

**U S WEST
Communications, Inc.
Technical Publication**

**U S WEST DIGIPAC® SERVICE
INTERFACE SPECIFICATIONS FOR
PUBLIC PACKET SWITCHING
NETWORK**

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Communications, Inc.
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INTERFACE SPECIFICATIONS FOR
PUBLIC PACKET SWITCHING
NETWORK

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1. Introduction

1.1 Overview

This Technical Publication describes the interface protocols necessary for:

- Asynchronous terminals and hosts (Chapter 2)
- X.25 terminals and hosts (Chapter 3)
- X.75 connections with Interexchange Carriers to communicate via the Packet Switched Public Data Network (PSPDN) (Chapter 4)
- Dial-up access for X.25 devices using the X.32 recommendation (Chapter 5) and
- Point of Sales terminal to host communications using T3POS protocol (Chapter 6).

Network level signaling messages are transmitted as American Standard Code for Information Interchange (ASCII) text. The terms used herein are consistent with the text of the International Telegraph and Telephone Consultative Committee (CCITT) Recommendations specified in this document. All reference in this Technical Publication to CCITT recommendations are per the 1984 issue "red book", unless specified otherwise.

The asynchronous interface is based on CCITT Recommendation X.28 which defines the protocol between the asynchronous device and the PSPDN. The asynchronous Data Termination Equipment (DTE)/X.25 DTE interface is based on CCITT Recommendation X.29 which specifies the protocol between the packet-mode DTE and the PSPDN. CCITT Recommendation X.3 defines a Packet Assembly/Disassembly (PAD) facility in a PSPDN. The X.25 interface is based on CCITT Recommendation X.25 which defines the protocol between the X.25 DTE and the PSPDN. The X.75 interface is based on CCITT Recommendation X.75 which defines the protocol between the Interexchange Carriers, data service providers and the PSPDN. The X.32 interface is based on CCITT Recommendation X.32 which defines the protocol and procedures for an X.25 DTE to access the PSPDN using a Dial-up connection, either to originate or terminate X.25 calls.

The T3POS interface defines the protocol, procedures, and PAD function within the PSPDN to allow Point of Sale (POS) terminals to use the Packet Network as a means to access Credit Card Association (CCA) hosts or Information Service Providers (ISP).

A table of all acronyms used in this Technical Publication can be found behind the tab titled Definitions.

All changes and reissues of this Technical Publication will be made on a U S WEST wide basis.

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2. Asynchronous Interface

2.1 Overview

This Chapter describes the interface protocols necessary for asynchronous devices to communicate via the DIGIPAC® Network. The asynchronous interface (based on CCITT Recommendation X.28) defines the protocol between an asynchronous Data Termination Equipment (DTE) and the Packet Switched Public Data Network (PSPDN). The asynchronous DTE/X.25 DTE interface (based on CCITT Recommendation X.29) specifies the protocol between a packet-mode DTE and the PSPDN. CCITT Recommendation X.3 defines a Packet Assembly/Disassembly (PAD) facility in a PSPDN. The asynchronous interface supports originating virtual call service (permits DTE to set up a call) to X.25 or other asynchronous DTE's. The interface also supports terminating virtual call service (allows the DTE to receive incoming calls) from X.25 DTE's and other asynchronous DTE's. The interface at both ends of a connection between two asynchronous DTE's 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 Data Communications Equipment (DCE).

In switched data networks, such as a PSPDN like DIGIPAC®, the network is considered to be DCE for functions other than the physical connection of equipment (i.e., layer 2 protocol, PAD function). For clarity, the term PSPDN will be used in this document to denote the location and responsibility of these functions, whatever they may be, in the network. The PAD service in the PSPDN performs X.25 functions on behalf of the DTE. How these basic functions are accomplished is determined by the user-set options available in the PAD parameters. Each parameter is identified by a reference number and is assigned a value used by the PSPDN to determine actions to take for the particular terminal or host. The PSPDN maintains a set of parameters, called a profile, for each active DTE.

A profile is a specific combination of parameter values. The asynchronous interface supports user-set profiles and a user-default profile that can be defined for each direct-access interface. A listing of standard profiles can be found in Table 2-A. A user-selected profile is stored in the PSPDN. This provides a simple means of setting the desired PAD parameters. When a user requests a user-selected profile the PSPDN immediately sets the user's parameters (of the current session) to the values defined in that profile (see Table 2-A). The asynchronous interface supports the simple and transparent standard profiles specified in CCITT Recommendation X.28. A total of up to 9 different profiles can be defined in one PAD.

A user default profile is a default profile defined for each interface port. The default profile used on all public asynchronous dial access lines, is the PSPDN user friendly profile. For dedicated access lines, a user profile will be set at service order time to one of the nine available profiles or the default profile if not specified by the customer. The user may alter parameters during a session by requesting a different profile or by setting individual parameters with X.28 commands. These changes last for the duration of the session only and do not affect the default parameter values.

2.2 Character Interchange and Service Initialization

The character formats used to exchange control information follow those indicated in X.28, International Alphabet No. 5, CCITT Recommendation V.3.

2.2.1 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. The physical link is always connected on direct access interfaces. After the physical link is set up, both the PSPDN and DTE transmit binary ones across the interface.

On dial-in connection calls to the PSPDN the transmission of the binary ones is heard as tone. The user initiates communication by transmitting a service request signal [3 periods followed by a carriage return (...<CR>)] to the PSPDN. The service request allows the PSPDN to detect the speed of the DTE. It is required for terminals accessing dial-up ports so that the binary speed parameter (parameter 11) of the simple standard profile (default for dial-up 90) can be set accordingly. To maintain a standard initialization procedure, a service request is also required of DTE's with direct access. After sending a service request, the DTE transmits binary ones. The PSPDN responds to a valid service request by sending a PAD-identification PAD-service signal. Typically, this signal welcomes the user to "DIGIPAC®". The PSPDN transmits binary ones after the PAD-identification PAD-service signal is sent. If service signals are suppressed (Parameter 6 is equal to 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.

2.2.2 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. Command and service signals are exchanged between the DTE and PSPDN while in the PAD command state and PAD service signals state, respectively. The description and format of these signals is given in Tables 2-B through 2-C. Command and service signals provide the following functions:

- PAD command signals (DTE and PSPDN)
 - Establish and clear virtual calls
 - Allow selection of standard profiles
 - Allow selection of individual PAD parameters
 - Request current PAD parameter status
 - Send interrupt
 - Request circuit status
 - Reset virtual call
- PAD service signals (PSPDN 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 20 seconds after the interface entered the PAD waiting state, the PSPDN performs DCE clearing in accordance with Paragraph 3.19 B. If, after receiving the first character of a PAD command, a complete PAD command signal is not received within 20 seconds the PSPDN sends an error PAD-service signal and the interface enters the PAD waiting state. The PSPDN also sends an error PAD-service signal if it receives an unrecognized PAD command. The error PAD-service signal indicates what error has occurred. Its format is illustrated in Tables 2-D and 2-F. This service signal is only sent when parameter 6 is set to 1 or 5. If the value of parameter 6 is set to 0 or 1, the PSPDN does not transmit a prompt to the DTE.

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 profiles as specified in Table 2-A. 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 identifier for network defined profiles is single or double decimal digits. Profile identifiers for the simple standard profile and the transparent standard profile are 90 and 91, respectively.

2.3 Procedures For Virtual Call Control

2.3.1 General

For dial and direct access ports, the interface supports intra-LATA, inter-LATA, and inter-network calls. (Only one data call can be on a line.) Signaling procedures for RPOA (Recognized Private Operating Agency) selection (on all calls), CUG (closed user group) request and reverse charging request are supported.

On the auto reverse charge dial access ports, the interface supports intra-LATA, inter-LATA, and inter-network calls. Signaling procedures for RPOA selection and reverse charge are also supported. DTE's may, but need not, use either or both of these signaling procedures for each virtual call. Regardless of whether the DTE uses the reverse charge request, the PSPDN automatically requests reverse charging on virtual calls originating from these ports.

Call Set-up is initiated when the DTE sends a selection PAD command signal to the PSPDN. The format of this command is illustrated in Tables 2-B and 2-C. 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.

The facility request block identifies the facilities used to establish the call. The available facilities include Network User Identification (NUI), closed user group (CUG), reverse charging, fast select and RPOA. Formats for the facility block are given in Tables 2-B and 2-C. If applicable to the particular access method, any combination of these facilities may be used.

The NUI signal is used to provide secure access to the network. The need to identify users, limits the use of this facility to direct access ports and private dial ports. 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 PSPDN. For direct access to the PSPDN, user identity is known because of the physical termination on the PSPDN.

Closed user groups (CUG) allow members to communicate but preclude 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). The need to identify users, limits the use of this facility to direct access ports and private dial ports.

Reverse charge originating facility is optional on asynchronous interfaces. On direct access and private dial ports, it allows users to request, via signaling procedures for each originating call, that the call be reverse charged. For public dial access, the interface ports are designated as automatic reverse charge. On these ports, the PAD automatically requests reverse charging on all virtual calls.

Fast Select Acceptance Unrestricted permits the request of up to 124 octets of user data in the call initiation packet and acceptance of up to 124 octets of data in the call termination packet. Additional data packets will be accepted following the acceptance of the call initiation packet.

Recognized Private Operating Agency (RPOA) facility allows users to specify the transit network for the carrying of inter-network calls.

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) of application dependent information to a call request (see Table 2-B).

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 PSPDN does the following depending upon whether or not service signals have been suppressed.

- If the value of parameter 6 is set to 0, the PSPDN does not send any service signals and the interface enters the connection-in-progress state. It remains in this state until the Virtual Call (VC) is established or cleared.
- If parameter 6 is set to 1 or 5, on receipt of a valid selection PAD command signal, the PSPDN transmits an acknowledgment PAD service signal (format illustrated in Tables 2-C through 2-G) followed by binary ones and the interface is in the connection-in-progress state. To indicate whether the call has been accepted or cleared, the PSPDN 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 set to 0. PAD service signals responding to previously transmitted PAD command signals have priority over PAD service signals arising from events within the network. No characters are echoed and no PAD commands are accepted while the interface is in state 8 (transmission of service signals). If the interface is in state 7 (connection in progress), the only command accepted is a clear request PAD command.

If the virtual 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 call being set up, the PSPDN disconnects the physical access. This does not apply to direct access. If the virtual call is established, the interface enters the data transfer state after receiving the connected PAD service signal. Data transfer is discussed in Paragraph 4.01.

Incoming calls are supported according to procedures defined in X.28. The PSPDN indicates only the presence of an incoming call to the DTE when the interface is in the PAD waiting state. The PSPDN does not expect a response from the terminal when a incoming call PAD service signal is sent (see Tables 2-D and 2-F for format). After the terminal receives this signal, the interface immediately enters the data transfer state.

2.3.2 Clearing

Clearing the virtual call can be initiated by either the DTE or the PSPDN. A DTE can clear a virtual 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 PSPDN responds with clear-confirmation PAD service signal. If an invalid clear-request PAD command signal is sent, the PSPDN includes a local procedural error cause in the clear-indication PAD service signal. The format of these signals is given Table 2-C. 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 is set to 0), no follow-on call is allowed and physical access is disconnected when the PSPDN receives the clear request.

The PSPDN initiates virtual 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 PSPDN then clears the dial-up connection.

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

2.3.3 Procedures for Setting, Changing and Reading 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 2-C, the commands include parameter references(s) and values(s). If parameter 6 is set to 1 or 5, the PSPDN 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 PSPDN responds to a valid set PAD command signal by transmitting an acknowledgment PAD signal. Both service signals are shown in Table 2-C. When parameter 6 is set to 0, the PSPDN accepts and invokes valid parameters without advising the DTE of any invalid parameters or parameter values.

A DTE may inquire about the current values of one or more parameters by transmitting a read PAD command signal (see Table 2-C). The PSPDN responds with a parameter value PAD service signal. If service signals are suppressed, the read command is ignored.

2.3.4 Packet Forwarding Conditions

A packet is forwarded when:

- Enough data to fill a packet has been received.
- A data forwarding character is sent.
- A break signal is transmitted (if parameter 7 is not set to 0).
- A PAD command signal is sent.
- The idle timer delay period is allowed to elapse. The idle time is restarted each time a character is received by the PSPDN. 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 set to 1.
- If none of the above conditions take place, packet forwarding also occurs upon expiration of the maximum assembly times delay period. This timer begins when the first character to be assembled into the packet is received by PSPDN. The value of the time-out, when implemented, is twenty fifths of a second (40 ms).

2.3.5 Reset Procedures

The DTE resets a virtual call by escaping from the data transfer state and transmitting a reset PAD command signal to the PSPDN. The format of this signal is given in Table 2-C. The PSPDN interprets a break signal as a reset PAD command signal if parameter 7 is set to 2. The PSPDN acknowledges the reset, if parameter 6 is set to 1 or 5 by sending an acknowledgment PAD service signal. If the remote DTE or the network resets the virtual call, the PSPDN sends a reset PAD service signal to the DTE when parameter 6 is set to 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 reset PAD service signal is illustrated in Tables 2-D and 2-F. If parameter 6 is set to 0, the PSPDN does not inform the DTE of a reset.

2.3.6 Flow Control

If parameter 5 is set to 1, the PSPDN can flow control the data input from the DTE. When the PSPDN can no longer accept characters from the DTE, it transmits an X-OFF character. When it can receive another character, the PSPDN transmits the X-ON character. A network-defined variable specifies the number of characters the PSPDN continues to accept after the X-OFF has been set. X-ON and X-OFF are used to switch a transmitting device on and off. For this parameter to have any effect, the DTE must recognize standard International Alphabet No. 5 (IA5) X-ON and X-OFF characters and respond to them (i.e., stop input on X-OFF, resume input on X-ON). If the interface is in the data transfer state and parameter 12 is set to 1, the DTE can flow control the PSPDN by using X-ON and X-OFF characters.

2.3.7 Echo

The value of parameter 2 dictates whether characters are echoed by the PAD or the remote DTE. Typically, they are echoed by the PAD (parameter 2 is set to 1) which reduces the amount of data transmitted between the PAD and the remote DTE. 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 PSPDN, because of flow restrictions, are not echoed.

2.3.8 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 of accomplishing this (see Table 2-A). The setting relies on the remote DTE knowing what to do with the information indicating that break has occurred. Parameter 8 is used in conjunction with parameter 7 being set to 21. It indicates whether data destined for the DTE is being flushed by the PSPDN or is being delivered.

2.3.9 Editing

The PSPDN provides editing functions for the DTE when parameter 15 is set to 1, so it can edit character input to the PSPDN before it is processed. The editing buffer is at least 128 characters. 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, 18 and 19 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 selected by setting parameter 15. If editing is selected, the value of the idle timer (parameter 4) is ignored during data transfer.

2.3.10 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 PSPDN performs the function of the parameter with the highest priority among those parameters whose values are duplicated. The following is the priority assignment to parameters that may be duplicated:

- | | |
|-----------|--------------------------------------------|
| (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) |

2.3.11 PAD Parameter and Call Clearing

The following condition applies when a call is cleared without being physically disconnected: Upon reception of a clear packet either before or after call set-up, the PSPDN resets the parameters to the values specified in the default profile.

2.4. Procedures for the Exchange of User Data

2.4.1 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 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 set to 1) are described in the beginning of the following Paragraph.

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 set to 8) to the PSPDN. If parameter 6 is set to 5 the PSPDN responds by sending a prompt PAD service signal. Upon receipt of the escape signal, the interface enters the waiting for command state. 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 PSPDN 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 20 seconds, or an invalid command is sent, the PSPDN 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 transmission of 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 state, or the PAD waiting state, whichever is appropriate (i.e., a valid selection PAD command leads to the connection in progress state). Upon escape from data transfer, the DTE can use any of the following procedures or PAD commands:

- Procedures described in the last paragraph of section 3.2.1 to clear a virtual call.
- Procedures described in Section 2.3.5 to reset a virtual call.
- If parameter 5 is set to 1 or 5, the DTE can check to see if a virtual call exists by sending a status PAD command signal. The PSPDN responds by sending either a call-established or a call-idle PAD service signal. The format of these signals is illustrated in Tables 2-D and 2-F.

- A request that an interrupt packet be sent to the remote DTE by transmitting an interrupt PAD command signal (see Tables 2-D through 2-G) to the PSPDN. If parameter 6 is not set to 0, the PSPDN responds with an acknowledgment PAD service signal.
- The profile selection is: set, set-and-read, and read PAD command signals (see Table 2-C).

2.4.2 Other Terminal-Dependent Parameters

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 nonprinting characters or time fill, is required. This value also specifies the padding inserted after the Line Feed (LF) character of the form effector. Through parameter 10, the DTE can select a line folding option and specify the maximum number of characters that the PSPDN can send to it as single line. After K characters (value of K set in parameter 10) in an output line the PSPDN inserts a format effector and provides appropriate format effector padding (parameter 9). Parameter 13 allows the DTE to specify the action taken by the PSPDN, with respect to line insertion, when it deals with a carriage return data transfer. Parameter 14 specifies whether or not padding is done after a line feed is transmitted to the DTE.

2.5. Interface Procedures (Asynchronous DTE to X.25 DTE)

2.5.1 General

This section describes the protocol required in the X.25 Interface Specification 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".

2.5.2 Call Set-Up

When the local PAD receives a selection PAD command signal from the local DTE (refer to Section 2.3) it maps the information contained in the signal into a call request packet and sends this packet to the remote PAD. The remote PAD 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 call request packet is divided into a protocol identifier field and a call field. The format of the protocol identifier field is illustrated in Exhibit 2-1. 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 PSPDN still accepts the call if none is provided.

2.5.3 Data Transfer

After the call has been established, the PSPDN 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-bits 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 PAD or has originated from the PAD. The PSPDN sets the D bit to 0 in all transmitted data packets containing user data. The PSPDN takes the following actions when receiving data packets containing user data. If the D bit is set to 1, the PSPDN 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 PSPDN need not withhold the acknowledgment if the data pack has the D bit set to 0.

2.5.4 PAD Messages

PAD messages allow the remote DTE to set parameters, read parameters and initiate call clearing from the PAD. PAD messages allow the PSPDN 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 Exhibit 2-2). Some PAD messages also include a parameter field. The control identifier field (bits 5 through 8 of the first octet) contain all zeros. The message code field (bit 4 Table 2-F) may be one of the following.

- 0 = Parameters Indication
- 1 = Invitation to Clear
- 2 = Set Parameters
- 3 = Indication of Break
- 4 = Read Parameters
- 5 = Error
- 6 = Set-and-Read Parameters
- 7 = Reselected PAD Message

Successive octets (this does not apply to message types 1 and 5) are interpreted in pairs where the first octet indicates the PAD parameter reference number and the second octet indicates the value of the parameter. The PSPDN supports PAD message lengths 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 PSPDN does not set the D bit to 1 when transmitting data packets containing PAD messages.

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

The PSPDN 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. Tables 2-D through 2-G specify the PSPDN'S response to set, read, and set-and-read PAD messages. The parameter field of these PAD messages, when present consists of successive parts of reference fields and value fields; each one octet long (see Exhibit 2-2). Parameter reference numbers are binary coded in bits 1 to 7 of the reference field. The PSPDN ignores bit 8 in all PAD messages it receives and only interprets bits 1 to 7. If bits 1 to 7 contain an invalid parameter reference (see Paragraph 5.04 N) the PSPDN 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 1 to 8 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 Tables 2-D through 2-G.

The remote DTE can request that the PAD clear a virtual call by sending it an invitation-to-clear PAD message. Upon receipt of this message, the PSPDN sends all previously transmitted data to the local DTE. The PSPDN 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 Exhibit 2-4.

The following procedures apply when the local DTE transmits a break and parameter 7 is set to 21. The PSPDN sends an interrupt packet with the user data field set to 0 followed by an indication-of-break PAD message (refer to Exhibit 2-5). 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 PSPDN and resume. If the PSPDN 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 PSPDN and parameter 7 is set to 1, the PSPDN responds by transmitting an interrupt packet with the user data field coded as 00000001. 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.

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 PSPDN 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 PSPDN receives an invalid PAD message, it responds by sending an error PAD message (see Exhibit 2-3). The error PAD message indicates what type of error has occurred and also contains the message code of the invalid PAD message.

2.6. User Facilities

2.6.1 Incoming Calls Barred

All the incoming calls for a subscriber are barred. This service is offered by the "one way logical channel" facility which blocks the incoming calls on all logical channels. If this service applies to a subscriber, all the incoming calls from the network will be rejected; but it is possible for this 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.

2.6.2 Outgoing Calls Barred

All the outgoing calls for a subscriber are barred. This service is offered by the "one way logical channel" facility which blocks the outgoing calls on all logical channels. If this service applies to a subscriber, all the outgoing calls to the network will be rejected; but, is possible for this subscriber to receive incoming calls. The logical channels retain their full-duplex capability.

2.6.3 Closed User Group Facilities

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

- Closed User Group is a facility in the basic form which enables a user to belong to one or more CUG's.
- Closed User Group with Outgoing Access is a variant to a CUG which also enables the user to make outgoing calls to the open part of the network; other users belonging to the same CUG's do not need the outgoing access possibility.
- Closed User Group with Incoming Access is another variant which allows individual members of a CUG to receive incoming calls either from other CUG's or from other network users.

At the destination node, a validation check about the acceptability of the call is made. The call is forwarded only in the cases when the interlock code received, matches with the interlock codes stored at the destination node associated with the 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 towards 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 CUG's. In the case when a user belongs to more than one CUG, one of these is nominated as the preferential CUG of that user. Each user belonging to at least one CUG, has either the closed use group facility or one or both of the closed use group with outgoing access. The realization of the CUG facilities is based on various validation checks at call set-up; determining whether or not a requested call to or from a user having a CUG facility is allowed. In particular, a validation check is performed by comparison of an interlock code, which is associated with each user belonging to a CUG. Facility registration, including allocation of interlock codes, is controlled by the service order and cannot be controlled by the user.

The DTE/PSPDN interface protocol and the actions at the originating node at call setup from a user belonging to a CUG, depends on whether the user belongs to one or more CUG's and on the combination of CUG facilities that applies. For each CUG that a user belongs to, the interlock code assigned to the CUG is stored, associated with the user at the local node. 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 including an index identifying a particular CUG, the CUG is selected by the originating node.
- In the case when the calling user makes no facility request identifying a particular CUG, the originating node selects the preferential (or only) CUG.
- Thus no facility request concerning CUG facilities is made by the calling user in the case:
 - When the user belongs to one CUG only.
 - When a user that belongs to more than one CUG makes a call within the preferential CUG.
 - When a user having the closed user group with outgoing access facility makes an outgoing access call.

In the case of a call request where the subscriber enters a selected CUG, the indication of outgoing access is not provided in the call request even when subscribed to. The called DTE must match the same interlock code as specified in the call request or the call will be cleared.

In a Call Setup from a user having the CUG with Outgoing Access Facility the call is regarded as an outgoing access call within the preferential (or only) CUG. The call is set up at the originating node. The CALL REQUEST packet forwarded to the next node includes the interlock code of the preferential (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 node between a call within a CUG and an outgoing access call.

