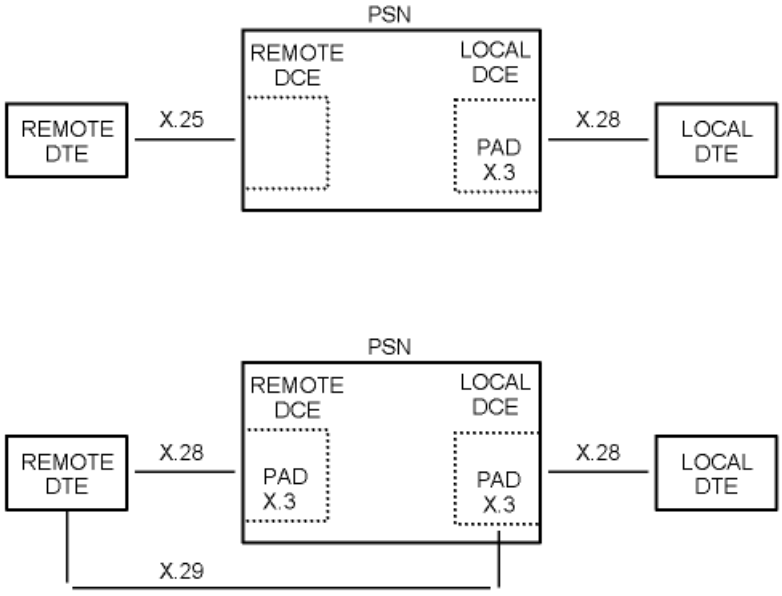

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FIGURE 2 *

STATE DIAGRAMS OF CALL ESTABLISHEMNT AND CALL
CLEARING BY PAD COMMAND AND SERVICE SIGNALS WHEN PARAM. 6 IS 1

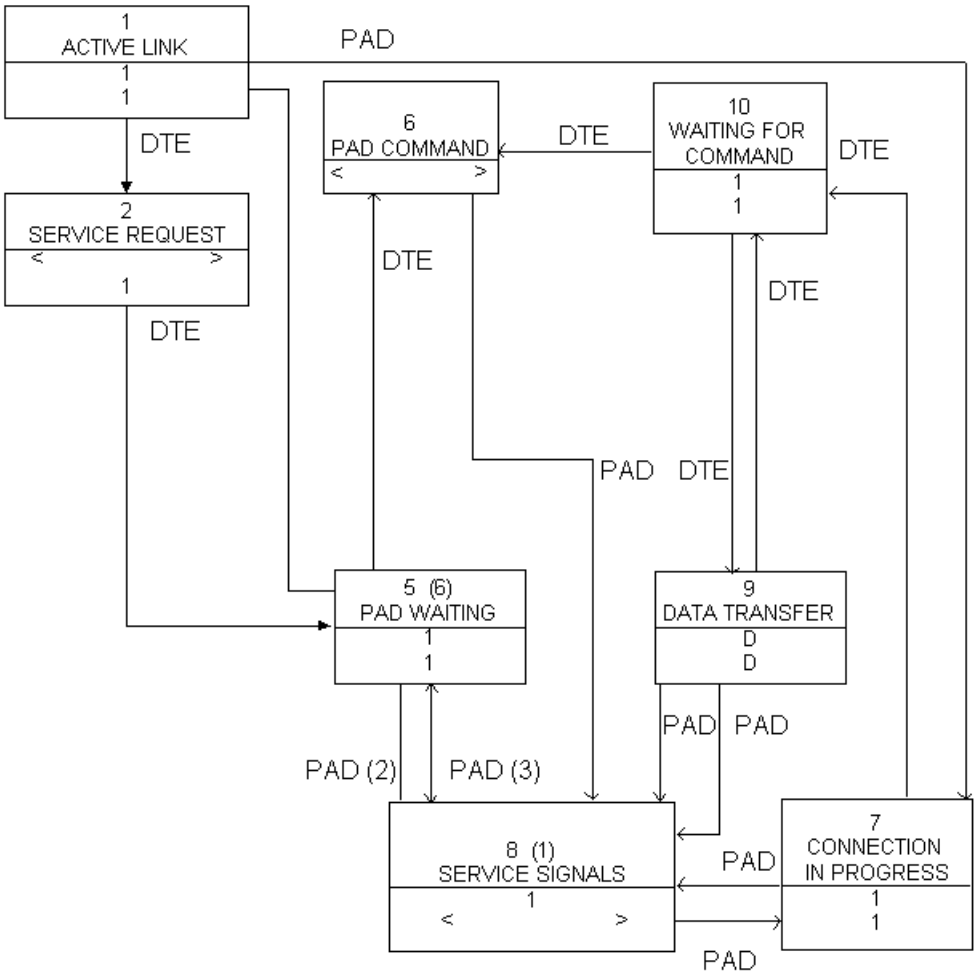

FIGURE 2 (Continued)

Notes:

1. State 8 is used to represent a state during which all PAD service signals are transmitted (except for the PAD identification and editing PAD signals).