For Calls to a User Having the Closed User Group or the Closed User Group with Outgoing Access Facility, an incoming call is accepted only when it is a CUG call; including the case when outgoing access 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 cleared. For 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. With CUG Calls to a User Having the Closed User Group with Incoming Access Allowed Facility, 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. For Calls Without CUG Facility an incoming call is accepted only when the called user has no CUG facility or incoming access is allowed.

2.6.4 Reverse Charging

Reverse charging is an optional user facility that may be requested by the user on a per call basis. This privileges 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/PSPDN interface. The Reverse Charge Option allows for billing of usage charges associated with calls to be billed to another network address.

Customers who select the Reverse Charge Acceptance (Terminating Calls) option will accept the charges for all calls sent to the network address(es) assigned to the customer. In order to receive calls from a dial access customer, this option must be selected.

Fast Select is an optional user facility which may be requested by a DTE for a given virtual call. DTE's can request the fast select facility on a per call basis by means of an appropriate facility request in a call request packet using any logical channel which has been assigned to virtual calls. The Fast Select facility, if requested in a call request packet, allows this packet to contain a call user data field of up to 124 octets. It authorizes the PSPDN to transmit to the DTE, during the DTE waiting state, a call connected or clear indication packet with a called or clear user data field respectively of up to 124 octets.

Table 2-A
Possible Values and Combinations of Values Of Pad Parameters
CCITT Parameter Values For X.3 Standard Profiles (Page 1 of 38)

PARM NO	PROFILE NUMBER									
	1	2	3	4	5	6	7	90	91	PSPDN USER FRIENDLY
1	1	1	0	1	1	0	1	1	0	1
2	0	0	0	0	0	0	1	1	0	1
3	126	2	0	2	2	0	2	126	0	126
4	0	0	20	0	0	4	0	0	20	0
5	1	0	0	0	0	0	0	1	0	2
6	1	1	0	1	1	0	1	5	0	5
7	2	21	2	21	2	0	21	2	2	2
8	0	0	0	0	0	0	0	0	0	0
9	0	2	0	2	2	0	2	0	0	0
10	0	0	0	0	0	0	0	0	0	0
11	Indicates speed of DTE									
12	1	0	0	0	1	0	0	1	0	1
13	16	4	0	16	5	0	4	16	0	16
14	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	1	0	0	0	0	0
16	127	127	127	127	127	127	127	127	127	127
										
17	24	24	24	24	24	24	24	24	24	24
	<CAN>	<CAN>	<CAN>	<CAN>	<CAN>	<CAN>	<CAN>	<CAN>	<CAN>	<CAN>
18	18	18	18	18	18	18	18	18	18	18
	<DC2>	<DC2>	<DC2>	<DC2>	<DC2>	<DC2>	<DC2>	<DC2>	<DC2>	<DC2>
19	2	2	2	2	2	2	2	1	1	2
20	0	0	0	0	0	0	0	0	0	0
21	0	3	0	0	3	3	3	0	0	0
22	0	0	0	0	0	0	0	0	0	0

Profile 90 = 1984 CCITT Simple Standard Profile

Profile 91 = 1984 CCITT Simple Standard Transparent

DIGIPAC® uses the PSPDN user friendly profile as the default standard for both dedicated and dial access

Table 2-A
Possible Values and Combinations of Values of Pad Parameters
DIGIPAC® Standard Profile #1 (Page 2 of 38)

Parameter Reference Number	Parameter Description	Values	PAD Parameter Meaning
1	PAD recall using a character	1	Character DLE
2	Echo	0	No echo
3	Selection of data forwarding character(s)	126	All characters in column 0 and 1 and character DEL
4	Selection of idle timer delay	0	Value of idle timer in twentieths of a second
5	Ancillary device control	1	Use of X-ON and X-OFF (data transfer)
6	Control of PAD service signals	1	PAD service signals are transmitted in the standard format
7	Selection of operation of the PAD on receipt of break signal from the start-stop mode DTE	2	Reset Interrupt and indication of break
8	Discard output	0	Normal data delivery
9	Padding after carriage return (CR)	0	No padding after CR (see Note 4)
10	Line folding	0	No line folding

Table 2-A
Possible Values and Combinations of Values of Pad Parameters
DIGIPAC® Standard Profile #1 (Page 3 of 38)

Parameter Reference Number	Parameter Description	Values	PAD Parameter Meaning
11 (read only)	Binary speed of start-stop mode DTE	0	110 bit/s
		1	134.5 bits/s
		2	300 bit/s
		3	1,200 bit/s
		4	600 bit/s
		5	75 bit/s
		6	150 bit/s
		7	1,800 bit/s
		8	200 bit/s
		9	100 bit/s
		10	50 bit/s
		11	75/1,200 bit/s
		12	2,400 bit/s
		13	4,800 bit/s
		14	9,600 bit/s
		15	19,200 bit/s
		16	48,000 bit/s
		17	56,000 bit/s
18	64,000 bit/s		
12	Flow control of the PAD	1	Use of X-ON (DC1) and X-OFF (DC3) for flow control
13	Linefeed insertion after carriage return	5	Insert linefeed after transmission to the start-stop mode DTE and after echo of CR
		16	Insert linefeed to the terminal after a pad generated <CR>
14	Padding after linefeed	0	No padding after linefeed
16	Character delete	127	Character 7/15 (DEL)
17	Line delete	24	Character 1/8 (CAN)
18	Line display	18	Character 1/2 (DC2)
19	Editing PAD service signals	2	Editing PAD service signals for display terminals
20	Echo mask	0	No echo mask (all characters echoed)
21	Parity treatment	0	No parity checking or generation
22	Page wait	0	Page wait disabled

Table 2-A
Possible Values and Combinations of Values of Pad Parameters
DIGIPAC® Standard Profile #2 (Page 4 of 38)

Parameter Reference Number	Parameter Description	Values	PAD Parameter Meaning
1	PAD recall using a character	1	Character DLE
2	Echo	0	Echo
3	Selection of data forwarding character(s)	2	Character CR
4	Selection of idle timer delay	0	Value of idle timer in twentieths of a second
5	Ancillary device control	0	No use of X-ON (DC1) and X-OFF (DC3)
6	Control of PAD service signals	1	PAD service signals are transmitted in the standard format
7	Selection of operation of the PAD on receipt of break signal from the start-stop mode DTE	21	Discard output, interrupt and indication of break
8	Discard output	0	Normal data delivery
9	Padding after carriage return (CR)	2	Number of padding characters inserted after CR
10	Line folding	0	No line folding

Table 2-A
Possible Values and Combinations of Values of Pad Parameters
DIGIPAC® Standard Profile #2 (Page 5 of 38)

Parameter Reference Number	Parameter Description	Values	PAD Parameter Meaning
11 (read only)	Binary speed of start-stop mode DTE	0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18	110 bit/s 134.5 bits/s 300 bit/s 1,200 bit/s 600 bit/s 75 bit/s 150 bit/s 1,800 bit/s 200 bit/s 100 bit/s 50 bit/s 75/1,200 bit/s 2,400 bit/s 4,800 bit/s 9,600 bit/s 19,200 bit/s 48,000 bit/s 56,000 bit/s 64,000 bit/s
12	Flow control of the PAD	0	Use of X-ON (DC1) and X-OFF (DC3) for flow control
13	Linefeed insertion after carriage return	4	Insert linefeed after echo of CR to start-stop mode DTE
14	Padding after linefeed	0	No padding after linefeed
15	Editing	0	No use of editing in the data transfer state
16	Character delete	127	Character 7/15 (DEL)
17	Line delete	24	Character 1/8 (CAN)

Table 2-A
Possible Values and Combinations of Values of Pad Parameters
DIGIPAC® Standard Profile #2 (Page 6 of 38)

Parameter Reference Number	Parameter Description	Values	PAD Parameter Meaning
18	Line display	18	Character 1/2 (DC2)
19	Editing PAD service signals	2	No editing PAD service signals Editing PAD service signals for printing terminals Editing PAD service signals for display terminals Editing PAD service signals using one character from the range of IA5
20	Echo mask	0	No echo mask (all characters echoed)
21	Parity treatment	3	Parity checking and parity generation
22	Page wait	0	Page wait disabled

Table 2-A
Possible Values and Combinations of Values of Pad Parameters
DIGIPAC® Standard Profile #3 (Page 7 of 38)

Parameter Reference Number	Parameter Description	Values	PAD Parameter Meaning
1	PAD recall using a character	0	Not possible
2	Echo	0	No echo
3	Selection of data forwarding character(s)	0	No data forwarding character(s)
4	Selection of idle timer delay	20	Value of idle timer in twentieths of a second
5	Ancillary device control	0	No use of X-ON (DC1) and X-OFF (DC3)
6	Control of PAD service signals	0	No PAD service signals are transmitted to the start-stop mode DTE
7	Selection of operation of the PAD on receipt of break signal from the start-stop mode DTE	2	Reset
8	Discard output	0	Normal data delivery
9	Padding after carriage return (CR)	0	No padding after CR
10	Line folding	0	No line folding

Table 2-A
Possible Values and Combinations of Values of Pad Parameters
DIGIPAC® Standard Profile #3 (Page 8 of 38)

Parameter Reference Number	Parameter Description	Values	PAD Parameter Meaning
11 (read only)	Binary speed of start-stop mode DTE	0	110 bit/s
		1	134.5 bits/s
		2	300 bit/s
		3	1,200 bit/s
		4	600 bit/s
		5	75 bit/s
		6	150 bit/s
		7	1,800 bit/s
		8	200 bit/s
		9	100 bit/s
		10	50 bit/s
		11	75/1,200 bit/s
		12	2,400 bit/s
		13	4,800 bit/s
		14	9,600 bit/s
		15	19,200 bit/s
		16	48,000 bit/s
		17	56,000 bit/s
18	64,000 bit/s		
12	Flow control of the PAD	0	No use of X-ON (DC1) and X-OFF (DC3) for flow control
13	Linefeed insertion after carriage return	0	No linefeed insertion
14	Padding after linefeed	0	No padding after linefeed
15	Editing	0	No use of editing in the data transfer state
16	Character delete	127	Character 7/15 (DEL)
17	Line delete	24	Character 1/8 (CAN)
18	Line display	18	Character 1/2 (DC2)
19	Editing PAD service signals	2	No editing PAD service signals for display terminals
20	Echo mask	0	No echo mask (all characters echoed)
21	Parity treatment	0	No parity checking or generation
22	Page wait	0	Page wait disabled

Table 2-A
Possible Values and Combinations of Values of Pad Parameters
DIGIPAC® Standard Profile #4 (Page 9 of 38)

Parameter Reference Number	Parameter Description	Values	PAD Parameter Meaning
1	PAD recall using a character	1	Character DLE
2	Echo	0	No echo
3	Selection of data forwarding character(s)	2	Character CR
4	Selection of idle timer delay	0	Value of idle timer in twentieths of a second
5	Ancillary device control	0	No use of X-ON (DC1) and X-OFF (DC3)
6	Control of PAD service signals	1	PAD service signals are transmitted in the standard format
7	Selection of operation of the PAD on receipt of break signal from the start-stop mode DTE	21	Discard output, interrupt and indication of break
8	Discard output	0	Normal data delivery
9	Padding after carriage return (CR)	2	Number of padding characters inserted after CR
10	Line folding	0	No line folding

Table 2-A
Possible Values and Combinations of Values of Pad Parameters
DIGIPAC® Standard Profile #4 (Page 10 of 38)

Parameter Reference Number	Parameter Description	Values	PAD Parameter Meaning
11 (read only)	Binary speed of start-stop mode DTE	0	110 bit/s
		1	134.5 bits/s
		2	300 bit/s
		3	1,200 bit/s
		4	600 bit/s
		5	75 bit/s
		6	150 bit/s
		7	1,800 bit/s
		8	200 bit/s
		9	100 bit/s
		10	50 bit/s
		11	75/1,200 bit/s
		12	2,400 bit/s
		13	4,800 bit/s
		14	9,600 bit/s
		15	19,200 bit/s
		16	48,000 bit/s
		17	56,000 bit/s
18	64,000 bit/s		
12	Flow control of the PAD	0	No use of X-ON (DC1) and X-OFF (DC3) for flow control
13	Linefeed insertion after carriage return	5	Insert linefeed after transmission to the start-stop mode DTE and after echo of CR
		16	Insert linefeed to the terminal after a PAD generated (CR)
14	Padding after linefeed	0	No padding after linefeed
15	Editing	0	No use of editing in the data transfer state
16	Character delete	127	Character 7/15 (DEL)
17	Line delete	24	Character 1/8 (CAN)

Table 2-A
Possible Values and Combinations of Values of Pad Parameters
DIGIPAC® Standard Profile #4 (Page 11 of 38)

Parameter Reference Number	Parameter Description	Values	PAD Parameter Meaning
18	Line display	18	Character 1/2 (DC2)
19	Editing PAD service signals	2	Editing PAD service signals for display terminals
20	Echo mask	0	No echo mask (all characters echoed)
21	Parity treatment	3	No parity checking generation
22	Page wait	0	Page wait disabled

Table 2-A
Possible Values and Combinations of Values of Pad Parameters
DIGIPAC® Standard Profile #5 (Page 12 of 38)

Parameter Reference Number	Parameter Description	Values	PAD Parameter Meaning
1	PAD recall using a character	1	Character DLE
2	Echo	0	No echo
3	Selection of data forwarding character(s)	2	Character CR
4	Selection of idle timer delay	0	Value of idle timer in twentieths of a second
5	Ancillary device control	0	No use of X-ON (DC1) and X-OFF (DC3)
6	Control of PAD service signals	1	PAD service signals are transmitted in the standard format
7	Selection of operation of the PAD on receipt of break signal from the start-stop mode DTE	2	Reset
8	Discard output	0	Normal data delivery
9	Padding after carriage return (CR)	2	Number of padding characters inserted after CR
10	Line folding	0	No line folding

Table 2-A
Possible Values and Combinations of Values of Pad Parameters
DIGIPAC® Standard Profile #5 (Page 13 of 38)

Para meter Reference Number	Parameter Description	Values	PAD Parameter Meaning
11 (read only)	Binary speed of start-stop mode DTE	0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18	110 bit/s 134.5 bits/s 300 bit/s 1,200 bit/s 600 bit/s 75 bit/s 150 bit/s 1,800 bit/s 200 bit/s 100 bit/s 50 bit/s 75/1,200 bit/s 2,400 bit/s 4,800 bit/s 9,600 bit/s 19,200 bit/s 48,000 bit/s 56,000 bit/s 64,000 bit/s
12	Flow control of the PAD	0	No use of X-ON (DC1) and X-OFF (DC3) for flow control
13	Linefeed insertion after carriage return	5	Insert linefeed after transmission to the start-stop mode DTE and after echo of CR
14	Padding after linefeed	0	No padding after linefeed
15	Editing	1	No use of editing in the data transfer state
16	Character delete	127	Character 7/15 (DEL)
17	Line delete	24	Character 1/8 (CAN)

Table 2-A
Possible Values and Combinations of Values of Pad Parameters
DIGIPAC® Standard Profile #5 (Page 14 of 38)

Parameter Reference Number	Parameter Description	Values	PAD Parameter Meaning
18	Line display	18	Character 1/2 (DC2)
19	Editing PAD service signals	2	Editing PAD service signals for display terminals
20	Echo mask	0	No echo mask (all characters echoed)
21	Parity treatment	3	Parity checking and parity generation
22	Page wait	0	Page wait disabled

Table 2-A
 Possible Values and Combinations of Values of Pad Parameters
 DIGIPAC® Standard Profile #6 (Page 15 of 38)

Parameter Reference Number	Parameter Description	Values	PAD Parameter Meaning
1	PAD recall using a character	0	Not possible
2	Echo	0	No echo
3	Selection of data forwarding character(s)	0	No data forwarding character(s)
4	Selection of idle timer delay	4	Value of idle timer in twentieths of a second
5	Ancillary device control	0	No use of X-ON (DC1) and X-OFF (DC3)
6	Control of PAD service signals	0	No PAD service signals are transmitted to the start-stop mode DTE
7	Selection of operation of the PAD on receipt of break signal from the start-stop mode DTE	0	Nothing
8	Discard output	0	Normal data delivery
9	Padding after carriage return (CR)	0	No padding after CR
10	Line folding	0	No line folding

Table 2-A
Possible Values and Combinations of Values of Pad Parameters
DIGIPAC® Standard Profile #6 (Page 16 of 38)

Parameter Reference Number	Parameter Description	Values	PAD Parameter Meaning
11 (read only)	Binary speed of start-stop mode DTE	0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18	110 bit/s 134.5 bits/s 300 bit/s 1,200 bit/s 600 bit/s 75 bit/s 150 bit/s 1,800 bit/s 200 bit/s 100 bit/s 50 bit/s 75/1,200 bit/s 2,400 bit/s 4,800 bit/s 9,600 bit/s 19,200 bit/s 48,000 bit/s 56,000 bit/s 64,000 bit/s
12	Flow control of the PAD	0	No use of X-ON (DC1) and X-OFF (DC3) for flow control
13	Linefeed insertion after carriage return	0	No linefeed insertion
14	Padding after linefeed	0	No padding after linefeed
15	Editing	0	No use of editing in the data transfer state
16	Character delete	127	Character 7/15 (DEL)
17	Line delete	24	Character 1/8 (CAN)
18	Line display	18	Character 1/2 (DC2)

Table 2-A
Possible Values and Combinations of Values of Pad Parameters
DIGIPAC® Standard Profile #6 (Page 17 of 38)

Parameter Reference Number	Parameter Description	Values	PAD Parameter Meaning
19	Editing PAD service signals	2	Editing PAD service signals for display terminals
20	Echo mask	0	No echo mask (all characters echoed)
21	Parity treatment	3	Parity checking and parity generation
22	Page wait	0	Page wait disabled

Table 2-A
Possible Values and Combinations of Values of Pad Parameters
DIGIPAC® Standard Profile #7 (Page 18 of 38)

Parameter Reference Number	Parameter Description	Values	PAD Parameter Meaning
1	PAD recall using a character	1	Character DLE
2	Echo	1	Echo
3	Selection of data forwarding character(s)	2	Character CR
4	Selection of idle timer delay	0	Value of idle timer in twentieths of a second
5	Ancillary device control	0	No use of X-ON (DC1) and X-OFF (DC3)
6	Control of PAD service signals	1	PAD service signals are transmitted in the standard format
7	Selection of operation of the PAD on receipt of break signal from the start-stop mode DTE	21	Discard output, interrupt and indication of break
8	Discard output	0	Normal data delivery
9	Padding after carriage return (CR)	2	Number of padding characters inserted after CR
10	Line folding	0	No line folding

Table 2-A
Possible Values and Combinations of Values of Pad Parameters
DIGIPAC® Standard Profile #7 (Page 19 of 38)

Parameter Reference Number	Parameter Description	Values	PAD Parameter Meaning
11 (read only)	Binary speed of start-stop mode DTE	0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18	110 bit/s 134.5 bits/s 300 bit/s 1,200 bit/s 600 bit/s 75 bit/s 150 bit/s 1,800 bit/s 200 bit/s 100 bit/s 50 bit/s 75/1,200 bit/s 2,400 bit/s 4,800 bit/s 9,600 bit/s 19,200 bit/s 48,000 bit/s 56,000 bit/s 64,000 bit/s
12	Flow control of the PAD	0	No use of X-ON (DC1) and X-OFF (DC3) for flow control
13	Linefeed insertion after carriage return	4 20	Insert linefeed after echo of CR to start-stop mode DTE Insert linefeed to terminal after a CR from terminal
14	Padding after linefeed	0	No padding after linefeed

Table 2-A
Possible Values and Combinations of Values of Pad Parameters
DIGIPAC® Standard Profile #7 (Page 20 of 38)

Parameter Reference Number	Parameter Description	Values	PAD Parameter Meaning
15 (see note 5)	Editing	0	No use of editing in the data transfer state
16	Character delete	127	Character 7/15 (DEL)
17	Line delete	24	Character 1/8 (CAN)
18	Line display	18	Character 1/2 (DC2)
19	Editing PAD service signals	2	Editing PAD service signals for display terminals
20	Echo mask	0	No echo mask (all characters echoed)
21	Parity treatment	3	Parity checking and parity generation
22	Page wait	0	Page wait disabled

Table 2-A
Possible Values and Combinations of Values of Pad Parameters
DIGIPAC® Standard Profile #90 (Page 21 of 38)

Parameter Reference Number	Parameter Description	Values	PAD Parameter Meaning
1	PAD recall using a character	1	Character DLE
2	Echo	1	Echo
3	Selection of data forwarding character(s)	126	All characters in column O and 1 and character DEL
4	Selection of idle timer delay	0	Value of idle timer in twentieths of a second
5	Ancillary device control	1	Use of X-ON and X-OFF (data transfer)
6	Control of PAD service signals	5	PSPDN user friendly format
7	Selection of operation of the PAD on receipt of break signal from the start-stop mode DTE	2	Reset
8	Discard output	0	Normal data delivery
9	Padding after carriage return (CR)	0	No padding after CR
10	Line folding	0	No line folding

Table 2-A
Possible Values and Combinations of Values of Pad Parameters
DIGIPAC® Standard Profile #90 (Page 22 of 38)

Parameter Reference Number	Parameter Description	Values	PAD Parameter Meaning
11 (read only)	Binary speed of start-stop mode DTE	0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18	110 bit/s 134.5 bits/s 300 bit/s 1,200 bit/s 600 bit/s 75 bit/s 150 bit/s 1,800 bit/s 200 bit/s 100 bit/s 50 bit/s 75/1,200 bit/s 2,400 bit/s 4,800 bit/s 9,600 bit/s 19,200 bit/s 48,000 bit/s 56,000 bit/s 64,000 bit/s
12	Flow control of the PAD	1	No use of X-ON (DC1) and X-OFF (DC3) for flow control
13	Linefeed insertion after carriage return	0 16	No linefeed insertion Insert linefeed to the terminal after a pad generated CR
14	Padding after linefeed	0	No padding after linefeed

Table 2-A
Possible Values and Combinations of Values of Pad Parameters
DIGIPAC® Standard Profile #90 (Page 23 of 38)

Parameter Reference Number	Parameter Description	Values	PAD Parameter Meaning
15	Editing	0	No use of editing in the data transfer state
16	Character delete	127	Character 7/15 (DEL)
17	Line delete	24	Character 1/8 (CAN)
18	Line display	18	Character 1/2 (DC2)
19	Editing PAD service signals	1	Editing PAD service signals for video terminals
20	Echo mask	0	No echo mask (all characters echoed)
21	Parity treatment	0	No parity checking generation
22	Page wait	0	Page wait disabled

Table 2-A
Possible Values and Combinations of Values of Pad Parameters
DIGIPAC® Standard Profile #91 (Page 24 of 38)

Parameter Reference Number	Parameter Description	Values	PAD Parameter Meaning
1	PAD recall using a character	0	Not possible
2	Echo	0	No echo
3	Selection of data forwarding character(s)	0	No data forwarding character(s)
4	Selection of idle timer delay	20	Value of idle timer in twentieths of a second
5	Ancillary device control	0	Use of X-ON (DC1) and X-OFF (DC3)
6	Control of PAD service signals	0	No PAD service signals are transmitted to the start-stop mode DTE
7	Selection of operation of the PAD on receipt of break signal from the start-stop mode DTE	2	Reset
8	Discard output	0	Normal data delivery
9	Padding after carriage return (CR)	0	No padding after CR
10	Line folding	0	No line folding