2. The transition from state 5 to state 8 occurs only when the PAD receives a call destined for the start-stop mode DTE.

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3. The PAD may permit entry to the PAD waiting state 10 times before performing PAD disconnecting.

4. Under certain circumstances DTE clearing is performed by disconnecting the access information path.

5. See Figure 4 for the symbol definitions of the state diagrams.

6. The condition of the interchange circuit 103 (Recommendations X.20 bis and V.21) or the T interchange circuit (Recommendation X.20) shown in state 5 is the preferred

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condition. The DTE may not have sufficient information to maintain this condition under all circumstances and consequently may transmit characters.

FIGURE 3

STATE DIAGRAMS OF CALL ESTABLISHEMNT AND CALL CLEARING BY PAD COMMAND AND SERVICE SIGNALS WHEN PARAM. 6 IS 0

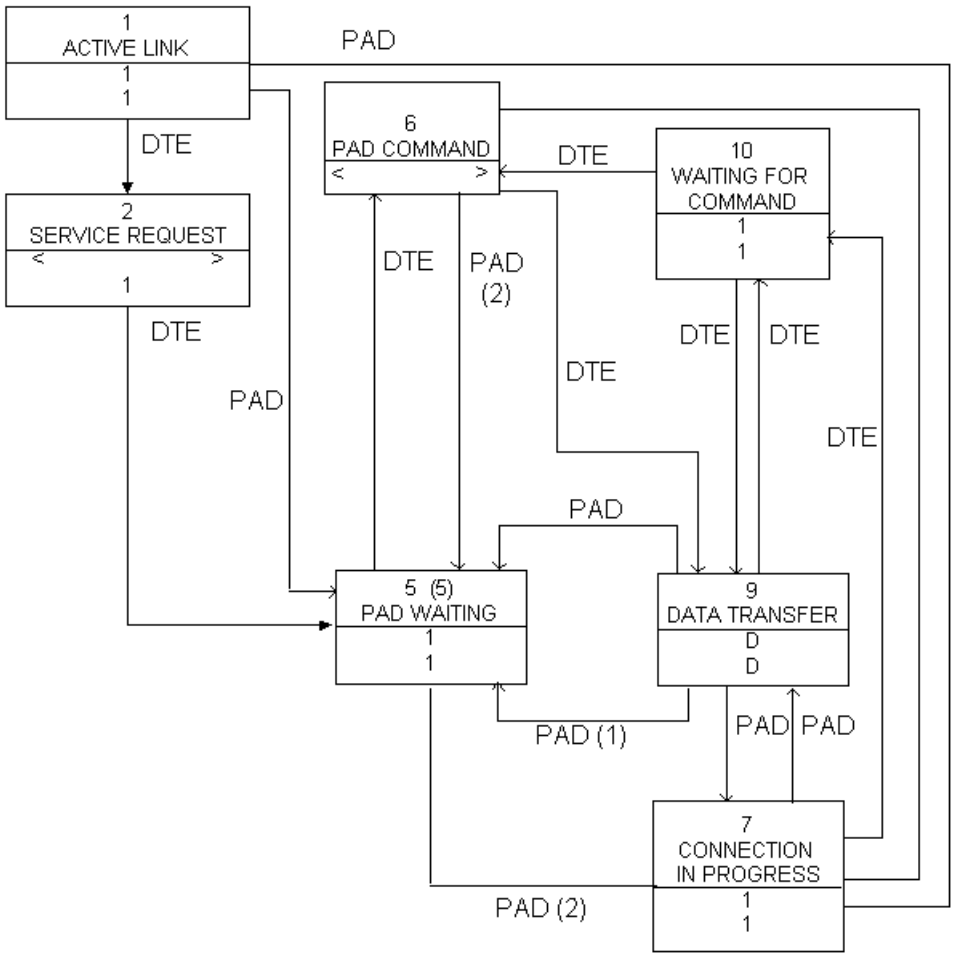

FIGURE 3 (Continued)

Notes:

1. The transition from state 5 to state 9 occurs only when the PAD receives a call destined for the start-stop mode DTE.

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2. The PAD permits entry to the PAD waiting state 10 times before performing PAD disconnecting.

3. Under certain circumstances the DTE is cleared by disconnecting the access information path.

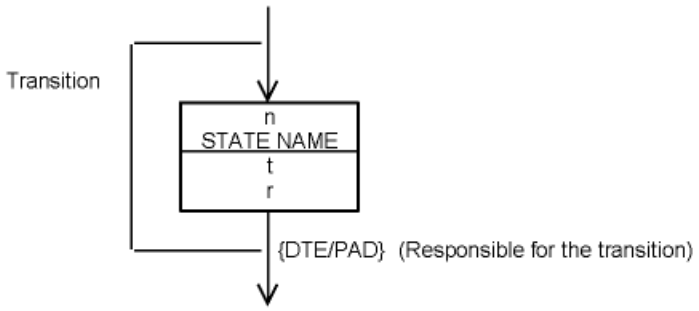
4. See figure 4 for the symbol definitions of the state diagram.

5. The condition of the interchange circuit 103 (Recommendations X.20 bis and V.21) or the T interchange circuit (Recommendation X.20) shown in state 5 is the preferred condition. The DTE may not have sufficient information to maintain this condition under all circumstances and consequently may transmit characters.

6. The condition of the interchange circuit 103 (Recommendations X.20 bis and V.21) or the T interchange circuit (Recommendation X.20) shown in state 5 is the preferred condition. The DTE may not have sufficient information to maintain this condition under all circumstances and consequently may transmit characters.

FIGURE 4

SYMBOL DEFINITIONS OF THE STATE DIAGRAMS



n	State number
t	Value on interchange circuit 103 when access is via X.20 bis or V.21; or on T interchange circuit when access is via X.20.
D	DTE to DCE data transfer.
r	Value on interchange circuit 103 when access is via X.20 bis or V.21; or on R interchange circuit when access is via X.20.
0 and 1	Standard binary conditions
< >	An International Alphabet No. 4 character sequence.