Table 2-A
Possible Values and Combinations of Values of Pad Parameters
DIGIPAC® Standard Profile #91 (Page 25 of 38)

Parameter Reference Number	Parameter Description	Values	PAD Parameter Meaning
11 (read only)	Binary speed of start-stop mode DTE	0	110 bit/s
		1	134.5 bits/s
		2	300 bit/s
		3	1,200 bit/s
		4	600 bit/s
		5	75 bit/s
		6	150 bit/s
		7	1,800 bit/s
		8	200 bit/s
		9	100 bit/s
		10	50 bit/s
		11	75/1,200 bit/s
		12	2,400 bit/s
		13	4,800 bit/s
		14	9,600 bit/s
		15	19,200 bit/s
		16	48,000 bit/s
		17	56,000 bit/s
18	64,000 bit/s		
12	Flow control of the PAD	0	No use of X-ON (DC1) and X-OFF (DC3) for flow control
13	Linefeed insertion after carriage return	0	No linefeed insertion
14	Padding after linefeed	0	No padding after linefeed
15	Editing	0	No use of editing in the data transfer state
16	Character delete	127	Character 7/15 (DEL)
17	Line delete	24	Character 1/8 (CAN)
18	Line display	18	Character 1/2 (DC2)
19	Editing PAD service signals	1	Editing PAD service signals for printing terminals
20	Echo mask	0	No echo mask (all characters echoed)
21	Parity treatment	0	No parity checking or generation
22	Page wait	0	Page wait disabled

Table 2-A
Possible Values and Combinations of Values of Pad
Parameters PSPDN User Friendly Profile DIGIPAC® Default Standard For
Dedicated and Dial Access (Page 26 of 38)

Parameter Reference Number	Parameter Description	Values	PAD Parameter Meaning
1	PAD recall using a character	1	Character DLE
2	Echo	1	Echo
3	Selection of data forwarding character(s)	126	All characters in column 0 and 1 and character DEL
4	Selection of idle timer delay	0	Value of idle timer in twentieths of a second
5	Ancillary device control	2	Use of X-ON and X-OFF (data transfer)
6	Control of PAD service signals	5	PAD service signals and the prompt PAD service signal are transmitted in the standard format
7	Selection of operation of the PAD on receipt of break signal from the start-stop mode DTE	2	Reset
8	Discard output	0	Normal data delivery
9	Padding after carriage return (CR)	0	No padding after CR
10	Line folding	0	No line folding

Table 2-A
Possible Values and Combinations of Values of Pad
Parameters PSPDN User Friendly Profile DIGIPAC® Default Standard For
Dedicated and Dial Access (Page 27 of 38)

Parameter Reference Number	Parameter Description	Values	PAD Parameter Meaning
11 (read only)	Binary speed of start-stop mode DTE	0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18	110 bit/s 134.5 bits/s 300 bit/s 1,200 bit/s 600 bit/s 75 bit/s 150 bit/s 1,800 bit/s 200 bit/s 100 bit/s 50 bit/s 75/1,200 bit/s 2,400 bit/s 4,800 bit/s 9,600 bit/s 19,200 bit/s 48,000 bit/s 56,000 bit/s 64,000 bit/s
12	Flow control of the PAD	1	No use of X-ON (DC1) and X-OFF (DC3) for flow control
13	Linefeed insertion after carriage return	0 16	No linefeed insertion Insert linefeed to the terminal after a PAD generated CR
14	Padding after linefeed	0	No padding after linefeed

Table 2-A
Possible Values and Combinations of Values of Pad
Parameters PSPDN User Friendly Profile DIGIPAC® Default Standard For
Dedicated and Dial Access (Page 28 of 38)

Parameter Reference Number	Parameter Description	Values	PAD Parameter Meaning
15	Editing	0	No use of editing in the data transfer state
16	Character delete	127	Character 7/15 (DEL)
17	Line delete	24	Character 1/8 (CAN)
18	Line display	18	Character 1/2 (DC2)
19	Editing PAD service signals	2	Editing PAD service signals for video terminals
20	Echo mask	0	No echo mask (all characters echoed)
21	Parity treatment	0	Parity checking and parity generation
22	Page wait	0	Page wait disabled

Table 2-A
Possible Values And Combination Of Values Of Pad
Parameters (See Note 1)
CCITT X.3 Profile (Page 29 of 38)

Parameter Reference Number	Parameter Description	Selectable possible values		PAD Parameter Meaning	Remarks
		Mandatory	Optional (see Note 2)		
1	PAD recall using a character	0	32 to 126	Not possible	
		1		Possible; using one graphic character defined by user	
2	Echo	0		No echo	
		1		Echo	
3	Selection of data forwarding character(s)	0	6 18	No data forwarding character(s)	Value formed by combination (2+4) Value formed by combination (2+16) Value formed by combination (2+4+8+16+32+64)
		2		Character CR	
		126		Characters CR, ESC, BEL, ENQ, ACK Characters CR, EQT, ETX All characters in column 0 and 1 and character DEL	
4	Selection of idle timer delay	0 20 255	1 to 19 21 to 254	Value of idle timer in twentieths of a second	(Note 3)
5	Ancillary device control	0	2	No use of X-ON (DC1) and X-OFF (DC3)	
		1		Use of X-ON and X-OFF (data transfer)	
				Use of X-ON and X-OFF (data transfer and command)	

Table 2-A
Possible Values And Combination Of Values Of Pad
Parameters (See Note 1)
CCITT X.3 Profile (Page 30 of 38)

Parameter Reference Number	Parameter Description	Selectable possible values		PAD Parameter Meaning	Remarks
		Mandatory	Optional (see Note 2)		
6	Control of PAD service signals	0		No PAD service signals are transmitted to the start-stop mode DTE	Value formed by combination (1+4)
		1		PAD service signals are transmitted in the standard format	
			5	PAD service signals and the prompt PAD service signal are transmitted in the standard format	
			8 to 15	PAD service signals are transmitted in a network dependent format	
7	Selection of idle operation of the PAD on receipt of break signal from the start-stop mode DTE	0		Nothing	Value formed by combination (1+4)
			1	Interrupt	
		2		Reset	
			5	Interrupt and indication of break	
	8		Escape from data transfer state	Valued formed by combination (1+4+16)	
21		Discard output, interrupt and indication of break			
8	Discard output	0		Normal data delivery	
		1		Discard output	

Table 2-A
Possible Values And Combination Of Values Of Pad
Parameters (See Note 1)
CCITT X.3 Profile (Page 31 of 38)

Parameter Reference Number	Parameter Description	Selectable possible values		PAD Parameter Meaning	Remarks
		Mandatory	Optional (see Note 2)		
9	Padding after carriage return (CR)	0 1 to 7	8 to 255	No padding after CR (see Note 4) Number of padding characters inserted after CR	
10	Line folding	0 1 to 255		No line folding Number of graphic characters per line	
11	Binary speed of start-stop mode DTE	0 2	1 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18	110 bit/s 134.5 bits/s 300 bit/s 1,200 bit/s 600 bit/s 75 bit/s 150 bit/s 1,800 bit/s 200 bit/s 100 bit/s 50 bit/s 75/1,200 bit/s 2,400 bit/s 4,800 bit/s 9,600 bit/s 19,200 bit/s 48,000 bit/s 56,000 bit/s 64,000 bit/s	The values implemented in individual PAD's depend on the range of DTE data transmission rates which are supported. The allocation of decimal values to all known rates is to avoid revision of the Recommendation in the future.
12	Flow control of the PAD	0 1		No USE OF X-ON (DC1) and X-OFF (DC3) for flow control Use of X-ON (DC1) and X-OFF (DC3) for flow control	

Table 2-A
Possible Values And Combination Of Values Of Pad
Parameters (See Note 1)
CCITT X.3 Profile (Page 32 of 38)

Parameter Reference Number	Parameter Description	Selectable possible values		PAD Parameter Meaning	Remarks
		Mandatory	Optional (see Note 2)		
13	Linefeed insertion after carriage return	0		No linefeed insertion	
		1		Insert linefeed after transmission of CR to the start-stop mode DTE	
		4		Insert linefeed after echo of CR to start-stop mode DTE	
		5		Insert linefeed after transmission to the start-stop mode DTE and after echo of CR	Combination (1+4)
		6		Insert linefeed in data stream after CR from the start-stop mode DTE and after echo of a CR to the start-stop mode DTE	Combination (2+4)
		7		Insert linefeed in the data stream to and from the start-stop mode DTE and after echo of a CR to the start-stop mode DTE	Combination (1+2+4)
		126	0	No line feed	
			1	Insert linefeed to terminal on CR from host	On detecting a CR from the host, insert a linefeed.

Table 2-A
Possible Values And Combination Of Values Of Pad
Parameters (See Note 1)
CCITT X.3 Profile (Page 33 of 38)

Parameter Reference Number	Parameter Description	Selectable possible values		PAD Parameter Meaning	Remarks
		Mandatory	Optional (see Note 2)		
13 (cont.)			4	Insert linefeed to the terminal on a CR from terminal or PAD	On detection of a CR from the terminal or PAD, echoes a linefeed.
			5	Insert linefeed to the terminal or CR from PAD, terminal or host	On detection of a CR from either the host or terminal, echoes a linefeed.
			6	Insert linefeed to the terminal on CR from terminal and insert linefeed in data to host on CR from terminal	On detection of a CR from the terminal, and insert a linefeed in data to host.
			7	Insert linefeed to terminal on CR from PAD, terminal or host or insert linefeed in data to host on CR from terminal	On detection of a CR from either the host or terminal, echoes a linefeed. On detection of a CR from terminal, inserts linefeed in data to host.
			16	Insert linefeed to the terminal after a PAD-generated CR	When a PAD generates a CR, LF is generated.
			17	Insert linefeed to the terminal after a PAD generated CR or a host CR	On detection of CR from a host or a PAD generated CR, echoes a linefeed.

Table 2-A
Possible Values And Combination Of Values Of Pad
Parameters (See Note 1)
CCITT X.3 Profile (Page 34 of 38)

Parameter Reference Number	Parameter Description	Selectable possible values		PAD Parameter Meaning	Remarks
		Mandatory	Optional (see Note 2)		
13 (cont.)			20	Insert linefeed to terminal after a CR from terminal	On detection of a CR from the terminal, echoes a linefeed
			21	Insert linefeed to terminal on CR from terminal or host	On detection of a CR from either the terminal or host, echoes a linefeed.
			22	Insert linefeed to terminal on CR from terminal. Insert linefeed in data to host on CR from terminal or PAD	On detection of a CR from terminal or PAD, echoes a linefeed. On detection of a CR in data from terminal, inserts a linefeed in data to host.
			23	Insert linefeed to terminal on CR from terminal or host. Insert linefeed in data to host on CR from terminal	On detection of a CR from terminal, PAD or host, echoes a linefeed. On detection of CR in data from terminal, inserts a linefeed in data to host.
14	Padding after linefeed	0		No padding after linefeed	NOTE: Applies only to data transfer state.
		1 to 7	8 to 255	Number of padding characters inserted after linefeed	
15 (See Note 5)	Editing	0		No use of editing in the data transfer state	
		1		Use of editing in the data transfer state	

Table 2-A
Possible Values And Combination Of Values Of Pad
Parameters (See Note 1)
CCITT X.3 Profile (Page 35 of 38)

Parameter Reference Number	Parameter Description	Selectable possible values		PAD Parameter Meaning	Remarks
		Mandatory	Optional (see Note 2)		
16 (See Note 5)	Character delete	127	0 to 126	One character from range of IA5 Character 7/15 (DEL)	
17 (See Note 5)	Line delete	24	0 to 23 25 to 127	One character from IA5 Character 1/8 (CAN) One character from range of IA5	
18 (See Note 5)	Line display	18	0 to 17 19 to 127	One character from range of IA5 Character 1/2 (DC2) One character from IA5	
19 (See Note 5)	Editing PAD service signals	1 2 8 32 to 126	0	No editing PAD service signals Editing PAD service signals for printing terminals Editing PAD service signals for display terminals Editing PAD service signals using one character from the range of IA5	

Table 2-A
Possible Values And Combination Of Values Of Pad
Parameters (See Note 1)
CCITT X.3 Profile (Page 36 of 38)

Parameter Reference Number	Parameter Description	Selectable possible values		PAD Parameter Meaning	Remarks
		Mandatory	Optional (see Note 2)		
20 (See Notes 6 and 7)	Echo Mask	0		No echo mask (all characters echoed)	Values may be formed by combination of basic values.
			1	No echo of CR	
			2	No echo of LF	
				No echo of VT, HT, FF	
				No echo of BEL, BS	
				No echo of ACK, NAK, STX, SOH, EOT, ETB, ETX	
20 (cont.)			64	No echo of editing characters as designated by Parameters 16, 17 and 18	
			128	No echo of all other characters in columns 0 and 1 not mentioned above and DEL	
21	Parity treatment	0		No parity checking or generation	Value formed by combination (1+2)
			1	Parity checking	
			2	Parity generation	
			3	Parity checking and parity generation	
22	Page wait	0		Page wait disabled	
			23	Number of line feed characters considered by the PAD for the page wait function	
			1 to 22		

Table 2-A
Possible Values And Combination Of Values Of Pad
Parameters (See Note 1)
CCITT X.3 Profile (Page 37 of 38)

NOTES:

1. Other values and possible combination of values are for further study.
2. These parameter values provide additional user facilities not necessarily provided in all PAD's.
3. Some PAD implementations may not offer all possible values of idle time delay within the possible range. In such cases, where the value selected is not available, the PAD assumes the next higher value available.
4. 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.
5. When parameter 15 is implemented, the values of parameters 16, 17 and 18 are either default values or are selected from the optional range shown. The editing function is provided during the PAD command state whether parameter 15 is implemented or not. If parameters 16, 17, and 18 are implemented, the editing characters and editing PAD service signals during the PAD command state are defined by the appropriate values of these parameters. If parameters 16, 17, and 18 are not implemented, default values for the functions of these parameters are applicable to the "PAD command" state.
6. This parameter does not apply if parameter 2 is set to zero.
7. If parameter 5 or 12 is set to a nonzero value, then the X-ON and X-OFF characters are not echoed.
8. ADDITIONAL PAD PARAMETERS

P118 CHARACTER DELETE

RANGE 0 -127

DESCRIPTION: Specifies a 7-bit ASCII value representing ITI delete character.
Corresponds to PAD parameters 16 and 118.

P119 LINE DELETE

RANGE 0 - 127

DESCRIPTION: Specifies a line delete, which overrides the standard default.
Corresponds to PAD parameters 17 and 119.

P120 LINE DISPLAY

RANGE 0 - 127

DESCRIPTION: Specifies a line display. Corresponds to PAD parameter 120.

Table 2-A
Possible Values And Combination Of Values Of Pad
Parameters (See Note 1)
CCITT X.3 Profile (Page 38 of 38)

NOTES: (cont.)

8. ADDITIONAL PAD PARAMETERS (cont.)

- P121 DATA FORWARD CHARACTER
RANGE 0 - 127
DESCRIPTION: Specifies a data forwarding character. An entry of 0 signals no additional data forwarding characters. Corresponds to PAD parameter 121.
- P122 DATA FORWARD CHARACTER 2
RANGE 0 - 127
DESCRIPTION: Specifies a data forwarding character. An entry of 0 signals no additional data forwarding characters. Corresponds to PAD parameter 122.
- P123 PARITY TREATMENT
RANGE 0, 1, 2, 3
DESCRIPTION: Specifies whether or not the PAD checks the parity of characters received from the DTE and whether the PAD generates parity for characters sent to the DTE.
- P125 OUT PENDING TIMER
RANGE 0 - 255
DESCRIPTION: Specifies the length of time that terminal output can be blocked (in sec units). Corresponds to PAD parameter 125.
0 = Not possible
1 = Character <DLE>
32 to 126 = Escape character is the specified ASCII character.
- P126 LINEFEED INSERTION
RANGE 0, 1, 4, 5, 6, 7, 16, 17, 20, 21, 22, 23
DESCRIPTION: Specifies the insertion of <LF> after every <CR>. Corresponds to PAD parameter 13 and 126.

Table 2-B
Format of Call Selection Command

Function: To establish a virtual connection through the network (see note 1 for NUI command).

Format (2): [NF][R][CUG<cug>][T(rpoa)]Addr,<user data> <cr>

Explanation: [] - Optional facility
NF - Non-restricted fast select call
R - Reverse-charge call
CUG - Closed user group
T - Transit network selection
Addr - 5 to 14 digits called data network address - X.121

OR

ISDN Packet address in the following format:
1+0+CC+N(S)N

Where

1 = Prefix Digit
0 = Escape Code
CC = Country Code (1 for North America)
N(S)N = National Significant Number
(NPA+NXX+XXXX for North America)
<cug> - Closed user group index number
<rpoa> - 4 digit Recognized Private Operating Agency indicator (3)
<user data> - 1 to 12 characters without fast select indication
- 1 to 124 characters with non-restricted fast select indication
- User data must immediately follow the comma
<cr> - Command delimiter (carriage return)

NOTES:

1. A NUI may be required on direct or private dial ports. If required, the NUI commands must be entered as follows prior to entering the call selection command state.

Format: NUI nui password

NUI - is 6 character Network User Identifier

PASSWORD - The password is requested on a separate line after the NUI command is entered. The password is 'blotted' by the Access Module so that is cannot be read, for security reasons.

2. All items should be separated by a single blank with the exception of the user data field which must immediately follow the comma.
3. The 4 digits of the RPOA should be the DNIC of the desired transit network.

Table 2-C
DIGIPAC® Pad Command Signals

The enter the PAD command state, the control key should be depressed and held while the P key is depressed.

Explanation: [] - Optional field
 No - Number
 Val - Value
 ... - etc.
 <cr> - carriage return

FUNCTION	DIGIPAC® FORMAT	
Read PAD Parameter Values	PAR? [No,] [No,] . . . <cr>	Note 1
Set PAD Parameter Values	SET [No:Val,] [No:Val,] . . . <cr>	Note 2
Set/Read PAD Parameter Values	SET? [No:Val,] [No:Val,] . . . <cr>	Note 2
Set Profile number	Prof No <cr>	Note 3
Clear Request	CLR <cr>	
Virtual Circuit Status Request	STAT <cr>	
Reset a Virtual Call	RESET <cr>	
Send an Interrupt Pack	INT <cr>	
Status	STAT	

NOTES:

1. All parameters are read if no reference number is specified.
2. If no reference number is specified, all parameters are reset to default values.
3. Profile numbers are 1-7, 90, and 91.
DIGIPAC® network parameters values for all profiles are shown in Table 2-A.

Table 2-D
Explanation of DIGIPAC® Network Messages
(Page 1 of 4)

NOTE:

The network generated messages listed in this table may appear at any time. All are preceded by the network identification; DIGIPAC®. All may be followed by a PAD prompt if Parameter 6 is set to 5, and the PAD is ready to accept a terminal command.

MESSAGE	EXPLANATION
1. Clear indication	
1.1 CALL CLEARED-DESTINATION NOT RESPONDING	Destination is either not acknowledging the request to connect or is not in operation.
1.2 CALL CLEARED-ACCESS BARRED	The network has blocked the call because of a closed user group violation.
1.3 CALL CLEARED-ADDRESS NOT IN SERVICE	The network address in the call request identifies a non-existent address.
1.4 CALL CLEARED-COLLECT CALL REFUSED	The destination does not accept charges (e.g., from public dial ports).
1.5 CALL CLEARED-REMOTE PROCEDURE ERROR	A network protocol error has occurred.
1.6 CALL CLEARED-REMOTE PROCEDURE ERROR	A destination protocol error has occurred.
1.7 CALL CLEARED-LOCAL DIRECTIVE	A virtual circuit has been cleared in response to a clear request packet from the terminal.
1.8 CALL CLEARED-REMOTE REQUEST	A virtual circuit has been cleared in response to an invitation from the destination to clear the call.

Table 2-D
Explanation of DIGIPAC® Network Messages
(Page 2 of 4)

MESSAGE	EXPLANATION
1. Clear indication (cont.)	
1.9 CALL CLEARED-DESTINATION BUSY	Destination cannot accept another call.
1.10 CALL CLEARED-INCOMPATIBLE CALL OPTIONS	Call request includes facilities not available at the destination, or incompatible with it.
1.10 CALL CLEARED-TEMPORARY NETWORK PROBLEM	A network problem has occurred.
1.12 CALL CLEARED-INCOMPATIBLE DESTINATION	A virtual circuit has been cleared because source and destination have incompatible packet (line) size or throughput class. On PVC's the message can mean two masters are trying to connect
2. Reset Indication	
2.1 RESET-TEMPORARY NETWORK PROBLEM	A network problem has occurred on the connection.
2.2 RESET-DESTINATION NOT RESPONDING	The destination end of a PVC is not responding; the access line, or the destination itself is down.
2.3 RESET-LOCAL PROCEDURE ERROR	The virtual circuit has been reset because of a network protocol error.
2.4 RESET-REMOTE PROCEDURE ERROR	A virtual circuit has been reset because of a destination protocol error.
2.5 RESET- LOCAL DIRECTIVE	The network response to a reset command from the terminal.
2.6 RESET-BY DESTINATION	The destination has reset the virtual circuit; data may have been lost.

Table 2-D
Explanation of DIGIPAC® Network Messages
(Page 3 of 4)

MESSAGE	EXPLANATION
3. General 3.1 xxxxxxxx	Part of the herald message, indicating that the terminal, address xxxxxxxx, is connected to the network.
3.2 [P/N] xxxxxxxx -YYYYYYYY 111	The herald message for PVC, showing that your terminal (address xxxxxxxx) is connected to the network and the host (address YYYYYYYY) through logical channel 111.
3.3 INVALID ADDRESS or MORE THAN 12 CHARACTERS or COMMA REQUIRED BEFORE DATA CHARACTERS INVALID LINE SIZE	Each of these messages indicates an error in the call request.
3.4 CLOSED USER GROUP ERROR	Error in the call request command. CUG requested is invalid.
3.5 SERVICE OPTION NOT SUBSCRIBED	Error in the call request command, attempted to use nonsubscribed service option.
3.6 CALLED BY [P/N] [R] [I] YYYYYYYY	A host or terminal (address YYYYYYYY) has called your terminal; P or N specifies the grade of service; R specifies reverse charging; I specifies an international call.
3.7 CALL CONNECTED TO dna TO dna HUNTED TO dna BACKED UP TO dna BACKED UP AND HUNTED	A SVC between your terminal and the destination has been established.