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FIGURE 5

SEQUENCE OF EVENTS AT THE INTERFACE: CALL ESTABLISHMENT

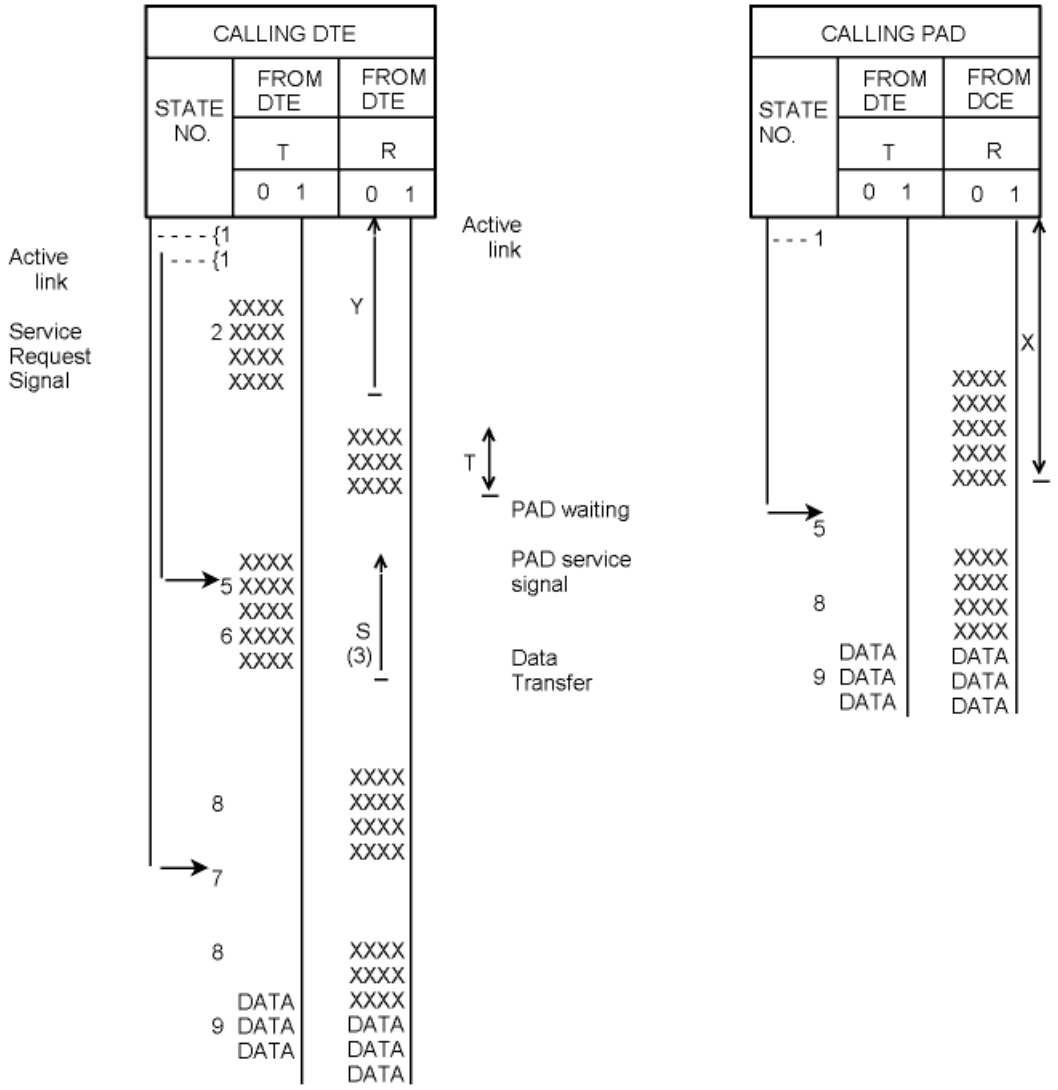

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FIGURE 6

SEQUENCE OF EVENTS AT THE INTERFACE: CALL CLEARING

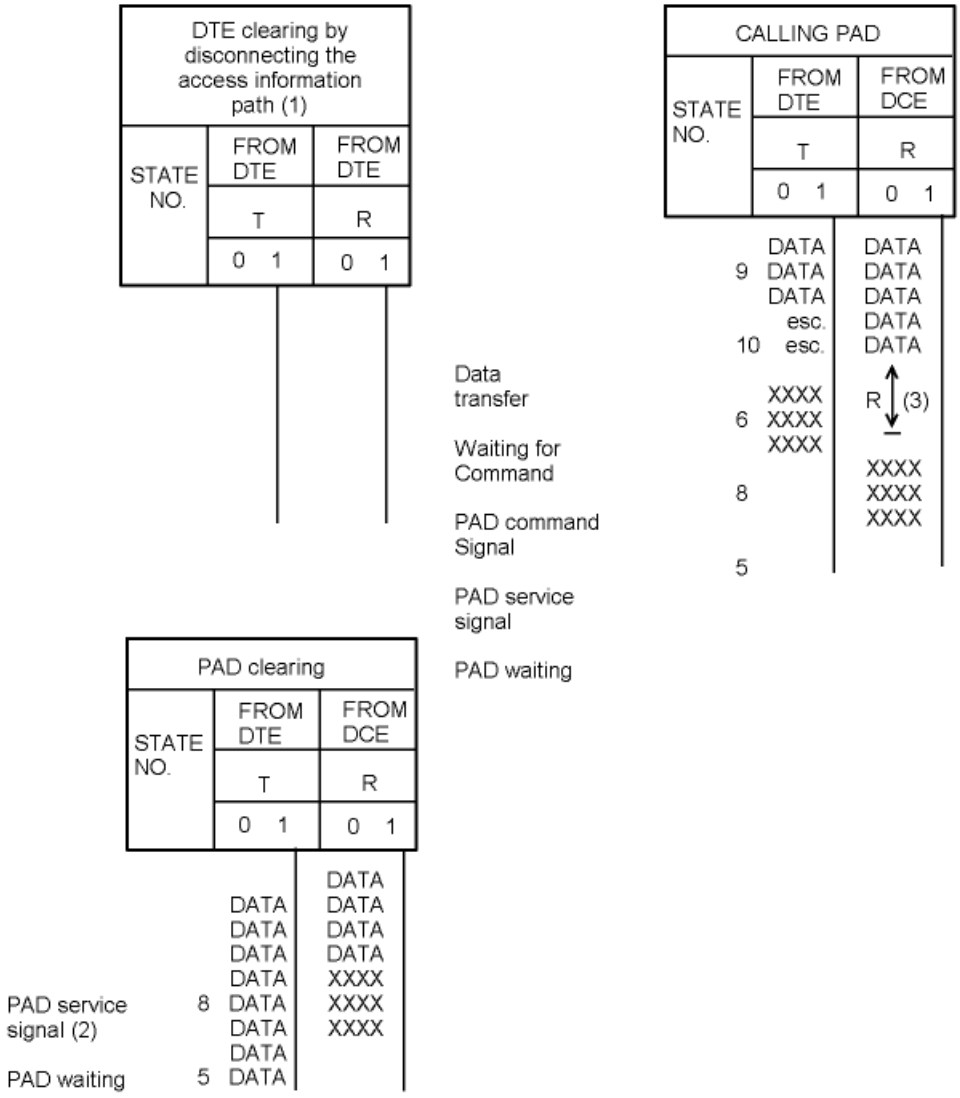

FIGURE 6 (Continued)

Notes:

1. The DTE clear may be performed by disconnecting the access information path. The response from the DCE is PAD clearing which also disconnects the access information path.

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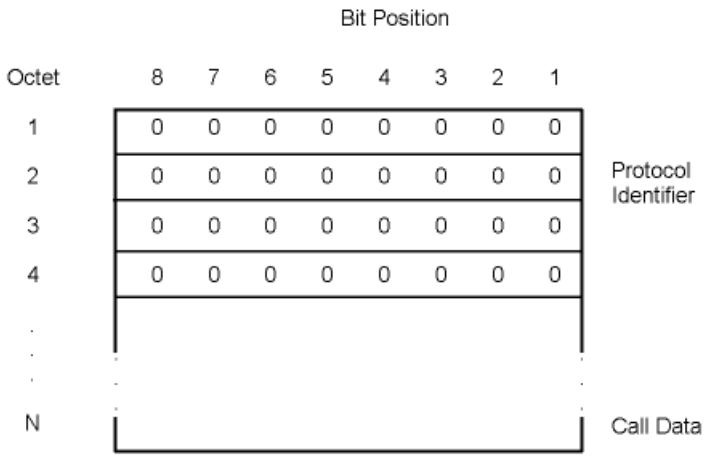
2. The PAD may be cleared by disconnecting the access information path.

3. The time-outs S and R and 60 seconds.

FIGURE 7

CALL USER DATA FIELD FORMAT



4<N<16 Octets or 124 if Fast Select

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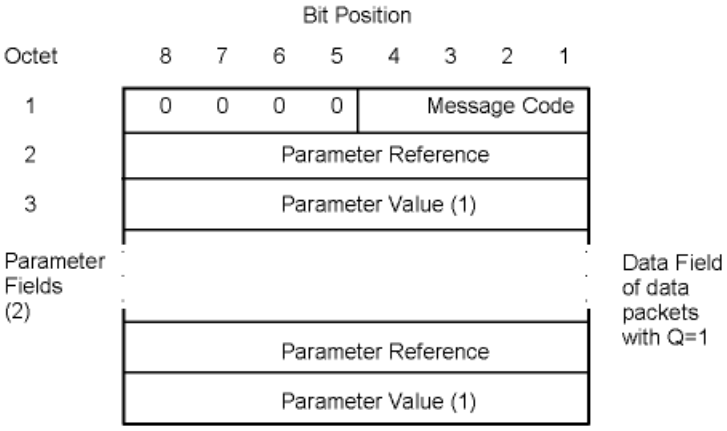
FIGURE 8

SET, READ, SET-AND-READ AND PARAMETER
INDICATION PAD MESSAGE FORMAT



Message Code:

0010 - Set
0100 - Read
0110 - Set and Read
0000 - Parameter indication

Notes:

(1) These Octets contain all 0's in read PAD messages

(2) Parameter field need not be present (see table 10)

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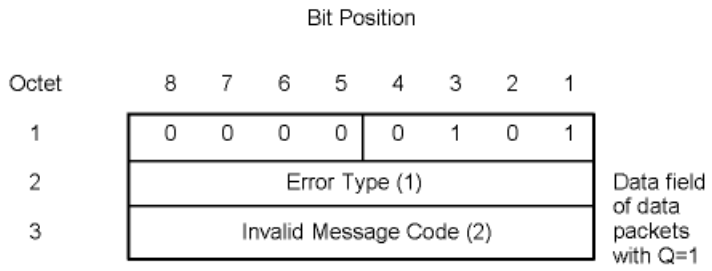
FIGURE 9

ERROR PAD MESSAGE FORMAT



Notes:

(1) See Table 12

(2) Does not occur for error type 00000000

FIGURE 10

INVITATION TO CLEAR PAD MESSAGE FORMAT

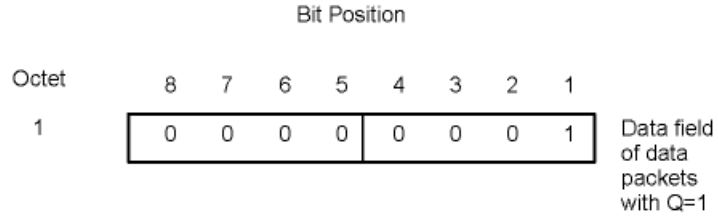


FIGURE 11

INDICATION OF BREAK PAD MESSAGE FORMAT

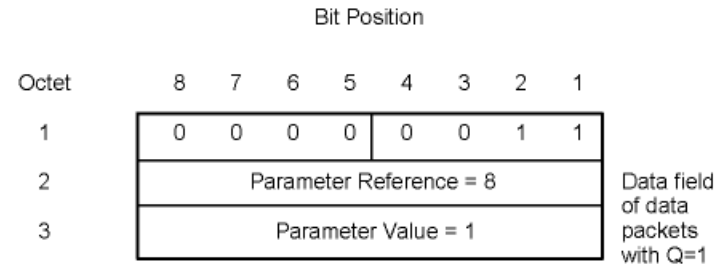


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TABLE 1

POSSIBLE VALUES AND COMBINATIONS OF VALUES OF PAD PARAMETERS

Param Ref No.	Param Desc.	Possible Values	PAD Param Meaning	Remark
1	PAD recall using a character	0	Not possible	
		1	Character DLE	
		32-126	One character from the permissible range of IA5	Octal representation of an ASCII char.
2	Echo	0	No echo	
		1	Echo	
3	Selection of data forwarding characters	0	No data forwarding characters	
		2	Character CR	
		6	Characters: CR, ESC, BEL, ENQ, ACK	value formed by combination of CCITT (2+4)*
		18	Characters: CR, EOT, ETX	value formed by combination (2+16)
		126	All characters in column 0 and 1 and character DEL	value formed by combination (2+4+8+16+32+64)
4	Selection of idle timer delay	0	No idle timer	
		1-255	Value of idle timer in 20ths of a second	

* Note: CCITT numbers 4, 16, 32 and 64 are not implemented on a stand alone basis.

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TABLE 1 (Continued)

Param Ref No.	Param Desc.	Possible Values Man/Opt	PAD Param Meaning	Remark
5	ancillary device control	0	No use of XON/XOFF (DC1/DC3 respect.)	
		1	Use of XON/XOFF in data transfer mode	
		2	Use of XON/XOFF in data transfer and command mode	
6	Control of PAD service Signals	0	No PAD service signals are sent to the start-stop mode DTE	
		1	PAD service signals are sent to the start-stop mode DTE in standard format	
		5	PAD service signals and the prompt PAD service signals are sent to the start-stop mode DTE in standard format	value formed by combination (1+4)
		9	PAD service signals and data and time are sent to the start-stop mode DTE in standard format	
		13	PAD service signals and date and time and the prompt PAD service signals are stop mode DTE in standard format at call estab/term	value formed by combination (1+13)

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TABLE 1 (Continued)

Param Ref No.	Param Desc.	Possible Values Man/Opt	PAD Param Meaning	Remark
7	Selection of operation of the PAD on receipt of break signal from the start-stop mode DTE	0	Nothing	
		1	Interrupt	
		2	Reset	
		5	Interrupt and indication of a break	value formed by combination (1+4)
		8	Escape from data transfer state	
		21	discard output, interrupt and indicate break	value formed by combination (1+4+16)
8	Discard output	0	Normal data delivery	
		1	Discard output	
9	Padding after CR	0	No padding after carriage return	Note 1
		1-255	Number of padding characters to insert after CR	
10	Line Folding	0	No line folding	
		1-255	Number of graphic characters per line	
11 read-only	Binary speed of start-stop mode DTE	0	110 bps	
		2	300 bps	
		3	1200 bps	
		5	75 bps	
		8	200 bps	
		10	50 bps	
		12	2400 bps	
		13	4800 bps	
		14	9600 bps	
		15	19200 bps	

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TABLE 1 (Continued)

Param Ref No.	Param Desc.	Possible Values Man/Opt	PAD Param Meaning	Remark
12	Flow control of the PAD	0	No use of XON/XOFF (DC1/DC3) respect.) for flow control	
		1	Use of XON/XOFF (DC1/DC3 respect.) for flow control	
13	Linefeed insertion after CR	0	No linefeed insertion	
		1	Insert linefeed after transmission of CR to the start-stop DTE	
		4	Insert linefeed after echo of CR to the start-stop mode DTE	
		5	Insert linefeed after transmission and echo of CR to the start-stop mode DTE	combination (1+4)
		6	Insert linefeed into data stream after CR from the start-stop mode DTE and after echo of a CR to the start-stop DTE	combination (2+4)
		7	Insert linefeed into data stream to and from the start-stop mode DTE after the echo of a CR to the start-stop DTE	combination (1+2+4) applies only to data transfer state

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TABLE 1 (Continued)