Table 2-D
Explanation of DIGIPAC® Network Messages
(Page 4 of 4)

MESSAGE	EXPLANATION
3.8 RE-ENTER	<p>a) A transmission error has occurred in the current input line.</p> <p>b) If the message occurs during a call request, the terminal is set to the wrong parity.</p>
3.9 INPUT DATA LOST	A transmission error has occurred; part of the current input line has already been sent.
3.10 PARITY ERROR	Parity error in the current input line from a terminal operating in echo mode. The character in error is not echoed.
3.11 INPUT ERROR	A network problem due to overruns.
3.12 PVC DISCONTINUED-TEMPORARY NETWORK PROBLEM	A network problem is preventing the requested call from continuing.
3.13 PVC DISCONTINUED-DESTINATION NOT RESPONDING	Either the access line to the destination, or the destination itself is down.
3.14 PVC DISCONTINUED-REMOTE REQUEST	The destination has asked that the circuit be discontinued.
3.15 INVALID COMMAND	A syntax error in the command.
3.16 COMMAND NOT ALLOWED	The command although syntactically correct, cannot be implemented due to the ITI state, or because it violates or conflicts with the service options; e.g., a call request when a SVC is already established.
3.17 EXCESS USER DATA	<p>When making a non-fast select call, too much user data (> 12 characters) was sent.</p> <p>When making a fast select call, too much user data (> 124 characters) was sent.</p>

Table 2-E
Pad Messages Transmitted by the Pad in Response to Set,
Set-and-Read, and Read Pad Messages

PAD MESSAGE RECEIVED BY THE PAD		ACTION UPON PAD PARAMETERS	CORRESPONDING PARAMETER INDICATION PAD MESSAGE TRANSMITTED TO THE PACKET MODE DTE
TYPE	PARAMETER FIELD		
Set	None	Reset all implemented Recommendation X.3 parameters to their initial values corresponding to the initial profile	None
	List of selected parameters with the desired values	Set the selected parameters to the given values: a) if no error is encountered b) if the PAD fails to modify the values of some parameters	a) None b) List of these invalid parameters (see Note)
Set-and-Read	None	Reset all implemented Recommendation X.3 parameters to their initial values corresponding to the initial profile	List all implemented recommendation X.3 parameters and their initial values
	List of selected parameters with the desired values	Set the selected parameters to the given values	List these parameters with their new current values (see Note)
Read	None	None	List implemented Recommendation X.3 parameters with their current values
	List of selected parameters	None	List of these parameters with their current values (see Note)

NOTE:

If any of the parameters contain an error, then the error bit is set and the parameter value field is coded as described in Table 2-G.

Table 2-F
Type and Coding of OCTET 1 of Pad Messages

TYPE	Message Code			
	Bits	4	3	2	1
Set PAD message	0	0	1	0
Read PAD message	0	1	1	0
Set-and-Read PAD message	0	0	0	0
Parameter indication PAD message	0	0	0	1
Invitation to clear PAD message	0	0	1	1
Indication of break PAD message	0	1	1	1
Reselection PAD message				
Error PAD message				

Ref. 1984 CCITT X.29 4.4.2

NOTE: The possibility of extending the message code field is for further study.

Table 2-G
Coding of Parameter Value Field in Case of Error

ERROR TYPE	Parameter Value Field Code								Decimal
	Bits								
	8	7	6	5	4	3	2	1	
No additional information.	0	0	0	0	0	0	0	0	0
The parameter reference does not exist or has not been implemented in the PAD.	0	0	0	0	0	0	0	1	1
The parameter value is invalid or has not been implemented in the PAD.	0	0	0	0	0	0	1	0	2
The parameter value cannot	0	0	0	0	0	0	1	1	3
The parameter is read only.	0	0	0	0	0	1	0	0	4
The parameter follows an invalid parameter separator.	0	0	0	0	0	1	0	1	5

Ref. 1984 CCITT X.29 4.4.5.3

Table 2-H
Coding and Meaning of OCTET 2 of Error Pad Message

Case	Meaning	Coding								
		Bits	8	7	6	5	4	3	2	1
a	Received PAD message contained less than eight bits		0	0	0	0	0	0	0	0
b	Unrecognized message code in received PAD message		0	0	0	0	0	0	0	1
c	Parameter field format of received PAD message was incorrect or incompatible with message code		0	0	0	0	0	0	1	0
d	Received PAD message did not contain an integral number of octets		0	0	0	0	0	0	1	1
e	Received parameter indication PAD message was unsolicited		0	0	0	0	0	1	0	0
f	Received PAD message was too long		0	0	0	0	0	1	0	1

Ref. 1984 CCITT X.29 4.4.6.1

Table 2-I
Summary of Asynchronous PDN Standard (Default) Interface Attributes

Direct Access	RS232-C: Up to 9.6 kbps
Dial Access	212A - Compatible Interface: 300 to 1200 bps
Character Set	ANSI X3.4
Editing Buffer	At least 128 octets
Signaling	X.28 commands and service signals. User friendly formats
Parameters	CCITT X.3 parameters 1-22
Profiles	CCITT simple standard profile CCITT transparent standard profile PSPDN Default Profile

	8	7	6	5	4	3	2	1	
1	0	0	0	0	0	0	0	1	Protocol Identifier
2	0	0	0	0	0	0	0	0	
3	0	0	0	0	0	0	0	0	
4	0	0	0	0	0	0	0	0	
									Call Data
N									

4<N<16 Octets or 128 if Fast Select

Ref. 1984 CCITT X.29 Paragraph 4.2

Exhibit 2-1
Call User Data Field Format

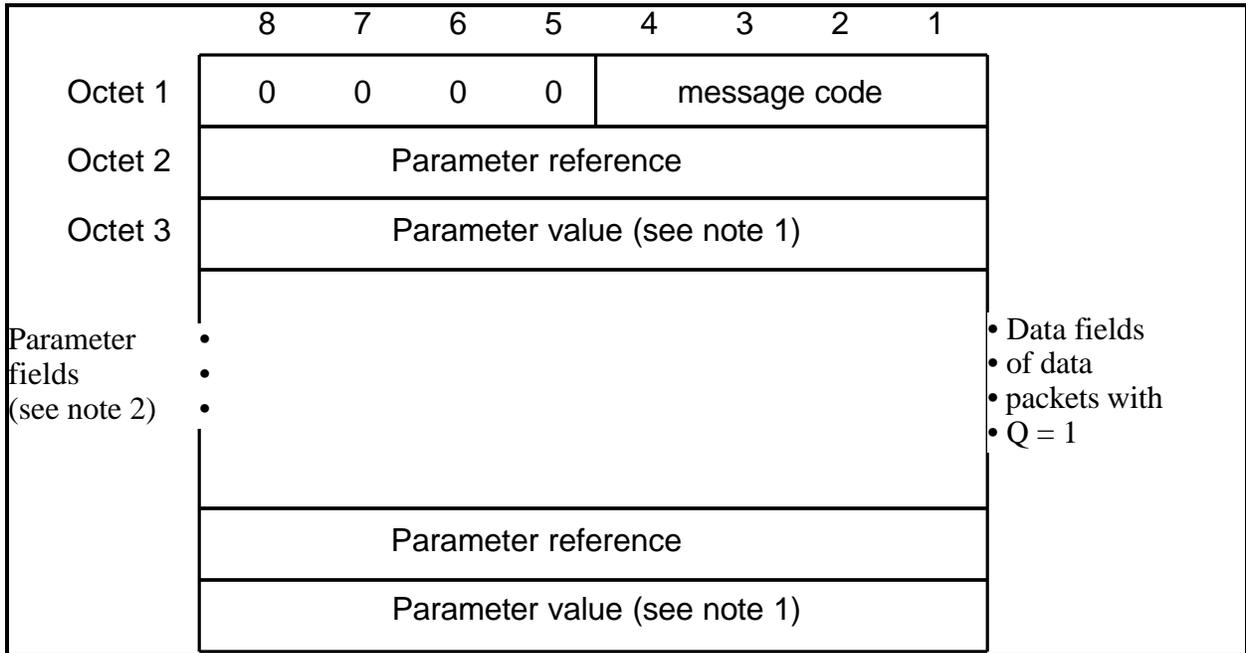


Exhibit 2-2
 Set, Read, Set-And-Read And Parameter Indication

Pad Message Format

	8	7	6	5	4	3	2	1	
Octet 1	0	0	0	0	0	1	0	1	<ul style="list-style-type: none"> • Data fields • of data • packets with • Q = 1
Octet 2	Error type (see Table 2-3)								
Octet 3	Invalid message code (see note 1) (see Table 2-H)								

Note: Does not occur for error type 00000000

Reference 1984 CCITT X.29 Paragraph 4.4.6

Exhibit 2-3
Error Pad Message Format

	8	7	6	5	4	3	2	1	
Octet 1	0	0	0	0	0	0	0	1	<ul style="list-style-type: none"> • Data fields • of data • packets with • Q = 1

Reference 1984 CCITT X.29 Paragraph 4.4.8

Exhibit 2-4
Invitation To Clear Pad Message Format

	8	7	6	5	4	3	2	1	
Octet 1	0	0	0	0	0	0	1	1	<ul style="list-style-type: none"> • Data fields • of data • packets with • Q = 1
Octet 2	Parameter reference = 8								
Octet 3	Parameter value = 1								

Reference 1984 CCITT X.29 Paragraph 4.4.7

Exhibit 2-5
Indication of Break Pad Message Format

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3. X.25 Interface (Multichannel-Direct Access)

3.1 Overview

This Chapter describes the service provided by the X.25 Interface of the PSPDN. The interface (based on CCITT Recommendation X.25) defines the interface between DTE and DCE for terminals or hosts operating in the packet mode on PSPDN. The X.25 interface supports Virtual Calls (VC) and Permanent Virtual Calls (PVC). The interface also supports Reverse Charging and Closed User Groups. The interface specifications for communications between an X.25 host and an asynchronous DTE is specified in Chapter 2, Section 2.5 - Interface Procedures (Asynchronous DTE to X.25 DTE). These specifications are based on CCITT Recommendation X.29.

3.2 Physical Level

The X.25 interface is available at data rates of 2400 bps to 9600 bps using a voice grade data channel or digital data channel; and a 56kb/s using a digital data channel (see Table 3-C). Details on the physical interfaces available on DIGIPAC® are found in Chapter 8.

Note The following link and packet level specification items refer to parts of the 1980 and 1984 CCITT Recommendation X.25. Information is also provided on system parameter options (see Tables 3-A, 3-B and 3-C).

3.3 Link Level

3.3.1 System Parameters (see Table 3-C)

The link level access protocol controls data transmission across the access link. Both information and control are transferred across the access link in transmission units called frames. The period of Timer T1, at the end of which re transmission of a frame may be initiated, will take into account whether T1 is started at the beginning or the end of the transmission of a frame. The period of Timer T1 is agreed for a period of time with the OTC, and may be set in increments of 5.3ms. The value of DCE Timer T1 for the DIGIPAC® network is between 0 and 15 seconds (default value equals 3 seconds).

Proper operation of the procedure requires that timer T1 must be greater than the maximum time between transmission of frames (SABM, DISC, I or supervisory commands) and the reception of the corresponding frame returned as an answer to this frame (UA, DM or acknowledging frame). Therefore, the DTE or DCE receiver should not delay the response or acknowledging frame returned to the above frame by more than a value T2 less than T1 where T2 is a parameter. The DCE will not delay the response or acknowledging frame returned to a command by more than T2. T2 should take into account the round trip propagation delay of the access line plus processing time in the DTE. The value of T2 for DIGIPAC® will not exceed 0.4 seconds. DIGIPAC® will not delay the response to a received frame by more than 0.3 seconds; this includes 0.1 seconds for the worst case round trip propagation for an access line.

The range of values for the number (N2) of attempts made by the DTE to complete the successful transmission of a frame to the PSPDN is from 1 to 20. The maximum number of bits (NI) in the Information field of an I frame or Test Frame should not exceed 2104 bits (level 3 Normal Mode). The number (k) of sequentially numbered I frames that the DTE and PSPDN may have outstanding (i.e., unacknowledged) at any given time is a system parameter. For Modulo 8, this number is from 1 to 7 and shall be agreed with the OTC. The value of k may be different for each direction of transmission. (For extended service, Modulo 128, you can have k = 1 to 127 outstanding packets.)

3.3.2 Timer Recovery

DIGIPAC® supports timer recovery procedures specified in 1984 CCITT X.25 Paragraph 2.4.5.9.

3.3.3 Link Disconnection

During the information transfer phase, the frame reject condition or the disconnected phase, the DTE shall indicate disconnecting of the link by transmitting a DISC command to the PSPDN. When receiving a DISC command during the information transfer phase or the frame reject condition, the PSPDN will return a UA response to the DTE and enter the disconnected phase. When the PSPDN wishes to disconnect the link, it will send the DISC command with the P bit set to 1 and start Timer T1. Upon reception of the UA or DM response, with F bit set to 1, from the DTE, the PSPDN will stop its Timer T1. Should Timer T1 expire before reception of the UA or DM responses from the DTE, the PSPDN will retransmit the DISC command and restart Timer T1. After transmission of the DISC command N2 times by the PSPDN, recovery action will be initiated.

3.3.4 Timer T3 (Idle Channel State)

Timer T3 (Idle Channel State) is supported on the DIGIPAC® network. This timer is started when no level two activity is detected (no flags sent or received). If the timer expires it will start link recovery actions. The default value of Timer T3 is set to 15 seconds.

In addition, an idle probe timer is implemented. This timer is started when there is no activity on the link (valid frames sent or received.). When the timer expires a command level RR/RNR with the poll bit set will be sent to check the conditions of the link. The default value of this timer is set to 15 seconds.

3.3.5 Link Level Addressing

The address field identifies a frame as either a command or a response. A command frame contains the address of the DCE or DTE to which the command is being sent. A response frame contains the address of the DCE or DTE sending the frame.

Frames containing commands transferred from the DCE to the DTE will contain the address "A" for the single link operation. Frames containing responses transferred from the DCE to the DTE will contain the address B for the single link operation. Frames containing commands transferred from the DTE to the DCE shall contain the address "B" for the single link operation. Frames containing responses transferred from the DTE to the DCE shall contain the address "A" for the single link operation. These addresses are coded as follows:

	Address	1	2	3	4	5	6	7	8	
Single link operation	A	1	1	0	0	0	0	0	0	DCE
	B	1	0	0	0	0	0	0	0	DTE

Note: The DCE will discard all frames received with an address other than A or B.

The default link level addressing mode for DIGIPAC® will have DIGIPAC® as the DCE.

3.4 Packet Level

3.4.1 Packet Level Access

The packet level access protocol provides the interface procedures required to set up, maintain and clear VC's and maintain permanent virtual circuits (PVC's) between DTE's. The packet types, formats and procedures are those given in X.25 for Virtual Call and Permanent Virtual Circuit services (see Tables 3-A, 3-B and 3-C for explanation and values of packet timers and parameters).

3.4.2 Standard Packet Level Attributes

Packet level interface attributes specified in X.25 include:

- User data field length of 128 octets (optionally 256 octets)
- Packet sequence numbering modulo 8
- Packet level window size of 2

3.4.3 Logical Channels

Logical channels are identified by a four bit logical channel group number and an eight bit logical channel number. This allows a maximum of 4096 logical channels. Logical channels supported:

<u>Speed</u>	<u>Max #</u>
2.4 kbs	127
4.8 kbs	255
9.6 kbs	511
56.0 kbs	1023

DIGIPAC® Logical channels will be assigned per Annex A of 1984 CCITT Recommendation X.25. For each range of logical channels applying to a VC interface, the user must specify the logical channel number. If either the incoming/outgoing calls barred facility applies to an interface, the user must specify the logical channel number range (beginning and end). For permanent virtual circuits, the user must specify the logical channel number for each permanent virtual circuit applying to an interface.

3.4.4 User Data Field Length of Data Packets

The standard User Data Field Length is 128 octets. However, the User Data field of data packets transmitted by a DTE may contain any number of bits up to the agreed maximum. If the User Data field in a data packet exceeds the locally permitted maximum User Data Field length, then the PSPDN will reset the virtual call or permanent virtual circuit with the resetting cause "local procedure error". Octet aligned (any integral number of octets up to 128 or optional 256) User Data fields are supported.

3.4.5 More Data Mark

The More Data Mark (M-bit) may only be set to 1 in a full data packet. When it is set to 1 in a full data packet, it indicates that more data is to follow. The network does not perform fragmentation or recombination of packets since the maximum packet length is the same at both ends and equal to 128 octets. The network checks if a data packet with the M-bit set is a full data packet. If not, the PSPDN considers this as a "local procedure error" and will reset the call. A sequence of data packets with every M-bit set to 1 except for the last one will be delivered as a sequence of data packets with the M-bit set to 1 except for the last one, when the original packets have M=1 are full.

3.4.6 Qualifier Bit

The Q-bit is handled transparently on the X.25 interface.

3.4.7 Delivery Confirmation

The delivery confirmation (D-bit) procedures are supported as specified in X.25. The DTE indicates whether it wishes to receive, by means of the packet receive sequence number P (R), and end-to-end acknowledgment (indicated by D = 1).

3.4.8 Significance of DCE (PSPDN) Clear, Reset, and Restart Confirmation Packets

DCE (PSPDN) Clear, Reset, and Restart Confirmation packets have local significance. Local significance permits a confirmation packet to be sent as soon as the network has cleared or reset the logical channel, rather than after the remote DTE has confirmed the reset or clear indication.

3.4.9 Flow Control Principles

The network follows the standard flow control principles specified in Section 4.4.1 1984 CCITT X.25.

3.4.10 Diagnostic Packet

Diagnostic Packet is not supported

3.4.11 Packet Format

See CCITT Recommendation X.25.

3.5 Addresses

The network numbering plan for Virtual Call services complies with CCITT Recommendation X.121. Network addresses consist of 10 digits. All 10 digits must be present whenever an address is given in the address field of a packet. It is expected that inter network calls will utilize 14 digits which consist of the network address preceded by a 4 digit DNIC.

For packet calls to and from Integrated Subscriber Digital Networks (ISDN) the address of the ISDN subscribers will be in a format that conforms to TR-TSY-000448, Issue 1, Revision 1, July 1989. For calls to and from ISDNs within the United States the format will be as follows:

1+0+CC+N(S)N

Where

- 1 = Prefix Digit
- 0 = Escape Code to non-native numbering plan
- CC = Country Code for North America

N(S)N = National Significant Number (NPA+NXX+XXXX for North America)

A multiple line hunt group is a grouping of access lines which can be called by DTE's using a single network address. The incoming calls are distributed across the available lines of the hunt group so that the number of VC on each line are approximately equal. Hunt group sizes of up to sixteen access lines are supported. The hunt group performs an access line selection for an incoming call if there is at least one idle logical channel available for VC's (excluding one-way outgoing logical channels). The hunt group is considered busy when VC's are established on all logical channels available for VC's on all lines in the group.

Once a virtual call is assigned to a particular access line, it is treated as a regular call (e.g., if the access line fails, the virtual call is disconnected). All packets associated with an individual virtual call are routed over the same access line. All access lines in a hunt group are treated as a single administrative unit when virtual call facilities are selected at service order time.

Address screening will be performed by the network on the calling address field of the call request packet from the calling DTE. If there is no address present in the calling address field of the call request packet from the calling DTE the address assigned to the access port will be placed in the calling address field and the call will also proceed. If there is an address in the calling address field of the call request packet from the calling DTE, and that address matches the address assigned to the access port the call will proceed. If there is an address in the calling address field of the call request packet from the calling DTE, and that address does not match the address assigned to the access port the call will be rejected.

3.6 Access Line Takedown

3.6.1 General

These capabilities apply to individual access lines, including access lines which are part of a hunt group.

3.6.2 Unconditional Access Line

A user may place a call to repair and request an unconditional take down of an access line. The line is then taken out of service until the user requests that it be returned to service. The network will take the line out of service by clearing all VC's and resetting all permanent virtual circuits toward the remote DTE's and by initiating the link level disconnect procedure on the local interface. For VC's, a Clear Indication packet will be transmitted to each remote DTE with a cause code of "out of order". For permanent virtual circuits, a Reset Indication packet will be transmitted to each remote DTE with a cause code of "out of order". A DISC command frame will be transmitted to the local DTE.

3.6.3 Conditional Access Line

This feature allows a user to take an access line gracefully out of service. The user calls, by standard voice telephone, to request a conditional take down of an access line. Based on the user request, action is taken to prevent any new VC's from being set up on the designated access line. Existing virtual call and permanent virtual circuits are unaffected. When the network detects that all VC's have been terminated, the network will take the line out of service by initiating the restart procedure at the interface and then initiating the link level disconnect procedure. The network will transmit a Restart Indication packet to the local DTE with a cause code of "network congestion". For each permanent virtual circuit, the restart procedure results in a Reset Indication packet being sent to the remote DTE with a cause code of "out of order". The line will remain out of service until the user calls and requests its return to service.

3.7 X.25 User Optional Facilities

3.7.1 Permanent Virtual Connections

The virtual circuit corresponding to the virtual call is a switched connection and the association only lasts for the duration of the call, whereas in a permanent virtual connection, the association is, by definition, a permanent one. To the subscribers who are connected, it resembles a point-to-point leased line and it is therefore unnecessary to go through the call establishment procedure. The permanent virtual connections are set up in the Network Control Center by the operator.

The procedures for the control of packets between the DTE and the PSPDN conform with the virtual call service in the data transfer state. In error conditions the PSPDN indicates a reset with "local procedure error"; the distant DTE is also informed of the reset by a Reset Indication packet with "remote procedure error". If the link level fails, the PVC is set in the "out-of-order" state. After recovery of the link level the PVC is set automatically in the operational state. The operator of the Network Control Center can establish or release a permanent virtual connection by an operator command.

3.7.2 Closed User Group Related Facilities

Closed User Groups (CUG's) provide a mechanism for creating private networks that restrict communication among group members and non-members in various ways. Ordinary CUG's permit members to communicate with each other but preclude communication with non-members. CUG's with outgoing access permit members to communicate with each other and to originate calls to subscribers who do not belong to any CUG's or to subscribers who belong to other CUG's with incoming access. Closed User Groups with incoming access permit members to communicate with one another and to receive calls from subscribers who do not belong to any CUG, or from subscribers who belong to other CUG's with outgoing access capability. The Closed User Group facility is designated as essential (E) in X.2. The Closed User Group with outgoing access facility and the Closed User Group with Incoming Access facility are designated as additional (A) in X.2.

3.7.3 Fast Select

This facility is requested by the DTE on a per call basis in the Call Request packet. It allows the calling DTE to send up to 124 octets of user data in the Call Request packet and receive up to 124 octets of user data from the called DTE in a Call Connected packet or a Clear Indication packet, if issued in direct response to the Call Request packet.

3.7.4 Multiple Addresses on Access Line

DIGIPAC® supports multiple addresses.

3.7.5 Multiple Line Hunt Group

See Section 3.5.

3.7.6 Reverse Charging

Reverse charging allows a user to request that the call be charged to the called party.

3.7.7 Reverse Charging Acceptance

Reverse charging acceptance allows the user to accept charges for all terminating calls to his access line.

3.7.8 Throughput Negotiation

Data throughput class and window negotiation are facilities offered by DIGIPAC® in conformance with CCITT 1980 Recommendations X.25/X.75. Window size for both directions of traffic can be chosen irrespective of the throughput classes used for the requested connection. The facilities are implemented in addition to the existing solution of flow control.

Ports unable to support negotiation can set up connections to ports with negotiation capability and vice versa. Throughput class negotiation is implemented on an end-to-end basis. The negotiated values are installed throughout the network. Window size negotiation has local significance and, if necessary, the destination node can perform window size matching. Throughput class negotiation and window size negotiation are combined. It is not possible to subscribe to one without having subscribed to the other.