Param Ref No.	Param Desc.	Possible Values Man/Opt	PAD Param Meaning	Remark
14	Padding after linefeed	0 1-7	No padding after linefeed Number of padding characters to insert after linefeed	 Applies only to data transfer state
15 Note 2	Editing	0 1	No use of editing in the data transfer state Use of editing in the data transfer state	
16 Note 2	Character delete	0-127	One character form range of IA5	
17 Note 2	Line delete	0-127	One character from range of IA5	
18 Note 2	Line display	0-127	One character from range of IA5	
19 Note 2	Editing PAD service signals	0 1 2 8 32-126	No editing PAD service signals Editing PAD service signals for print terminal Editing PAD service signals for display term. Editing PAD Service signals using a character from range of IA5	

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TABLE 1 (Continued)

Param Ref No.	Param Desc.	Possible Values Man/Opt	PAD Param Meaning	Remark
20 Note 3	Echo Mask	0	No echo mask	Values may be formed by combining basic values
		1	No echo of CR	
		2	No echo of LF	
		4	No echo of VT, HT, FF	
		8	No echo of BEL, BS	
		16	No echo of ESC, ENQ	
		32	No echo of ACK, NAK, STX, SOH, ETB, ETX	
		64	No echo of editing characters as designed by param.'s 16, 17, 18	
		128	No echo of all characters in columns 0 and 1 not mentioned above and DEL	
21	Parity treatment	0	No parity detect or generation	
		1	Parity checking	
		2	Parity generation	
		3	Parity checking and generation	Value formed by combination (1+2)
22	Page Wait	0	Page wait disabled	
		1-255	Number of line feed characters considered by the PAD for the page wait function	

Table 1 Notes:

1. There is no padding after CR except that PAD service signals contain a number of padding characters according to the data signaling rate of the start-stop mode DTE.

2. When parameter 15 is implemented (set to 1), the values of parameter 16, 17, 18, and 19 are either default values or are selectable from the optional range shown. The editing function is provided during the PAD command state whether parameter 15 is implemented or not. If parameter 16, 17, 18, and 19 are implemented, the editing

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characters and editing PAD service signals during the PAD command state are defined by the appropriate values of these parameters. If parameters 16, 17, 18, and 19 are not implemented, default values for these parameters are applicable to the PAD command state.

3. This parameter does not apply if parameter 2 is zero. If parameter 5, 12, or 22 is set to a nonzero value, then XON/XOFF characters are not echoed.

TABLE 2

CALL SET UP

CCITT Terminology (description)	PSN service format
Service Request Signal (allows network to detect speed and code)	H
PAD identification service signal (network response to a valid service request)	<PAD identification> <PSN Herald>
Selection PAD command signal (used to establish a virtual call)	[facility] address [user data] (Note 1)
Connected PAD service signal (informs user that the call had been accepted)	[called address] COM
[ ] indicates that data within the brackets is optional	

Table 2 Notes:

Note 1 - Available Facilities:

DESCRIPTION	FACILITIES INDICATION CODE
Network User Identification (NUI)	N <NUI string>
PROA selection	T <4 digit DNIC>
Reverse charging	R
Closed User Group (CUG)	G <index>
Charging informaton	C
Fast select	F

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The facility field is terminated with a dash (-). (Multiple facilities are separated by commas).

- Address Block:

Full addresses and abbreviated addresses are supported. An abbreviated address is preceded by a period (.). A single period (.) is used to indicate a direct call.

- User Data Field:

The user data field is preceded by an asterisk (*) or a dash (-). Characters P or D will be sent followed by up to 12 characters of user data (124 characters for fast select). A P indicates echo suppression (e.g. password) and D indicates echo enable (e.g. data).

TABLE 3

CALL CLEARING BY THE USER

CCITT Terminology (description)	PSN service format
Clear request PAD command signal (user clears the virtual call)	CLR
Clear confirmation PAD service signal (response to clear request)	CLR CONF [charging info] (Note 1)
[ ] indicates that data within the brackets is optional	

Table 3 Notes:

Note 1 -

Charging information is provided if the charging facility is subscribed to in the selection PAD command.

After a call is cleared, charging information in a standard format (see below) can be received. First, the duration of the call is shown in Days:Hours:Minutes:Seconds. Next, are three columns which refer to different billing periods. The top row of a column represents the number of segments received, and the bottom row represents the number of segments transmitted.