3.7.9 Network User Identification (NUI)

The NUI is used to provide secure access to the network. Network User Identification, if subscribed to, will be four (4) numeric characters. The network user address is forwarded to the called party on the calling DT. The network user address is used for billing. The NUI is assigned at subscription time by the Network Control Center (NCC).

3.7.10 Recognized Private Operating Agency (RPOA)

Recognized Private Operating Agency (RPOA) selection is per virtual call facility. This facility is the signaling mechanism that allows X.25 subscribers to select, at call setup, the transit network through which an inter network call is routed. Only the basic format of the RPOA facility, CCITT 1984, is supported on DIGIPAC®.

Interchange Carrier (IC) Preselection. A user may select a preferred IC at subscription time. If the user does not select an IC during call setup using the RPOA selection facility, this preferred or preselected IC will be used.

Table 3-A
DCE Time-Outs

<u>Time-out number</u>	<u>Time-out value</u>	<u>State of the logical channel</u>	<u>Start when</u>	<u>Normally terminated when</u>	<u>Actions to be taken when the time-out expires (See Note 1)</u> <u>Local side</u>	<u>Remote side</u>
T10	60s	r3	DCE issues a restart indication	DCE leaves the r3 state (i.e., the restart request is received)	DCE re transmits the restart indication and remains in state r3. After n re trans--missions: See Note 2.	For permanent virtual circuits, the remote DTE is informed with RESET and "out of order" after n(2) unsuccessful re transmissions
T11	180s	p3	DCE issues an incoming call	DCE leaves the p3 state (e.g. the call accepted, clear request or call request)	DCE enters the p7 state signaling a clear indication (local procedure error)	DCE enters the p7 state signaling a clear indication (remote procedure error)
T12	60s	d3	DCE issues a reset indication	DCE leaves the d3 state (i.e., the reset confirmation or reset request is received)	DCE re transmits the restart indication and remains in state d3. After n re trans--missions: See Note 3.	See Note 3
T13	60s	p7	DCE issues a clear indication	DCE leaves the p7 state (e.g., the clear confirmation or clear request is received)	DCE re transmits the clear indication and remains in p7. After n re transmissions: See Note 4.	

Notes:

- The following Notes 2, 3, and 4 describe alternative DCE actions on time-out. The maximum number of retries applying to the following notes is less than or equal to 3. The values of n (=3) will not necessarily be the same for the clear, reset and restart procedure.
- The DCE will re transmit the RESTART INDICATION at regular intervals of t until a DTE RESTART CONFIRMATION is received or restart collision occurs or a period of (n+1) t elapses since the first transmission of the RESTART INDICATION. If the reset procedure is not completed within the time-out period, the Restart Time-out Failure (rf) state is entered. In the case of permanent virtual circuits the distant DTE will be informed by a RESET INDICATION packet with the cause "out of order".
- The DCE will transmit the RESET INDICATION at regular intervals of t until a DTE RESET CONFIRMATION is received or a reset collision occurs or a period (n+1) t elapses since the first transmission of the RESET INDICATION. If the reset procedure is not completed within the time-out period DCE will either:
 - Clear the virtual call with an indication of "out of order". The remote DTE is informed by a clear indication (out of order).
 - or
 - In the case of permanent virtual circuit, the logical channel is placed in the FLOW CONTROL READY state d1. The distant DTE will be informed by a RESET INDICATION packet with the cause "out of order" only if the previous d3 state was not caused by a reset "out of order".
- Alternatively the DCE re transmits a CLEAR INDICATION at regular intervals of t until a DTE CLEAR CONFIRMATION is received or a clear collision occurs or a period (n+1) t elapses since the first re transmission of the CLEAR INDICATION. If the clear procedure is not completed within the time-out period, the logical channel is placed in the READY state pl.

Table 3-B
DTE Time-Outs

<u>Time-out number</u>	<u>Time-out value</u>	<u>State of the logical channel</u>	<u>Started when</u>	<u>Normally terminated when</u>	<u>Preferred action to be taken when time limit expires</u>
T20	180s	r2	DTE issues a restart	DCE leaves the r2 state (i.e., the restart request confirmation or indication is received)	To re transmits the restart (Note 1)
T21	200s	p2	DTE issues a call request	DTE leaves the p2 state (e.g. the call connected, clear indication, or incoming call is received)	To transmit a clear request
T22	180s	d2	DTE issues a reset request	DTE leaves the d2 state (e.g., the reset confirmation or reset indication is received)	For virtual calls, to re transmit the reset request or to transmit a clear request For permanent virtual circuits to transmit the reset request (Note 2)
T23	180s	p6	DTE issues a clear indication	DTE leaves the p6 state (e.g., the clear confirmation or clear indication is received)	To re transmit the clear request (Note 2)

Notes:

1. After unsuccessful retries, recovery decisions should be taken at higher levels.
2. After unsuccessful retries, the logical channel should be considered out-of-order. The restart procedure should only be invoked for recovery if re initialization of all logical channels is acceptable.

Table 3-C
Summary of X.25 PDN Standard (Default) Interface Attributes

PHYSICAL LEVEL

Transmission Rates	2.4 to 56 kb/s
Interface	EIA-232 Recommendation for 2.4 to 9.6 kb/s CCITT Recommendation V.35 for 56 kb/s

LINK LEVEL

Procedure	LAPB/SLP
Parameter K	K = 7 (Modulo 8) = 127 (modulo 128)
Parameter N1	2120 bit (256 octets)
Parameter N2	10
Timer T1	3 Seconds
Parameter T2	0.4 seconds
Time T3	15 Seconds
Frame Address Field Convention	
Command	03
Response	01

PACKET LEVEL

Packet Types	All basic packets
Number of logical channels per link (2 way)	Default = 10
Packet Size	128 octets
Packet Window Size	W = 2
Packet Sequence Numbering	Modulo 8
Address Format	Inter network: 4 digit DNIC + 10 digit NTN Intra-network: 10 digit NTN ISDN Addresses: 1+0+CC+N(S)N CC = Country Code (1 for North America) N(S)N = National Significant Number
Addresses per Line	1000 maximum
Lines per Address (Hunt Group)	16 maximum
Access Line Take Down	Unconditional and Conditional
Timer T10	60 Seconds
Timer T11	180 Seconds
Timer T12	60 Seconds
Timer T13	60 Seconds

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4. X.75 Interface and Interexchange Carriers

4.1 Overview

This Chapter describes the interface between the Interexchange Carriers (IC) data service providers and the DIGIPAC® Network. In addition this section discusses the support of X.75' between different switch types used in the DIGIPAC® Network as well as the connection between Integrated Services Digital Network (ISDN) and DIGIPAC®. The X.75 IC interface supports Switched Virtual Calls (SVC) and Permanent Virtual Circuits (PVC).

4.2 Physical Level

The X.75 interface is available at a data rate of 9600 bps using a voice grade data channel or digital data channel; and at 56 Kbps using a digital data channel. The high speed interface of 56 Kbps is provided only by a Public Data Network (PDN) Packet Switching (PS) node. Details on the physical interfaces available on DIGIPAC® are found in Chapter 8.

4.3 Link Level

4.3.1 General

The link level interface provides point-to-point communication between two end points. The link level protocol procedures provide link initialization and termination, flow control, recovery from procedural error through exception condition reporting and recovery, transparency and frame sequencing and synchronization.

4.3.2 System Parameters (see Table 4-E for Default Parameters)

N1 - Maximum number of bits in an I frame - The maximum number of bits in an information frame (excluding flags and 0 bits inserted for transparency). Parameter N1 may not exceed 8192 bits for X.75 links connected to DIGIPAC®.

k - Maximum number of outstanding I frames - DIGIPAC® supports a selective window size, parameter k, from 1 to 7 at the Link level. This is compatible with modulo 8 (non-extended) sequence numbering. Optionally, DIGIPAC® supports a window size of 1 to 127 in support of modulo 128 (extended) sequence numbering at the Link level.

Timer T1 - DIGIPAC® supports the Link level timer T1, or acknowledgment timer. This timer is the system parameter at the end of which retransmission of a frame may be initiated. The timer T1 is started at the end of the transmission of a frame. It is used by the network to detect that a transmitted frame was not acknowledged. The value of T1 is greater than the maximum time between transmission of a command frame and the reception of the corresponding frame returned as a response. The range of value for links connected to DIGIPAC® is from 1 to 15 seconds in increments of 1 second.

Parameter T2 - DIGIPAC® supports Link level parameter T2. The period of parameter T2 indicates the amount of time available at the Signaling Terminal Equipment (STE) before the acknowledging frame must be initiated in order to ensure its receipt by the STE prior to Timer T1 running out at the STE (parameter T2 < Timer T1). The DIGIPAC® T2 parameter is set to 200 milliseconds.

N2 - Maximum number of attempts to complete a transmission - DIGIPAC® supports Link level parameter N2 which is the maximum number of transmissions and retransmissions of a frame following the expiration of Timer T1. After N2 attempts, the network will clear all virtual calls and reset all permanent virtual circuits on that link. On those links connected to DIGIPAC® the range of value for this parameter is 1-15. The default setting of this parameter is 10.

Timer T3 - DIGIPAC® has the ability to support Timer T3. The period of Timer T3, at the end of which an indication of an observed excessively long idle channel state condition is passed to the packet level, shall be sufficiently greater than the period of the Timer T1 so that the expiration of T3 provides the desired level of assurance that the link channel is in a non-active, non-operational state, and is in need of link set up before normal link operation can resume. The range of value for this timer is 1 to 655 seconds with a default value of 15 seconds.

4.3.3 Exception Condition Reporting and Recovery

These are exception conditions in an otherwise normal link level procedure. Exception conditions are those situations which may occur as the result of transmission errors, STE malfunction or operational situations.

- Send Sequence Number N(S) Sequence Error Condition

An N(S) sequence error exception condition occurs in the receiver when an I frame is received out of sequence. The receiver does not acknowledge the I frame causing the error, or any I frame which may follow until an I frame with the correct N(S) is received. The Reject (REJ) frame is sent by the receiver of the out of sequence I frame. The STE receiving the REJ initiates sequential retransmission of I frames starting with the I frame indicated by the Receive Sequence Number N(R) obtained in the REJ frame.

- Time-out Recovery

The time-out recovery allows either STE, which transmitted an unacknowledged I frame, to take appropriate action when the system specified timer T1 expires.

When timer T1 expires, the STE enters the time-out recovery condition, transmits an appropriate supervisory frame with the Poll (P) bit set to 1 (poll), and timer T1 reset. If the STE receives a supervisory frame from the other end with the Final (F) bit set to 1 (final), then the time-out recovery is cleared. This response frame includes N(R) that identifies where in the numbering cycle I frame retransmission should resume. The STE makes N2 attempts (that includes initial I frame transmission plus subsequent S frame transmission with P bit set to 1) to obtain an acknowledgment from the remote STE. After N2 unsuccessful attempts, the STE will reset the link. If a response is received, but without the F bit set to 1, then the retransmission state is not cleared but the N(R) of the non-final response is used to update the V(S) such that the next retransmission may be a different frame with P bit set to 1.

4.3.4 Link Level Frame Structure

The frame structure as defined in § 2.2 of the 1988 CCITT X.75 Recommendation is supported by DIGIPAC®. The control field of a length of 1 octet is used in support of modulo 8 frame sequencing. The Frame Checking Sequence (FCS) is implemented as described in § 2.2.7 of the 1988 CCITT X.75 Recommendation.

4.3.5 Procedures for the Use of the Poll/Final (P/F) Bit

The uses of the P/F bit are as specified in § 2.4.3 of the 1988 CCITT X.75 Recommendation. The STE will also send the Set Asynchronous Balanced Mode (SABM)/ Set Asynchronous Balanced Mode Extended (SABME) or DISC command with the P bit set to 1. The P bit is also used during time-out recovery as described above

4.3.6 Link Level Procedures

The link level procedures provided by DIGIPAC® conform to the Single Link Procedure (SLP) described in §§ 2.2 through 2.4 in the 1988 CCITT X.75 Recommendation. SLP is used for data interchange over a single physical circuit between two STE's. The single link procedure is based upon the Link Access Procedure Balanced (LAPB) described in § 2 of Recommendation X.25. The procedure uses the principle and terminology of the High Level Data Link Control (HDLC) procedure specified by the International Organization for Standardization (ISO).

- Link Set-Up

Procedures for the set-up of the link level are specified in § 2.4.4.1 of the 1988 CCITT X.75 Recommendation. Either STE may send SABM to initialize the link. The sending STE, in "SABM Sent" state, starts timer T1. If the timer T1 expires as a result of not receiving a valid response to the SABM command, the STE will resend the SABM and restart timer T1. After N2 such attempts, the STE will initiate higher lever recovery action and will enter the disconnected phase. If a valid response Unnumbered Acknowledgment (UA)) is received, then the link is considered initialized and it enters the information transfer state. If a Disconnected Mode (DM) or DISC (disconnect) is received, then the link enters the disconnected phase.

- Information Transfer Phase

The procedures used during the information transfer phase are as specified in § 2.4.4.2 of the 1988 CCITT X.75 Recommendation. If the SABM command is received in this phase then the STE will reset the link. The busy condition of the receiving STE is defined so that it can save and process some additional I frames which are in transit while the busy STE sends an RNR. When busy condition is cleared, the STE sends a REJ frame or a Receive Ready (RR) frame, with N(R) set to current Receive State Variable V(R) which takes into account those I frames which were correctly received during busy condition.

- Link Disconnection

Procedures for link disconnection of the link level are as specified in § 2.4.4.3 of the 1988 CCITT X.75 Recommendation.

- Disconnected Phase

The disconnected phase is implemented as specified in § 2.4.4.4 of the 1988 CCITT X.75 Recommendation. After recovery from an internal temporary malfunction the STE may send a DISC command with the P bet set to 1. In the disconnected phase, the STE may initiate link set-up.

4.4 Packet Level

The packet level logical interface is the highest level in X.75 and specifies the manner in which virtual circuits are established, maintained and cleared through the X.75 STE's, as well as how user data and control information are structured into packets for presentation between networks. The X.75 packet level also specifies the manner in which Permanent Virtual Circuits (PVC) are maintained. Basically, there are two types of packets being transferred, data packets and control packets. Data packets are used to transfer data delivered to the network layers from the layer above it or, sometimes, to transfer some parameters and/or management data immediately following connection establishment. Control packets are used to establish and disestablish network connections and to perform flow control, reset, clear and restart functions whenever required. Each packet transferred across the interface is contained within a single link level I frame. That is, the level 3 packet (control or data) is carried as information within the I frame. The limitation on the length of this field is described in Section 4.5.5.

4.4.1 Logical Channels

The logical channels are used to enable simultaneous Virtual Calls (VC) and/or PVC's. Each VC and PVC is assigned a logical channel group number (0 to 15 inclusive) and a logical channel number (in a range of 1 to 255 inclusive). This permits a total of 4096 logical channels for given X.75 interface. The combined logical channel group number and logical channel numbers are interpreted as a single 12 Bit Logical Channel Number (LCN) field. Logical channel 0 (zero) is reserved for control packets which affect the entire interface (i.e., restart, and diagnostic packets). Thus only 4095 channels are available for assignment. The range of logical channels and logical channel groups available for assignment to VC's or PVC's is agreed bilateral for a period of time. The assignment procedure of logical channels as new PVC's is also agreed bilaterally for a period of time.

DIGIPAC® STE's have the capability to support 1024 logical channels for VC's and PVC's on a 56 Kbps line and 512 logical channels for VC's and PVC's on a 9.6 Kbps line. Each logical channel number has only local significance. That is, the assignment of a logical channel number for a VC through an STE is independent of any other similar assignment of logical channel number at some other X.75 interface, even for the same end-to-end connection. The DIGIPAC® default is 128 logical channels for 56 Kbps lines and 64 logical channels on a 9.6 Kbps line. Due to varying demands on memory, required by different facilities, DIGIPAC® will not simultaneously support 4095 logical channels on any single interface.

4.4.2 Logical Channel States

The states defined below represent states at the Packet Switched Public Data Network (PSPDN) STE end of the locally selected logical channel and not for the network connection itself. To illustrate, the logical channel may be in Ready (P1) state, which implies that it may be used as the logical channel of a network connection that does not yet exist. In describing these states and in the rest of the document, STE-X refers to the PSPDN STE and STE-Y refers to an IC STE.

- Packet Level Ready State (R1): This is general state for the packet level "machine".
- STE-X Restart Request (R2): This state is entered when the STE-X sends a Restart Request packet (to reinitialize the whole interface).
- STE-Y Restart Request (R3): This state is entered when the STE-Y sends a Restart Request packet (possibly to reinitialize the whole interface).

- Ready State (P1): If no call or call attempts exist and if call setup is possible, the logical channel is in the Ready state (P1), within the Packet Level Ready state (R1).
- STE-X Call Request (P2): This state is entered when the STE-X sends a Call Request packet and is awaiting a response (either Call Connected or Clear Request) from STE-Y.
- STE-Y Call Request (P3): This state is entered when the STE-Y sends a Call Request packet and is awaiting a response (either Call Connected or Clear Request) from STE-X.
- Data Transfer State (P4): This state is entered after the successful connection establishment procedures; that is, when an STE receives or sends Call Connected in response to a sent or received Call Request. There are three sub-states defined under Data Transfer state (P4):
 - Flow Control Ready (D1): A sub-state during which Data packets, Interrupt packet or flow control packets are permitted. In any other p or r states these packets are not permitted. Four other sub-states are defined within sub-state D1. They are:
 - Not Interrupted (I1): When STE X/Y is in state D1 and no Interrupt packet has been received.
 - STE-X Interrupt Request (I2): When STE-Y has received an Interrupt packet from STE-X and hence cannot accept another interrupt packet but would have no impact on data flow in either direction.
 - STE-Y Interrupt Request (I3): When STE-Y has sent an Interrupt packet. In may receive an Interrupt Confirmation (as a response) or an Interrupt packet. Data packets are permitted in this state.
 - STE-X and STE-Y Interrupt Request (I4): When both STE's have sent an Interrupt packet. Only valid Interrupts Confirmation, Data or Flow control packets are allowed.
 - STE-X Reset Request (D2): A substate of Data Transfer (P4) when a Reset packet, received to reinitialize VC or PVC, is outstanding (to STE-Y).
 - STE-Y Reset Request (D3): A substate of Data Transfer (P4) when a Reset packet, sent to reinitialize VC or PVC, is outstanding (to STE-X).
- STE-X Clear Request (P6): A state entered after receiving a Clear Request packet by STE-Y to STE-X.
- STE-Y Clear Request (P7): A state entered after sending a Clear Request Packet by STE-Y to STE-X.

4.4.3 Flow Control Principles

The interface follows standard flow control principles specified in the CCITT Recommendation X.75. The standard method of packet sequence numbering (modulo 8) along with a window size from 1 through 7 is to be supported by both STE's. Each direction may be negotiated with a different window size on each logical channel. Receive Not Ready (RNR) is not transmitted by the PSPDN STE. However, RNR packets which are received are treated as specified in Section 3.4.1.4 of CCITT Recommendation X.75. The PSPDN only uses N(R) conveyed in the Receive Ready (RR) packet to imply that all data packet numbers up to and including P(R)-1 were accepted. The RNR packet is not used by the network. The N(R) conveyed in the data packet is updated to the value sent in the last RR packet.

4.4.4 Relationship between Levels

In the event of failure at the link level and the physical level, the link level reinitializes and notifies the packet level of the problem. The packet level, in turn, initiates a restart procedure to reset all the PVC's and clear all the VC's at the STE X/Y interface.

4.5 X.75 Virtual and Permanent Call Service

4.5.1 General

This section describes the Virtual and Permanent Call Services provided by the X.75 packet level interface between DIGIPAC® and an IC.

4.5.2 Virtual Call Service

The X.75 interface provides VC service to facilitate a dynamic establishment of a network (packet level) connection. The virtual call provides the following capabilities:

- Interface initialization and re initialization
- Multiplexing VC's/PVC's on the same link
- Virtual Call Set up, resetting and clearing
- Flow control
- Sequenced data transfer

The following sections define the procedures involved in providing the VC service. Further information about the protocol definitions, packet formats and timers is provided in CCITT Recommendation X.75. All unrecoverable errors must be forwarded to the upper layer.

4.5.3 Call Setup

This section describes the call setup procedures for a VC over the interface between two STE's (also called the STE-X/STE-Y interface). The procedures apply independently to each logical channel. This implies, where utilities are negotiated on a per call basis, that these utilities also apply independently for each VC and hence each logical channel.

If no call attempt exists and if call setup is possible, the logical channel is in the Ready state (P1), within the Packet Level Ready state (R1). A Call Request packet is sent which specifies a logical channel which is in the Ready State (P1). The logical channel is now in the Call Request state (P2 or P3). A response to the Call Request must be received before the timer T31 expires. If the timer T31 expires then the calling STE will clear the call (see procedure "Call Clearing") with the cause as "network congestion". The default value of timer T31 for X.75 links connected to the DIGIPAC® network is 200 seconds (see Table 4-F). The called STE may accept the call by responding with a Call Connected packet with the same logical channel as in the Call Request packet. The Logical Channel (LC) now enters the Data transfer state (P4). The STE may respond to this call request with a Clear Request packet if it cannot set up the call. The reasons for this includes invalid packet format, call collision, invalid utility field or network congestion. To minimize call collision, in which the STE-X and STE-Y send Call Requests at the same time selecting the same logical channel, the logical channel selected by the STE-X begins with the highest LC number while those selected by the STE-Y begins with the lowest LC number.

4.5.4 Call Clearing

The Call Clearing procedure is used to clear the VC and reinitialize the logical channel to Ready state. The reason for the clearing is coded in the Clearing Cause field of the Clear Request packet. The diagnostic code contains additional information on the reason for the clearing of the call. The contents of these fields will remain unaltered if the origination of the clearing procedure is a remote DTE and not the local X/Y interface, except when the clearing cause field is Network Congestion, in which case the diagnostic code will be as defined in the CCITT Recommendation X.75. The sender of the Call Clear packet waits T33 seconds to receive either the Clear Confirmation or the Clear Request packet from the other end. If T33 expires, the clearing procedure is repeated. If T33 expires again, the clearing procedure will be assumed complete and the logical channel will be placed in Ready (P1) state from the present Clear Request state (P6 or P7). The default value of the T33 timer for X.75 links connected to the DIGIPAC® network is 180 seconds (see Table 4-F).

If a valid response (Clear Confirmation or Clear Request) is received, the logical channel will be placed in the Ready state. This procedure applies only to the local interface and it does not imply clearing of remote DTE. A clear collision puts the logical channel in the Ready (P1) state.

4.5.5 Data Interrupt and Flow Control Packet Transfer

The data Transfer state is reached after successfully establishing the virtual call across the X.75 interface. The Data Interrupt or flow control packets may be transferred in this state. That is, only in this state would the flow control mechanism described in Section 4.4.3, paragraph 1 apply. Each Data packet transmitted at the X/Y interface in each direction of a VC is sequentially numbered either from 0 to 7 for normal mode (modulo 8) or from 0 to 127 for extended mode (modulo 128). This sequence numbering is common to all logical channels at the X/Y interface. Procedures for sequencing the data flow are described in § 3.4.1 of the 1988 CCITT X.75 Recommendation. The DIGIPAC® network will only support the normal mode (modulo 8) of packet sequencing.

4.5.6 Addressing

The DIGIPAC® network is capable of supporting both X.121 and E.164 addressing on X.75 links. The normal mode X.75 link numbering plan will be set to X.121. The X.121 address for Inter-LATA calls will be 14 digits in length (4 digit Data Network Identification Code (DNIC)+ 10 digit NTN). For Intra-network calls, primarily used on X.75', the X.121 address will be 10 digits in length (10 digit NTN). When E.164 addresses appear in a Call Request packet on the X.75 link, they will be preceded by an escape digit of 0 or 9. The remainder of the E.164 number will be intact and consist of the Country Code (1 is the Country Code for North America) and the National Significant Number (in North America this will be NPA + NXX + XXXX).

4.5.7 Data Field Length

The standard maximum data field length is 128 octets and must be provided by all network administrators. In addition, optional maximum data field lengths may be provided on a per call basis through the packet size indication network utility defined in Section 4.6.4. If an STE receives an invalid Data packet, such as one with the data field length exceeding the maximum length allowed, it will reset the VC with network congestion as the cause. Optional data field lengths of 16, 32, 64, 256, 512 and 1024 octets are also supported.

4.5.8 Delivery Confirmation (D), More Data (M) and Qualifier (Q) Bits

The Delivery confirmation (D-bit) procedures are supported as specified in the X.75 Recommendation. The required end-to-end acknowledgment is provided by means of the packet receive sequence number P(R). If a remote source Data Terminal Equipment (DTE) sets the D-bit in the Data packet that it sends, the STE also sets the D-bit in the (mapped) Data packet across the X/Y interface and vice versa.

The More Data flag (M-bit) procedures are supported as specified in the X.75 Recommendation. The More Data Bit (M-bit) may only be set to 1 in a full data packet (full means that the data field contains bit numbers of maximum data field length). When it is set to 1, it indicates that more data is to follow. Each complete packet sequence consists of any number (including 0) of full data packets with M = 1 followed by one other packet of any length up to and including the maximum with M = 0. If a STE receives a packet which is not full but has M-bit set to 1, it will reset the virtual circuit. The resetting cause shall be Network Congestion.

The Qualifier Bit (Q-bit) is handled transparently at the X/Y interface.

4.5.9 Interrupt Procedures

The interrupt procedure allows a DTE to transmit urgent, expedited data to the remote DTE without following the flow control procedure applying to data packets between the two STE's. The length of the user data field is not checked. The receipt of the interrupt packet is acknowledged by transmitting an interrupt confirmation packet. Only one interrupt may be outstanding at a time. If the STE attempts to issue a second interrupt packet without receiving an acknowledgment for the first one, the receiving STE may either discard this interrupt packet or reset the virtual call of the permanent virtual circuit with the cause network congestion. There is no defined time-out time for interrupt confirmation. The network waits indefinitely for the interrupt confirmation.

4.5.10 Reset Procedures

The reset procedure is used to reinitialize a VC or a PVC. The STE initiates a reset procedure for several reasons as defined in the CCITT Recommendation X.75. If any other resetting cause is received, the STE will pass this cause unchanged. When a VC at the X/Y interface has just been reset, the window related to each direction of data transmission has a lower window edge equal to 0, and the numbering of the subsequent data packets to cross the X/Y interface for each direction of data transmission will start from 0. When a reset occurs, any previous busy condition, e.g., STE, RNR, will be cleared. Reinitialization involves two distinct actions:

- Place the logical channel in the 'flow control ready' state
- Remove and discard all Data packets in process of being transmitted

When entering Data Transfer (P4) state, the logical channel will be placed in the state D1. One of the other two states within state P4, namely Reset Request (D2 or D3) state, is entered when a Reset Request packet is sent. In any other state the reset procedure is abandoned. In the Reset Request state (D2 and D3) the STE will discard Data, Interrupt, RR and RNR packets.

When an STE receives a Reset Request packet, it will confirm the reset by transmitting a Reset Confirmation packet before timer T32 expires, where the value of T32 is a system parameter (see Table 4-F). This completes the reset procedure and places the logical channel in Flow Control Ready state (D1). The reset procedure has only local significance. The data discarded in the procedure is recovered at higher level functions of the end systems (see Tables 4-F and G). If T32 expires, then another attempt is made by sending a Reset Request. On the second time-out, the STE initiates clearing procedures (see Table 4-G). The resetting cause field and diagnostic field are as defined in the 1988 CCITT X.75 Recommendation. If a resetting cause other than that defined in the 1988 CCITT X.75 Recommendation is received, the STE will pass it unchanged. If reset collision occurs, the STE's will consider the reset procedure as complete.

4.5.11 Restart Procedure

Effect of the restart procedure on the PVC will be discussed in this section. The restart procedure is used to reinitialize all logical channels at the STE X/Y interface. This procedure clears all VC's putting the corresponding logical channel into the ready (P1) state. As soon as all VC's are cleared and the corresponding logical channels placed in the ready state, the STE will return a Restart Confirmation packet unless a collision has occurred. All Data, Reset or Interrupt packets will be discarded during restart. If a collision occurs, both STE's will consider the restart as completed.

When the timer T30 expires the first time, another restart request packet has signaled the link, all virtual calls are cleared towards the network and all permanent virtual circuits are reset towards the network. If T30 expires again, the STE enters the packet level ready state (see Tables 4-F and G).

4.5.12 Permanent Virtual Circuit Services

The X.75 Permanent Virtual Circuit (PVC) service will be supported by the PSPDN STE. It provides the same capabilities as the VC service with the following exceptions:

- There are no call set ups or clearing procedures.
- When restart procedures are invoked, all the PVC's are reset (while all the VC's are cleared) with the cause "network congestion" and then will continue to handle data traffic.
- Certain facility/utility negotiations performed at call set up for VC's are handled through service provisioning for PVC's.

If the network has a temporary inability to handle traffic, the STE will reset the PVC with the cause "network out of order". When the network is again able to handle data traffic, the STE should reset the PVC with the cause "network operational".

4.6 Network Utilities

This section provides a description of all the X.75 Network utilities supported in the DIGIPAC® network. All of the utilities described here are considered important for the support of services to the customers of DIGIPAC®. These utilities conform to the 1988 CCITT X.75 Recommendation. The words Mandatory and Optional that appear after the title of the utility only apply with respect to compliance to the 1988 CCITT X.75 Recommendation. A complete list of the 1988 X.75 utilities and the degree of support for the utilities can be found in Table 4-H.

X.75 utilities are network administrative signaling mechanisms contained in Call Request, Call Connected packets, and in some instances the Clear Request packet. The network utility field complements the user facility and serves to separate user service signaling from network administrative signaling. The request for a service through an optional user facility may, in certain instances, require the use of a network utility.

4.6.1 Transit Network Identification (Mandatory)

The *Transit Network Identification* is a network utility used to name the transit network(s) controlling a portion of the virtual circuit. A transit network is identified by its' DNIC. A pictorial representation of the TNIC utility appears in Figure 4-1.

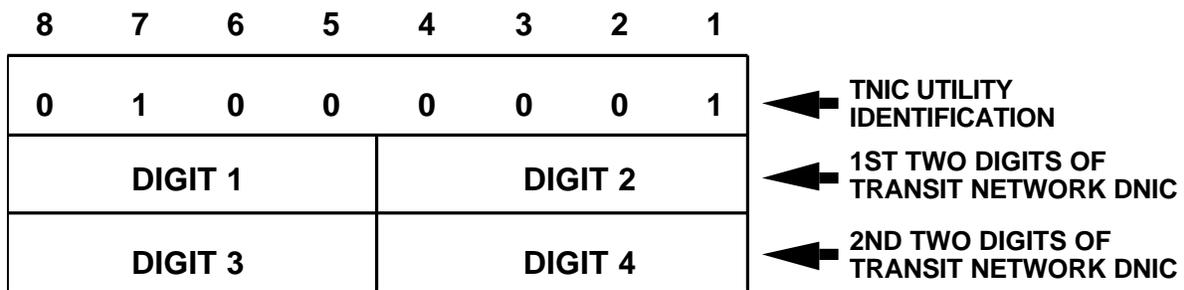


Figure 4-1
Transit Network Identification Utility (TNIC)

A *Transit Network Identification* is always present in the incoming *call request* packet on an X.75 from an IC or VAN if the call did not originate in the IC or VAN's network. If more than one transit network is involved then more than one transit network will be identified, the order of identification in the network utility field is identical to the order of traversal of transit networks following the path being established from the calling DTE to the destination network. A *Transit Network Identification* is always present for each transit network in the *Call Connected* packet, or the *Clear Request* packet issued as a direct response to the *Call Request* packet.

4.6.1 Call Identifier (Mandatory)

The *Call Identifier* is a network utility which is always present in the *Call Request* packet. The *Call Identifier* parameter is established by the originating network and is an identifying name for each virtual circuit established. The *Call Identifier* when used in conjunction with the calling DTE address, uniquely identifies the virtual call. The *Call Identifier* utility is pictured in Figure 4-2.

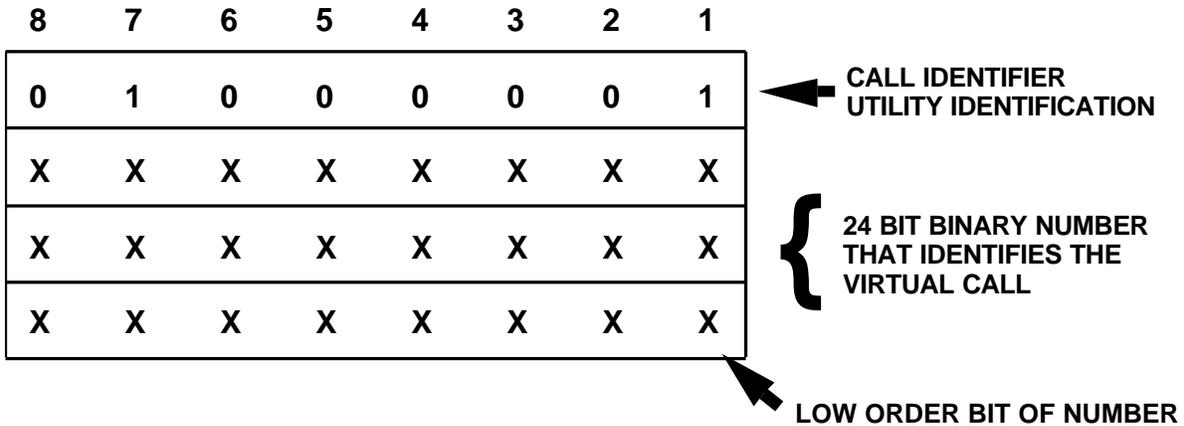
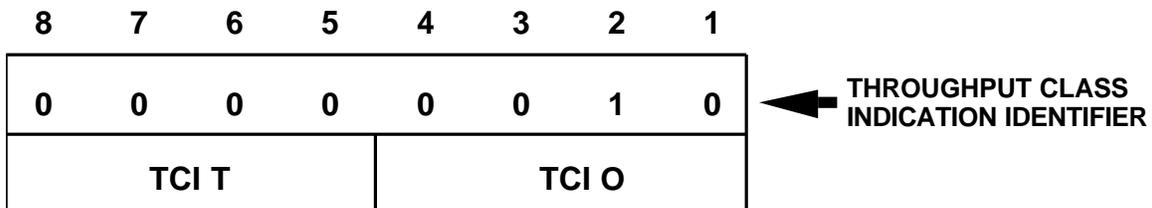


Figure 4-2
Call Identifier Utility

4.6.2 Throughput Class Indication (Mandatory)

The *Throughput Class Indication* is a network utility that can be used by any Signal Terminal Equipment (STE) for specifying the throughput classes applying to that call. A pictorial representation of the *Throughput Class Indication* utility appears in Figure 4-3.



**TCI O = THROUGHPUT CLASS INDICATION OF THE
ORINATION END OF THE VIRTUAL CALL**

**TCI T = THROUGHPUT CLASS INDICATION OF THE
TERMINATING END OF THE VIRTUAL CALL**

**SEE TABLE 4-A FOR CODING OF THROUGHPUT
CLASSES**

Figure 4-3
Throughput Class Indication Utility

The STE associated with the virtual call originating network may request, in the *Throughput Class Indication* utility of the call request packet, the throughput class values selected at the calling DTE/DCE interface. Any transit STE may also request throughput class values, in the *Throughput Class Indication* utility, of the *Call Request* packet. If particular throughput classes are not explicitly requested, the STE is assumed to request the default throughput class values agreed between both Administrators.

The coding of the throughput class that can be found in the *Throughput Class Indication* utility are found in the Table 4-A.

Table 4-A
Coding Of Throughput Classes

Bit: 4 3 2 1 or Bit: 8 7 6 5	Throughput Class (bit/s)
0 0 0 0	Reserved
0 0 0 1	Reserved
0 0 1 0	Reserved
0 0 1 1	75
0 1 0 0	150
0 1 0 1	300
0 1 1 0	600
0 1 1 1	1200
1 0 0 0	2400
1 0 0 1	4800
1 0 1 0	9600
1 0 1 1	19200
1 1 0 0	48000
1 1 0 1	64000
1 1 1 0	Reserved
1 1 1 1	Reserved

When the called DTE has accepted the call, the STE associated with the virtual call destination network may confirm the *Throughput Class Indication* utility of the *Call Connected* packet and the throughput class values that finally apply to the virtual call following the negotiation with the called DTE. Any transit STE may also confirm throughput class values in the *Throughput Class Indication* utility of the *Call Connected* packet. The STE should not alter the throughput class values received in a *Call Connected* packet. The *Throughput Class Indication* utility should not be present in the *Clear Request* packet. No Indication of *Throughput Classes* should be present in the user facility of the *Call Request*, *Call Connected*, and *Clear Request* packets.

4.6.3 Window Size Indication (Mandatory)

The *Window Size Indication* is a network utility that can be used by any STE for negotiating the window sizes on a specified logical channel at the STE X/Y interface for each direction of transmission. A pictorial representation of the *Window Size Indication* utility appears in Figure 4-4.

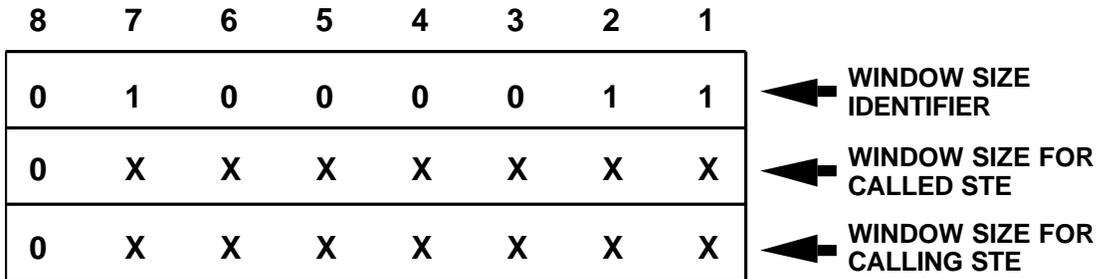


Figure 4-4
Window Size Indication Utility

When using the *Window Size Indication* utility in the *Call Request* packet, STE-X requests particular window sizes to be used at the STE X/Y interface for that call. If particular window sizes are not explicitly requested, STE-X is assumed to request the default values for that call, that is either the standard value of 2 or other values agreed between both Administrators.

When using the *Window Size Indication* in the *Call Connected* packet, STE-Y confirms the window sizes finally applying at the STE X/Y interface to that call. If particular window sizes are not explicitly confirmed, STE-Y is assumed to confirm the default values as finally applying to that call. Each finally applying value should be in the range from the values requested by STE-X or assumed as a default value to the standard value of 2 (both inclusive). If an STE detects that a value finally applying to that call is out of range, it should clear the call with an indication of "Network congestion". The *Window Size Indication* utility should not be present in the *Clear Request* packet. No Indication of *Window Sizes* should be present in the user facility of the *Call Request*, *Call Connected*, and *Clear Request* packets.

The window size for the direction of transmission from the called STE is indicated in bits 1 to 7 of the first octet. The window size for the direction of transmission from the calling STE is indicated in bits 1 to 7 of the second octet. Bit 1 is the least significant bit. Bit 8 of each octet is set to 0. Each window size value is binary encoded. The range of window size values allowed at the STE X/Y interface is subject to a bilateral agreement between Administrators. Window sizes of 8 through 127 are only valid for calls employing extended numbering.

4.6.4 Packet Size Indication (Mandatory)

The *Packet Size Indication* is a network utility that can be used by any STE for negotiating the maximum data field length of *data* packets on a specified logical channel at the STE X/Y interface for each direction of data transmission. A pictorial representation of the *Packet Size Indication* utility appears in Figure 4-5.

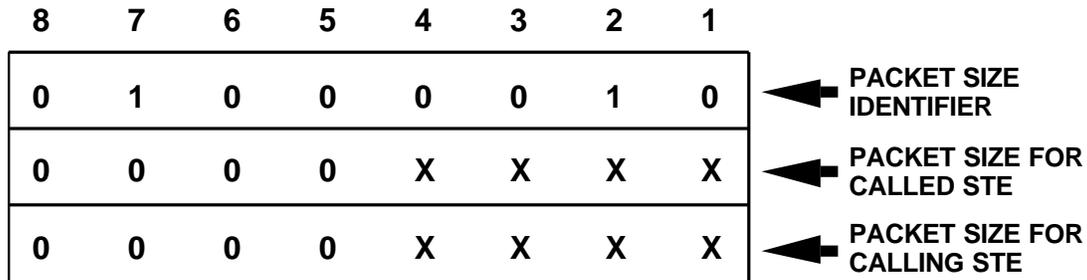


Figure 4-5
Packet Size Indication Utility

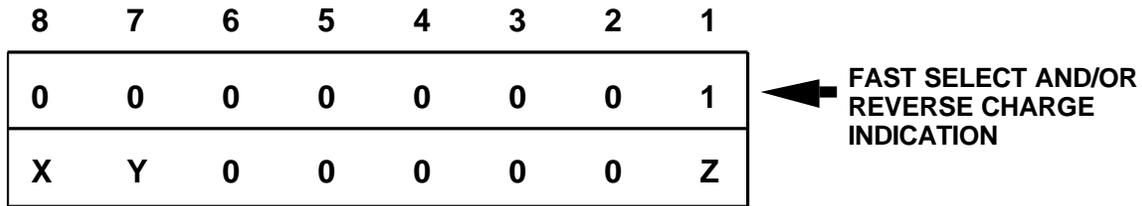
When using the *Packet Size Indication* utility in the *Call Request* packet, STE-X requests the maximum data field length to be used at the STE X/Y interface for that call. If particular data field lengths are not explicitly requested, STE-X is assumed to request default values for that call, that is either the standard value of 128 octets or other values agreed between both Administrators. When using the *Packet Size Indication* utility in the *Call Connected* packet, STE-Y confirms the data field lengths finally applying at the STE X/Y interface for that call. If particular data field lengths are not explicitly confirmed, STE-Y is assumed to confirm the default values as finally applying to that call. Each finally applying value should be in the range from the value requested by STE-X or assumed as a default value to the standard value of 128 octets (both inclusive). If an STE detects that a value finally applying to that call is out of this range, it should clear the call with an indication of "Network congestion".

The *Packet Size Indication* utility should not be present in the *Clear Request* packet. No indication of packet sizes should be present in the user facility field of the *Call Request*, *Call Connected* and *Clear Request* packets.

The maximum user data field length for the direction of transmission from the called STE is indicated in bits 1 through 4 of the first octet. The maximum user data field length for the direction of transmission from the calling STE is indicated in bits 1 through 4 of the second octet. Bits 5 through 8 of both octets are unassigned and set to 0. The four bits indicating each maximum user data field length are binary encoded and express the logarithm to base 2 of the maximum number of octets of the field of *data* packets. Bit 1 is the least significant bit. The maximum user data field length values allowed at the STE X/Y interface are subject to a bilateral agreement between Administrators; however all Administrators will allow 128 octets.

4.6.5 Fast Select And/Or Reverse Charge Indication (Mandatory)

The *Fast Select and/or Reverse Charge Indication* utility is a network utility used for indicating that either the *Fast Select* user facility applies to the call or that the *Reverse Charging* user facility applies to the call being established. A pictorial representation of the *Fast Select and/or Reverse Charge Indication* utility is found in Figure 4-6.



↑

X = 0 and Y = 0 or 1 for Fast Select not requested
X = 1 and Y = 0 for Fast Select requested no restriction
X = 1 and Y = 1 for Fast Select requested with restriction
Z = 0 for Reverse Charging not requested
Z = 1 for Reverse Charging requested

Figure 4-6
Fast Select And/Or Reverse Charge Identification

In the case of *Fast Select Indication*, when used in the *Call Request* packet, the STE indicates that the *Fast Select* facility applies to that call and that up to 128 octets of user data is contained at the end of the *Call Request* packet. The *Fast Select Indication* can be either with restriction or no restriction. When restriction is indicated, the only valid response to the *Call Request* packet is a *Clear Request* packet with a clear user data field of up to 128 octets. The responding STE is not allowed to send a *Call Connected* packet. When no restriction is indicated, the responding STE is permitted to respond with a *Call Connected* packet with called user data field of up to 128 octets or at any time a *Clear Request* packet with a clear user data field of up to 128 octets. If the call is connected, the originating STE is authorized to transmit a *Clear Request* packet with a clear user data field of up to 128 octets.

When the *Reverse Charging Indication* utility is used in the *Call Request* packet, STE-X indicates a request for reverse charging to apply to the call. In the absence of the *Reverse Charging Indication* utility, STE-X is assumed not to request reverse charging for that call.

The *Fast Select and/or Reverse Charging Indication* utility should not be present in the *Call Connected* and the *Clear Request* packets. No indication of *Fast Select and/or Reverse Charging* should be present in the user facility field of the *Call Request*, *Call Connected*, and *Clear Request* packets.

4.6.6 Closed User Group Indication (Mandatory)

The *Closed User Group Indication* is a network utility used for enabling the establishment of virtual calls by DTE's which are members of international closed user groups. A pictorial representation of the *Closed User Group Indication* utility appears in Figure 4-7.