CHARGING INFORMATION FACILITY:

00:00:01:34

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03512 00000 00000

00361 00000 00000

TABLE 4

CALL INDICATION PAD SERVICE SIGNALS DURING CALL SET UP

CCITT Terminology (description)	PSN service format
Remote DTE is busy	CLR DCC
Network problem. Fault condition or congestion	CLR NC
Invalid facility request (facility unavailable or not subscribed to)	CLR INV
DTE not permitted to access host (i.e. incompatible CUG or not authorized for access)	CLR NA
Address non-existent or out of numbering plan	CLR NP
Destination out of order or not acknowledging	CLR DER
Destination does not accept charges	CLR RNA
Destination RPOA unable to forward call	CLR RPOA

Table 4 Notes:

- Clear Indication PAD service signals may also include the 2 optional fields [called DTE address] and [charging info].

TABLE 5

CLEAR INDICATION PAD SERVICE SIGNALS DURING CALL SESSION

CCITT Terminology (description)	PSN service format
Local procedural error	CLR ERR
Remote Procedural error detected	CLR RPE

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PAD clearing, initiated by remote DTE	CLR PAD
Remote DTE clears	CLR DTE

Table 5 Notes:

- Clear Indication PAD service signals may also include the 2 optional fields [called DTE address] and [charging info].

TABLE 6

SESSION COMMANDS

CCITT Terminology (description)	**PSM service format**
Interrupt PAD command signal (sends interrupt packet to destination)	-
Response to interrupt packet	-
Status PAD command Signal (used to question call establishment)	STAT
(Response to status command if call is established)	ENGAGED
(Response to status command if call is not established)	FREE
Reset PAD Command Signal (user resets virtual call)	RESET
(Syntax error in command, question call establishment)	ERR
(Command issued in an inappropriate state or in violation of service options)	ERR
Page wait PAD command signal (indicates the page wait condition has occurred)	PAGE

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TABLE 7

PARAMETER AND PROFILE SIGNALS

CCITT Terminology (description)	PSN service format
Read PAD command signal (user's request to read parameters)	PAR? (parameter reference no.) (i.e. PAR? 1,2,7) (NOTE 1)
Set PAD command signal (user's reequest to set parameters)	SET (reference no. and value) (i.e. SET 2:0,3:2,9:4)
Set and read PAD command signal (user's request to set and read parameter values	SET? (reference no. and value) i.e. SET? 2:0,3:2,9:4
Parameter value PAD service signal (network response to a read command or a set and read command)	PAR (reference no & value) i.e. PAR 2:1.3,3:2,64:INV) (NOTE 2)
Standard profile selection command (user to select profile	PROF (identifier) (i.e. PROF 3)
Profile select and read PAD command signal (used to select and read profile)	PROF? i.e. PRF? 3) (NOTE 3)
Acknowledgment PAD service signal (network response to a profile select and read command)	<CR> and <LF>
Profile select and read PAD service signal (network response to a profile select and read command	PROF (identifier) PAR (reference and value)

Table 7 Notes:

Note 1 - All parameters are read if no reference number is specified.

Note 2 - INV indicates an invalid reference number or value.

Note 3 - The current profile is read if no identifier is specified.

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TABLE 8 INCOMING CALLS	
CCITT Terminology (description)	PSN service format
Incoming call PAD service signal (informs user of an incoming call)	(calling address) [facility block] CDM [call data block] (NOTE 1)
Restriction PAD service signal (informs user of call transfer)	TRANSFER (calling address) [facility block] CDM [call data block]
[ ] indicates that data withing the brackets is optional	

Table 8 Notes:

- The facility block format if FAC:<facility string>. The call data block contains up to 12 characters from the call data field received from the remote DTE.

TABLE 9 RESET PAD SERVICE SIGNALS	
CCITT Terminology (description)	PSN service format
Remote DTE resets virtual call	RESET DTE
Reset due to local procedural error	RESET ERR
Reset due to network congestin	RESET NC

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Reset due to network operational error	RESET NKO
Reset due to other errors (e.g. line failure)	RESET DER

TABLE 10

PAD MESSAGES TRANSMITTED BY THE PAD
IN RESPONSE TO SET, READ, AND SET-AND-READ PAD MESSAGES

PAD Message Received		Action upon PAD Parameters	Corresponding Parameter indication PAD message transmitted to the packet mode DTE
TYPE	Parameter Field		
Set	None	Reset all implemented X.3 parameters to the initial values of the initial profile	None
	List of selected parameters desired values	Set the selected parameters to the given values: a) if on error is encountered b) if the PAD fails to modify the values of some parameters	a) None b) List of these invalid parameters with the error bit set
Set-and-read	None	Reset all implemented X.3 parameters to the initial values of the initial profile	List of all implemented X.3 parameters and their initial values
	List of selected parameters with the desired values	Set the selected parameters to the given values:	List of these parameters with their new current values with the error bit set appropriately
Read	None	None	List of all implemented X.3 parameters and their current values
	List of selected parameters	None	List of these parameters with their current value

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