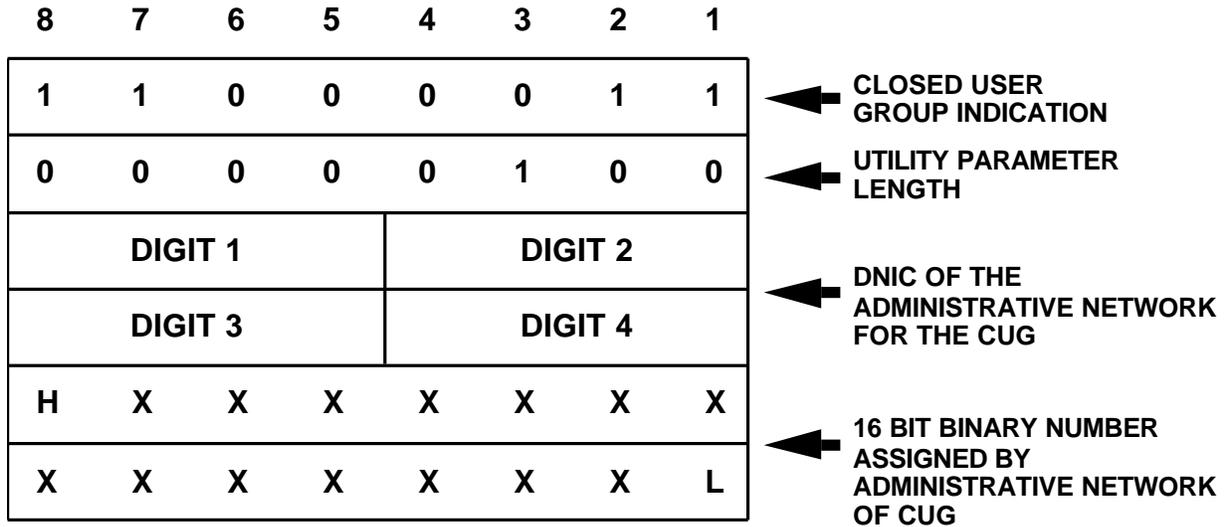


Figure 4-7
Closed User Group Indication

When using the *Closed User Group Indication* utility in the *Call Request* packet, the STE indicates that the international virtual call is requested on the basis of valid international closed user group membership. The network of the calling DTE supplies the relevant international interlock code. The STE should not alter the closed user group indication received in a *Call Request* packet. Only one of the Closed User Group Indication and the Closed User Group with Outgoing Access Indication utilities may be present in a Call Request packet. No indication of closed user group should be present in the user facility field of the Call Request, Call Connected, and Clear Request packets. The Closed User Group Indication utility should not be present in the Call Connected and Clear Request packets.

4.6.7 Closed User Group With Outgoing Access (Mandatory)

The *Closed User Group with Outgoing Access Indication* is a network utility used for enabling the establishment of virtual calls by DTE's which are members of international closed user groups. A pictorial representation of the *Closed User Group with Outgoing Access Indication* utility appears in Figure 4-8.

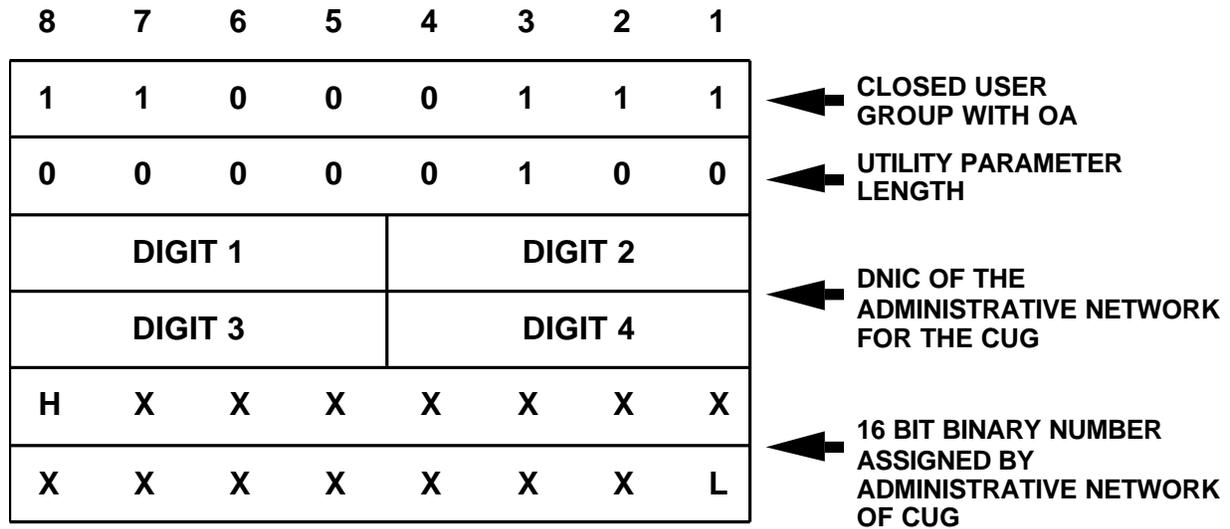


Figure 4-8
Closed User Group With Outgoing Access Indication

When using the *Closed User Group with Outgoing Access Indication* utility in the *Call Request* packet, the STE indicates that the international virtual call is requested on the basis of valid international closed user group membership. In addition the STE signals an associated outgoing access capability. The network of the calling DTE supplies the relevant international interlock code. The STE should not alter the closed user group with outgoing access indication received in a *Call Request* packet. Only one of the *Closed User Group Indication* and the *Closed User Group with Outgoing Access* capability may be present in a *Call Request* packet. The network of the calling DTE supplies the relevant international interlock code. No indication of *Closed User Group with Outgoing Access* should be present in the user facility field of the *Call Request* packets. The *Closed User Group with Outgoing Access* utility should not be present in the *Call Connected* and *Clear Request* packets.

4.6.8 Called Line Address Modified Notification (Mandatory)

The *Called Line Address Modified Notification* is a network utility used for indicating the reasons for the called address in the packet being different from that specified in the *Call Request* packet. A pictorial representation of the *Called Line Address Modified Notification* utility appears in Figure 4-9.

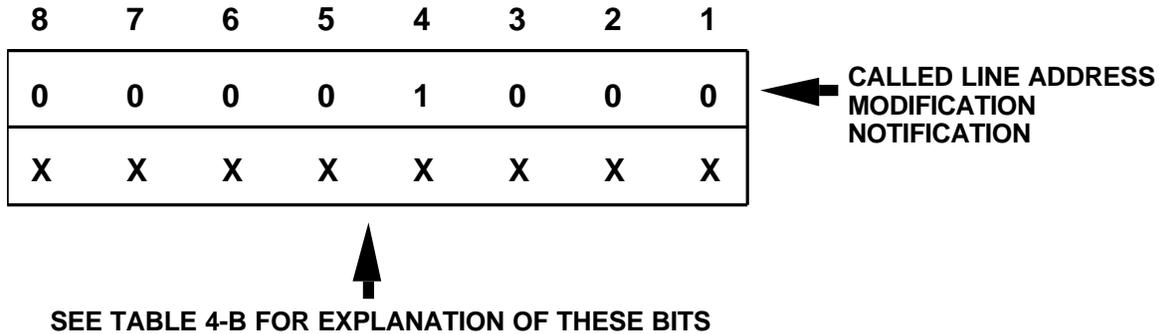


Figure 4-9
Called Line Address Modification Notification

Table 4-B shows the coding of the utility parameter for the *Called Line Address Modified Notification* utility. Both the call distribution within a hunt group and the call redirection are limited to the network of the DTE originally called. The *Called Line Address Modified Notification* utility will be present in *Call Connected* packets where the called DTE address is different from that specified in the *Call Request* packets. It will also be present in the *Clear Request* packet where the call is cleared by a different DTE from the one originally called as a direct response to *Call Request* packet. The *Called Line Address Modified Notification* utility should not be present in the *Call Request* packet as well as the *Clear Request* packet sent after the call is connected. No indication of *Called Line Address Modified Notification* should be present in the user facility field of the *Call Request*, *Call Connected* and *Clear Request* packets.

Table 4-B
Coding Called Line Address Modified Utility Parameter

0 0 0 0 0 1 1 1	Call distribution within a hunt group
0 0 0 0 0 0 0 1	Call redirection due to originally called DTE out of order
0 0 0 0 1 0 0 1	Call redirection due to originally called DTE busy
0 0 0 0 1 1 1 1	Call redirection due to prior request from the originally called DTE for systematic call redirection
1 0 X X X X X X	Called DTE originated (see Note 1)
1 1 X X X X X X	Call deflection by the originally called DTE (see Note 2)

Notes:

1. Each X may be independently set to 0 or 1 by the called DTE and is passed transparently.
2. The X's are those set by the originally called DTE in the call forwarding selection facility.

4.6.9 Clearing Network Identification Code (Optional)

The *Clearing Network Identification Code* is a network utility providing additional information on the origin of the *Clear Request* packet and is present only in the *Clear Request* packet issued after the call is connected. A pictorial representation of this utility appears in Figure 4-10.

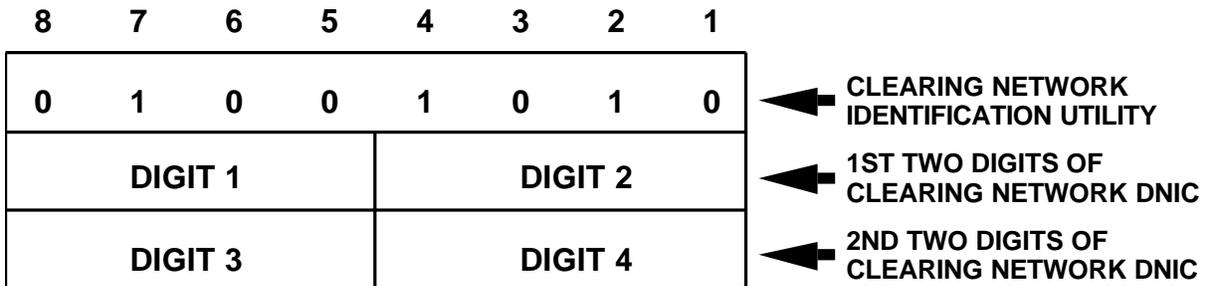


Figure 4-10
Clearing Network Identification Code

The network originating the *Clear Request* is identified by the DNIC of the network that is clearing the call. An STE receiving a *Clearing Network Identification Code* will pass this code unchanged whenever applicable.

4.6.10 Transit Delay Indication (Mandatory)

The *Transit Delay Indication* is a network utility that signals the accumulated expected nominal transit delay of a virtual circuit. It is included in the *Call Request* packet and *Call Connected* packet when a calling DTE has requested a transit delay in the transit delay selection and indication facility. The STE in the originating network will signal a value dependent on the characteristics of the originating network and on the characteristics of the outgoing link (e.g., link speed, satellite or cable). Any outgoing STE in a transit network will add to the value received in the *Transit Delay Indication* utility a value that depends on the characteristics of the network and the outgoing link. A pictorial representation of this utility appears in Figure 4-11.

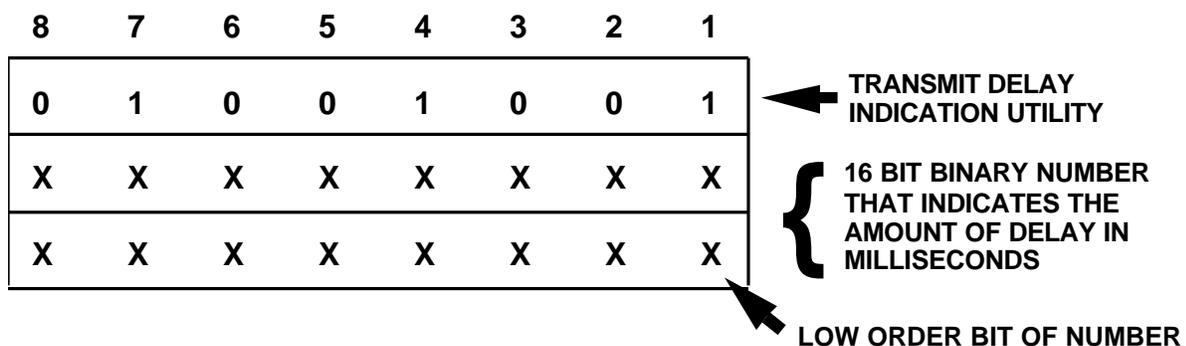


Figure 4-11
Transit Delay Indication Utility

The transit delay is defined as t_{3c} in Recommendation X.135, and is expressed in terms of a mean value. However, the detailed determination of the value is considered as a national matter. If the resulting value of the transit delay exceeds the maximum value that can be signaled in the utility parameter field, all bits of the utility parameter field will be set to "1". The STE will signal the final value of the accumulated expected nominal transit delay transparently in the *Call Connected* packet. For an interim period, when not all networks have yet implemented the transit delay signaling, an STE will not send the *Transit Delay Indication* utility to a network that does not support it. This STE will signal, towards its own network, all 1's in the *Transit Delay Indication* utility parameter field of the *Call Connected* packet. No indication of transit delay selection and indication should be present in the user facility field of the *Call Request*, *Call Connected* and *Clear Request* packets.

4.6.11 Transit Delay Selection (Optional)

The *Transit Delay Selection* utility is a network utility that signals the transit delay requested by the calling DTE in the *Transit Delay Selection and Indication* facility. This utility will be signaled transparently from the originating network to the destination network in the *Call Request* packet. This utility may be used in conjunction with the *Transit Delay Indication* utility for routing purposes. A pictorial representation of this utility appears in Figure 4-12.

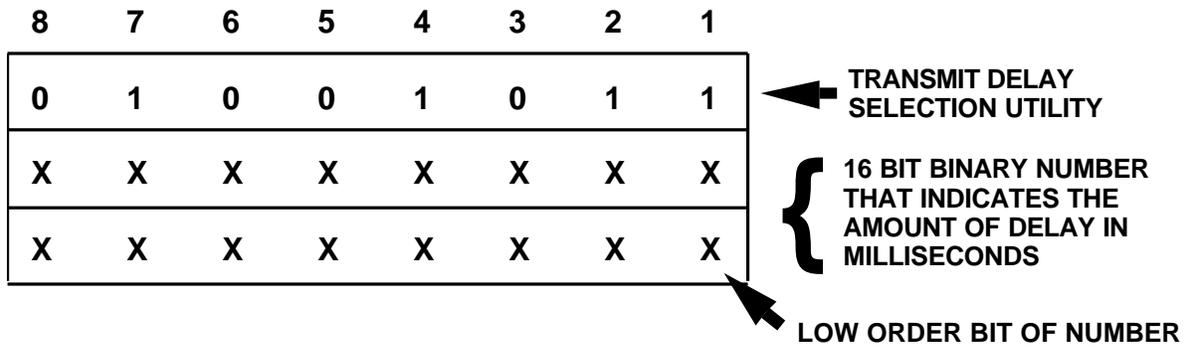
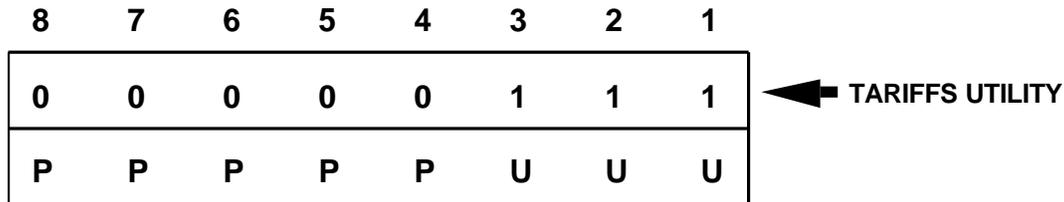


Figure 4-12
Transit Delay Selection Utility

The *Transit Delay Selection* utility should not be present in *Call Connected* or *Clear Request* packets. No indication of *Transit Delay Selection and Indication* should be present in the user facility field of the *Call Request*, *Call Connected* and *Clear Request* packets.

4.6.12 Tariffs Utility (Optional)

The *Tariffs Utility* is a network utility that is used to pass information from one network to one or more other networks participating in the call for the purpose of implementing billing, accounting, or tariff arrangements that may exist among the respective Administrators. A pictorial representation of this utility appears in Figure 4-13.



↑

PPPPP = PRIMARY TARIFF SUBFIELD AND CONTAINS THE SUBCLASS CODE FOR THE INTERFACE.

UUU = SECONDARY NETWORK SPECIFIC SUBCLASS CODE. IF NOT USED SHOULD BE ZERO FILLED.

SEE TABLE 4-C FOR PRIMARY TARIFF SUBFIELD

Figure 4-13
 Tariffs Utility

The *Tariffs Utility* may appear in the *Call Request*, *Call Connected*, and *Clear Request* packets. If this utility appears in the *Call Request* packet, the information it contains relates to the ultimate destination interface or network. The utility may appear in a *Clear Request* packet only if that packet is initiated by the destination DTE or DCE, in direct response to the *Call Request*. The content of this utility is determined by the originating or destination network and does not depend on information passed to the network by a DTE. The primary subclass codes are binary encoded into the upper 5 bits of the utility parameter. The currently assigned codes are found in Table 4-C.

Table 4-C
Interpretation Of Primary Subclass Codes

Primary subclass codes	Interface
0	X.25
1	Switched access X.28
2	Dedicated access X.28
3	X.32
4	X.75
5-15	[Reserved] (Note)
16-30	Reserved for national use
31	Unspecified or non-standard

Note: It is for further study whether a portion of the reserved range will be used to specify access interfaces associated with ISDN service.

The three bits of the second subfield (UUU) are used to designate a secondary, network-specific subclass code that has billing, accounting, or tariff significance. The origination/destination network can optionally use this subfield to specify one of up to seven subclass codes, with significance set by the network providing the tariff class code value. If this secondary subfield is not utilized, it should be zero filled. Even if this utility is supported on the STE X/Y interface, it may not be present in a packet for a given virtual call if there is no need to exchange tariff-related information with that packet. No more than one instance of this utility may appear in a packet.

4.6.13 Recognized Private Operating Agency (RPOA) Selection (National)

Recognized Private Operating Agency Selection is a network utility that may be used to name a RPOA transit network within the originating country through which a call is to be routed. In the case of international calls, this utility may indicate an international RPOA in the originating country. A pictorial representation of this utility appears in Figure 4-14.

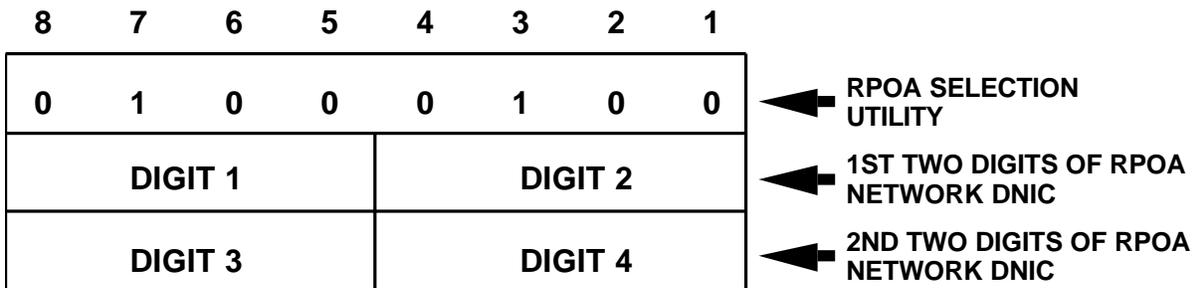


Figure 4-14
RPOA Selection Utility

This utility can be used to carry a RPOA transit network or ISDN Network Identifier Code (INIC) specified by the calling DTE. When more than one transit network is specified by the calling DTE, a sequence of *RPOA Selection* utilities may be present in the *Call Request* packet. In this case, the order of identification of transit networks by the *RPOA Selection* utilities is identical to the order specified by the calling DTE.

A network receiving a *Call Request* packet containing one or more *RPOA Selection* utilities will route to the next requested network, removing the *RPOA Selection* utility that names the next requested network. If it is not possible to route to the next requested network, the receiving network will clear the call. The *RPOA Selection* utility should not be present in the *Call Connected* and *Clear Request* packets. No indication of the *RPOA Selection* should be present in the user facility field of the *Call Request* packet.

4.6.14 Utility Marker (Optional)

The *Utility Marker* is used to separate international and national X.75 utilities from non-X.75 utilities that may be agreed bilaterally by the Administrators. On an X.75' interface the *Utility Marker* is used to separate the international and national X.75 utilities from the X.75' utilities defined by Bellcore in the Public Packet Switching Network Generic Requirement (PPSNGR). The coding of the utility is two octets of zeros and a pictorial representation of the utility appears in Figure 4-15.

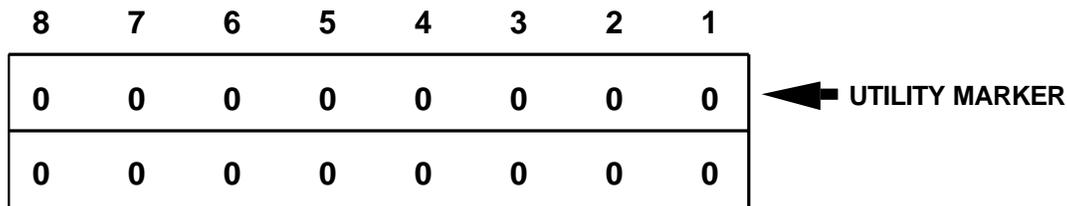


Figure 4-15
Utility Marker

4.7 Bellcore X.75' Utilities

4.7.1 General

This section describes the Bellcore X.75' utilities that are supported on the DIGIPAC® network. A complete listing of all of the Bellcore X.75' utilities can be found in Table 4-I. A more complete description of the Bellcore X.75' utilities can be found in the PPSNGR, TR-TSY-000301.

4.7.2 Access Characteristics (X.75') (Required)

In a Bell Operating Company (BOC) multi-vendor or PSPDN/ISDN inter-networking environment, a subnetwork responsible for billing a call needs information available in other subnetworks to completely populate the AMA billing records. Such information is passed between subnetworks over X.75' interfaces. Much of the needed information is available as a standard part of the X.75/X.75' protocol (e.g., call identifier and termination cause). However, there are currently two items of information needed to fully populate AMA records that are not passed between subnetworks in the X.75' protocol: access or gateway interface type and sensor identifier. A utility specified for BOC networks, entitled the *Access Characteristics* utility, is introduced to meet this need for X.75' interfaces. The protocol information carried in this utility also provides part of the information needed for implementation of protocol screening in a multi-vendor environment. The X.75' *Access Characteristics* utility is distinct from the CCITT Tariffs utility, although there is a relationship between the two. Both carry information recorded in the AMA records (in different fields), but the *Access Characteristics* information may also be used in real time for protocol screening by the PSPDN's.

The Tariffs utility carries information that applies to an origination or destination access interface and is used exclusively for billing purposes. The *Access Characteristics* utility carries sensor identifier information, in addition to interface characteristics information similar to that carried by the Tariffs utility. The interface characteristics information carried in the first octet of the *Access Characteristics* utility applies to either an access interface (origination or destination) or to an inter-network X.75 interface (incoming or outgoing), whichever is the BOC network boundary for that direction of the call. This difference from the Tariffs utility reflects the fact that protocol screening is based on net protocol conversion from edge to edge within a single network (not access interface to access interface for the complete virtual circuit).

The Tariffs utility is relevant only for inter-network calls. The *Access Characteristics* utility is required only when X.75' interfaces are crossed. For an inter-network call, instances of both utilities may be present across an X.75' interface. The Tariffs utility information would apply to the access interface and *Access Characteristics* utility information would apply to the interface at the edge of the network, which may be the same access interface or an X.75' interface. When X.75' interfaces are present, the *Access Characteristics* utility also serves to pass information concerning the access interface local to the network for mapping into the Tariffs utility at an outgoing X.75 interface. The contents of the Tariffs utility are never mapped into the *Access Characteristics* utility. When the Tariffs utility is received over an incoming X.75 interface, it is passed transparently over any subsequent X.75' interface encountered within that network for that packet.

Procedures

- Only a single instance of the *Access Characteristics* utility is permitted in any packet. The presence of the utility is required in all *Call Request* and *Call Connected* packets over X.75' interfaces. The utility is present in the *Clear Request* packets only as specified below.

- The subnetwork containing the originating access interface or the incoming X.75 inter-network gateway is responsible for inserting the *Access Characteristics* utility in the *Call Request* packet passed over an X.75' interface. All successive X.75' interfaces over which the *Call Request* packet is carried pass this instance with no change. When the *Access Characteristics* utility appears in a *Call Request* packet, the information it carries pertains to the originating access or incoming X.75 gateway interface within the BOC's network.
- The subnetwork containing the destination access interface or outgoing X.75 inter-network gateway is responsible for inserting the *Access Characteristics* utility in the *Call Connected* packet over an X.75' interface. This utility instance is passed without change in the *Call Connected* packet carried over any subsequent X.75' interface. When the *Access Characteristics* utility appears in the *Call Connected* packet, the information it carries pertains to the destination access or outgoing X.75 gateway interface within the BOC's network. The information contained in the utility instance carried in *Call Request* packet is not repeated in the *Call Connected* packet.
- The clearing subnetwork is responsible for first inserting the *Access Characteristics* utility in the *Clear Request* packet over an X.75' interface if the utility is inserted at all. The *Access Characteristics* utility is present in the *Clear Request* packet if and only if all of the following conditions prevail:
 - The *Call Request* packet has already been passed over the outgoing X.75 interface (originating or transit network for an inter-network call) or the Incoming Call packet has already been passed to the destination DTE/CPE (all other cases)
 - The *Call Connected* packet for that call has not previously been passed over the X.75' interface.
- If an undelivered *Call Connected* packet is being replaced by a *Clear Request* packet, the clearing subnetwork transfers the *Access Characteristics* utility, if present, from the *Call Connected* to the *Clear Request* packet, unmodified, if the clearing cause is not of a type that prevents the information in the upstream *Call Connected* packet from being received by the clearing network element. For example, if a Packet Switch (PS)/Packet Handler Function (PHF) clears a call because of a protocol problem (not affecting the presence or validity of the utility) detected in a *Call Connected* packet received across the X.75' interface, the *Access Characteristics* utility received should be included in the resulting *Clear Request* generated. This requirement assures that key items of billing information (the network boundary interface type and sensor identifier) is passed to the AMA recording point so that whatever network services have been rendered up to this point can be successfully billed, if appropriate.
- The *Access Characteristics* utility instance (if present) is passed without change in the *Clear Request* packet carried over any subsequent X.75' interface. The information contained in the utility carried in a *Clear Request* packet pertains to the destination access or outgoing X.75 gateway interface within the BOC's network.

Coding

- The utility code for the class C *Access Characteristics* utility is "10100000" (bit 8 to the left). As a utility specified for BOC networks, it follows the utility marker. The utility instance consists of the utility code and a parameter field of three additional octets, as depicted in Figure 4-16.

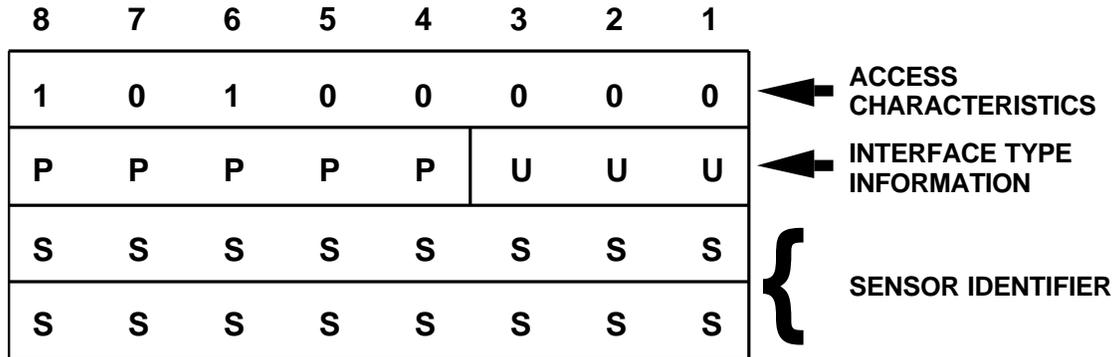


Figure 4-16
Access Characteristics

- The first octet of the parameter field consists of two subfields, encoded in binary. Table 4-D shows the encoding of the P P P P P subfield.
- The relevant interface is the originating access interface or incoming X.75 interface (if call does not originate on the BOC's network) for the *Call Request* packet. The relevant interface is the destination access interface or outgoing X.75 interface [if call is not destined for a Data Terminal Equipment (DTE)/Customer Provided Equipment (CPE) within the BOC's network] for the *Call Connected* or *Clear Request* packets.

Table 4-D
Encoding Of Relevant Interface Type

P P P P P	Relevant Interface Type
0 0 0 0 0	X.25 (Includes ISDN X.25 access*)
0 0 0 0 1	Dial-Up X.28
0 0 0 1 0	Dedicated X.28
0 0 0 1 1	X.32 (Includes ISDN circuit-switched access to PSPDN dial-in port*)
0 0 1 0 0	X.75 (Dedicated)
1 0 0 0 0	Dedicated 3270 Bisynchronous
1 0 0 0 1	Dial-Up 3270 Bisynchronous
1 0 0 1 0	Dedicated 2780/3780 Bisynchronous
1 0 0 1 1	Dial-Up 2780/3780 Bisynchronous
1 0 1 0 0	Dedicated SNA/SDLC
1 0 1 0 1	Dial-Up SNA/SDLC
1 1 1 1 1	Unspecified or Nonstandard
Other	(Reserved)

*Until CCITT or American National Standards Institute (ANSI) specify distinct ISDN code points for Tariffs utility counterparts.

- The three bits of the UUU subfield are used to designate a network-specific class code. The source network can optionally use this subfield to specify one of up to seven (significant, non-zero) class codes, with significance set by the network providing the class code value. Each DTE/Data Circuit Terminating Equipment (DCE), CPE/Packet Handler Function (PHF), and X.75 gateway interface is configured with two 3-bit values that can be set by the BOC. The two values corresponding to the two possible modes or directions in which the interface can be operating with respect to call establishment (origination/incoming or destination/outgoing). One of the potential uses for the UUU subfield is subcategorizing the interface type specified in the PPPPP subfield or indicating a network-specific type if the PPPPP value is "Unspecified or Nonstandard." If the optional UUU subfield is not used by the BOC, it should be zero filled.
- The second and third octets of the parameter field contain a 16-bit binary value. Bit 8 of the first of these two octets is the most significant bit and bit 1 of the last octet is the least significant. These 16 "S" bits constitute the sensor identifier assigned by the BOC to the network element associated with access or X.75 gateway interface characterized by the first octet of the parameter field. This field allows the BOC to uniquely identify over 65,000 network elements within the network, using binary encoding. The most significant bit is reserved to distinguish between PSPDN and (Integrated Services Digital Network (ISDN) network elements (0=PSPDN; 1=ISDN). Thus, each network element capable of servicing an access or gateway interface would be configured with a 16-bit sensor identifier that is selected by the BOC, for the purpose of populating this field.
- For additional information concerning the *Access Characteristics* utility consult the PPSNGR, TR-TSY-000301.

4.7.3 X.75 Interface Identifier (X.75') (Required)

For inter-network calls, the AMA billing record includes a unique identifier for each X.75 interface between the BOC network and the connecting network (two such interfaces are present when the BOC network is operating as a transit network). In a BOC multi-vendor or PSPDN/ISDN inter-working environment, the X.75 interface identifier for the outgoing and/or incoming X.75 interface must be passed over any X.75' links between the subnetwork containing the X.75 interface and the subnetwork responsible for creating the Automatic Message Accounting (AMA) record. These conditions correspond to the cases for which the *Access Characteristics* utility specifies X.75 as the protocol for the BOC network boundary interface.

X.75 Interface Identifier is a utility specified for BOC packet mode networks and designed to pass the X.75 interface identifying information between subnetworks via X.75' interfaces. When needed, this utility is passed over X.75' interfaces in addition to the *Access Characteristics* utility. The detailed specifications for the *X.75 Interface Identifier* utility follow:

- The PS/PHF should support the *X.75 Interface Identifier* utility for X.75' interfaces. The Access Concentrator (AC) should support the *X.75 Interface Identifier* utility if it is capable of also either directly supporting X.75 interfaces or generating AMA records for calls chargeable to attached DTE's. In the case that an AC is capable of itself generating AMA records, but is not capable of supporting an X.75 interface, the AC need only support the utility for *Call Connected* and *Clear Request* packets.

- The procedures, coding, and application for the *X.75 Interface Identifier* utility are as specified below and in subsections 3.5.4.7.1, 3.5.4.7.2, and 3.5.4.7.3 of the PPSNGR (TR-TSY-000301). References to "incoming" and "outgoing" X.75 interfaces below are with respect to the *Call Request* packet path through the network as illustrated in Figure 4-17.

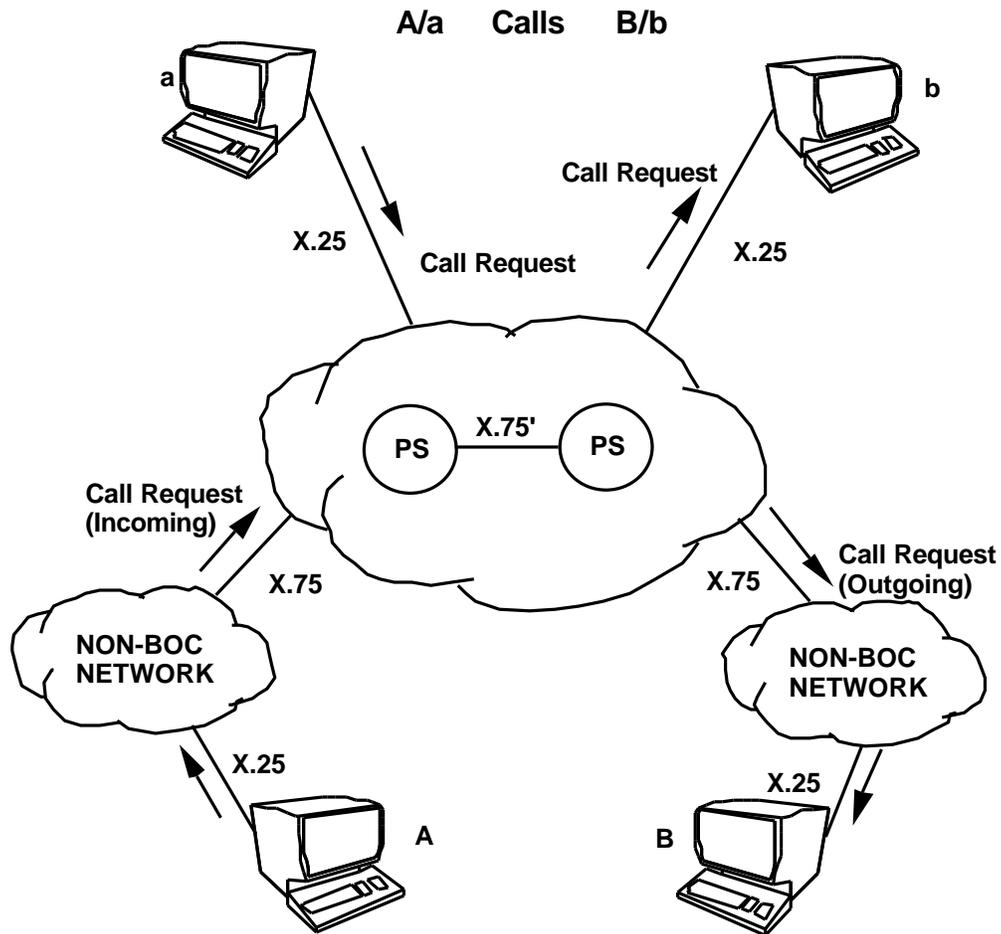


Figure 4-17
Incoming' and 'outgoing' X.75 Interfaces Relative to a BOC Network

Procedures

- Only a single instance of the *X.75 Interface Identifier* utility is permitted in any packet. The utility appears in a *Call Request* packet passed over an X.75' interface if and only if that *Call Request* entered the BOC network over an incoming X.75 interface (i.e., the "PPPPP" subfield carried in the *Access Characteristics* utility to be passed over the X.75' interface for the packet contains "00100"). The utility appears in a *Call Connected* packet passed over an X.75' interface if and only if that *Call Connected* packet entered the BOC network over an outgoing X.75 interface (i.e., the "PPPPP" subfield carried in the *Access Characteristics* utility to be passed over the X.75' interface for the packet contains "00100"). The same rule applies to the insertion of the utility in a *Clear Request* packet passed over an X.75' interface as applies for a *Call Connected* packet, except that the utility is inserted in the *Clear Request* packet only if both of the following are satisfied:
 - The *Call Request* packet has already been passed over the outgoing X.75 interface for the call.
 - The *Call Connected* packet for the call has not previously been passed over the X.75' interface.
- The subnetwork containing the incoming X.75 inter-network gateway is responsible for inserting the *X.75 Interface Identifier* utility in the *Call Request* packet passed over the X.75' interface. All successive X.75' interfaces over which the *Call Request* packet is carried pass this instance with no change. When the *X.75 Interface Identifier* utility appears in a *Call Request* packet, the information it carries pertains to the incoming X.75 gateway interface within the BOC's network.
- The subnetwork containing the outgoing X.75 inter-network gateway is responsible for inserting the *X.75 Interface Identifier* utility in the *Call Connected* or *Clear Request* packet over an X.75' interface. Once inserted, this utility instance is passed without change in the *Call Connected* or *Clear Request* packet carried over any subsequent X.75' interface. When the *X.75 Interface Identifier* utility appears in a *Call Connected* or *Clear Request* packet, the information it carries pertains to the outgoing X.75 gateway interface within the BOC's network.
- If an undelivered *Call Connected* packet is being replaced by a *Clear Request* packet, the clearing subnetwork transfers the *X.75 Interface Identifier* utility, if present, from the *Call Connected* to the *Clear Request* packet, unmodified, if the clearing cause is not of a type that prevents the information in the upstream *Call Connected* packet from being received by the clearing network element. For example, if a PS/PHF clears a call because of a protocol problem (not affecting the presence or validity of the utility) detected in a *Call Connected* packet received across the X.75' interface, the *X.75 Interface Identifier* utility received should be included in the resulting *Clear Request* generated. This requirement assures that a key item of billing information (the outgoing X.75 interface identifier) is passed to the AMA recording point so that whatever network services have been rendered up to this point can be successfully billed, if appropriate.

Coding

- The utility code for the class D *X.75 Interface Identifier* utility is "11100011" (bit 8 to the left). As a utility specified for BOC networks, it follows the utility marker. The utility instance consists of (a) the utility code; (b) a parameter length octet containing "00000110" (bit 8 to the left, specifying 6 octets to follow); and (c) a parameter field of 6 additional octets, encoding an 11-digit X.75 interface identifier in Binary Coded Decimal (BCD). A pictorial representation of the utility appears in Figure 4-18. The most significant digit is encoded in bits 5 through 8 of the first of these octets and the least significant digit is encoded in bits 5 through 8 of the last octet. Bits 1 through 4 of the last octet are not used and are set to all zeros.

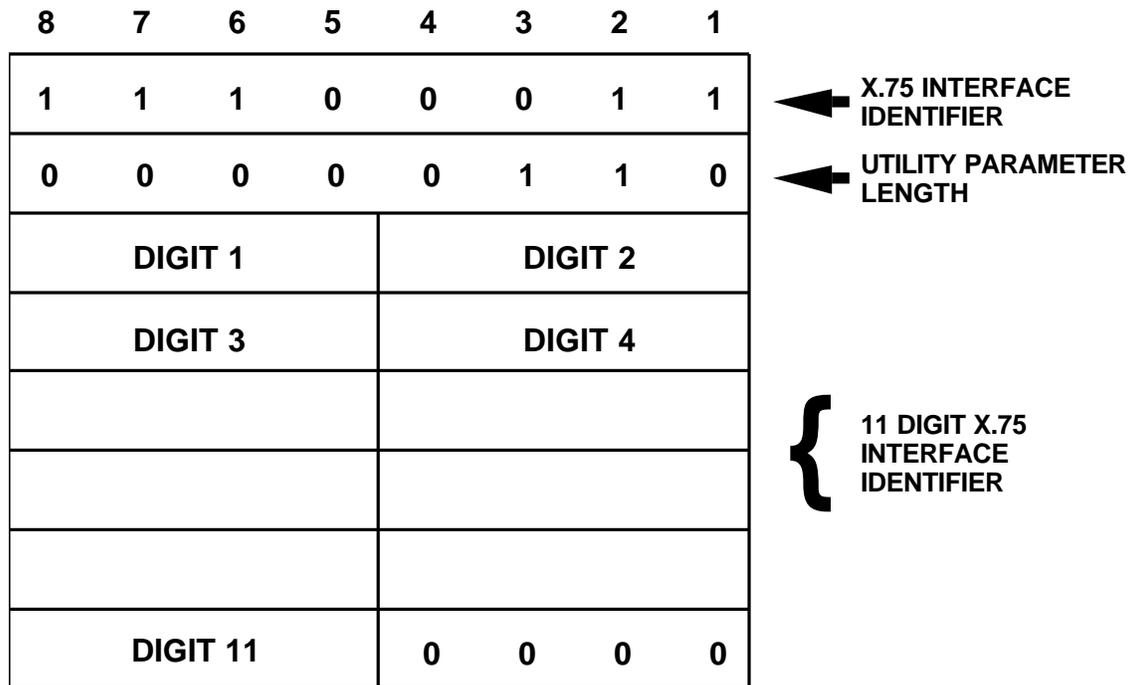


Figure 4-18
X.75 Interface Identifier

- The 11-digit X.75 interface identifier carried in this utility is based on the BOC-assigned value configured for the X.75 interface to which this utility instance refers. All values are right-justified within the 11-digit field with leading zeros. No X.75 interface should be configured with a value of all zeros. If Multi Link Procedure (MLP) is supported on the interface, all Single Link Procedures (SLP) belonging to the MLP share a common X.75 interface identifier, which uniquely identifies the MLP. For additional information concerning the *X.75 Interface Identifier* utility consult the PPSNGR, TR-TSY-000301.

4.8 Routing

Packet Switched Public Data Network (PSPDN) Data Terminal Equipment (DTE) to Interexchange Carrier (IC) Data Terminal Equipment (DTE)

- On internetwork calls, the PSPDN DTE enters an address of up to 14 digits for the called DTE that is connected to the IC preceded by the prefix "1". This address consists of a 4-digit DNIC of the destination IC and a DTE address of up to 10 digits. The PSPDN STE strips the prefix "1" and passes the called address to the IC STE at the network interface in a Call Request packet. It also passes the calling address in the same Call Request packet. The IC routes the call based on the address information.

Interexchange Carrier (IC) Data Terminal Equipment (DTE) to Packet Switched Public Data Network (PSPDN) Data Terminal Equipment (DTE)

- Internetwork calls that originate from terminals connected to the IC are routed on the basis of the PSPDN DNIC and the address of the called DTE connected to the PSPDN. The number of digits on this internetwork call is a total of 14, of which the first four digits are the PSPDN DNIC. The IC would use the next three or six digits of the called DTE address to route the call to the appropriate PSPDN gateway (STE). The PSPDN DNIC will be provided by the terminal user at call set up time. The destination DCE (in the PSPDN) may add the prefix "1" to the calling address before it delivers the Incoming Call packet to the DTE.

Packet Switched Public Data Network (PSPDN) Data Terminal Equipment (DTE) to Packet Switched Public Data Network (PSPDN) Data Terminal Equipment (DTE) (Inter-LATA)

- Calls that originate on a PSPDN in one LATA and terminate on a DTE connected to the PSPDN in another LATA would use an IC for inter-LATA communications. The call would be routed by the PSPDN to the selected IC (STE). **THE PSPDN would be included in fields of X.75 call Request packet.** The IC network would then determine the appropriate routing based on either the next three or six digits of the called address and route the call toward the corresponding gateway. The destination PSPDN would then route the call to the appropriate DTE.

Packet Switched Public Data Network (PSPDN) Data Terminal Equipment (DTE) to Integrated Services Digital Network (ISDN) Data Terminal Equipment (DTE) (Inter-LATA)

- Calls that originate on a PSPDN and terminate on a DTE connected to an ISDN in another LATA would use an IC for inter-communications. The call would be routed by the PSPDN to the selected IC (STE). The ISDN E. 164 address, CC+N(S)N (Country Code + National Significant Number), will be in the called DTE address field of the X.75 Call Request Packet preceded by an escape code of 0 or 9. The IC will route on either the Country Code, for calls beyond North America (CC other than 1), or the first six (6) digits of the National Significant Number (NPA+NXX), for calls within North America (CC = 1), toward the corresponding gateway. The destination ISDN and/or PSPDN will route the call to the appropriate DTE.

Integrated Services Digital Network (ISDN) Data Terminal Equipment (DTE) to Integrated Services Digital Network (ISDN) Data Terminal Equipment (DTE) (Inter-LATA)

- Calls that originate on an ISDN and terminate on a DTE connected to an ISDN in another LATA and transit the PSPDN to access the selected IC for inter-communications will be routed in the same manner identified above. Both the called DTE address field and the calling DTE address field in the X.75 Call Request Packet sent by the PSPDN will contain an E.164 address preceded by an escape code of 0 or 9.

- Calls that originate on an ISDN and terminate on a DTE connected to an ISDN in another LATA and where the IC has direct X.75 connection to the ISDN will be routed in the same manner as identified above for ISDN DTE transiting the PSPDN.

Table 4-E
Summary of X.75 DIGIPAC® Default Interface Attributes

PHYSICAL LEVEL	
Transmission Rates	9.6 and 56 Kbps
Interfaces	EIA-232 for 9.6 Kbps CCITT Recommendation V.35 for 56 Kbps
LINK LEVEL	
Procedure	LAPB/SLP
Parameter K	K = 7 (Modulo 8)
Parameter N1	2096 Bits (256 octets)
Parameter N2	10
Timer T1	3 Seconds
Parameter T2	200 milliseconds
Timer T3	15 Seconds
Frame Address Field Convention	
Command	03
Response	01
PACKET LEVEL	
Packet Types	All Basic Packets
Number of logical channels per link	128 @ 56 Kbps 64 @ 9.6 Kbps 32 @ 4.8 Kbps 16 @ 2.4 Kbps
Packet Size	128 octets
Packet Window Size	W = 2
Packet Sequence Numbering	Modulo 8
Address Format	Inter-network: 4 digit DNIC + 10 digit NTN Intra-network: 10 digit NTN ISDN addresses: 0 + CC + N(S)N CC = Country Code (1 for North America) N(S)N = National Significant Number
Packet Level Timers	
T30	180 seconds
T31	200 seconds
T32	180 seconds
T33	180 seconds

Table 4-F
STE time-outs (First Time)

TIMER NUMBER	TIME-OUT VALUE	STATE OF LOGICAL CHANNEL	STARTED WHEN	NORMALLY TERMINATED WHEN	ACTIONS TO TAKEN WHEN THE TIME OUT EXPIRES	
					TOWARD STE X/Y	TOWARD NETWORK
T 30	180 sec.	r2/r3	STE X/Y issues a restart	STE X/Y leaves the r2/r3 state (i.e., a restart confirmation or restart request is received)	STE X/Y signals a restart request packet (network congestion, #52) again, and restarts time-out T30	For permanent virtual circuits, the STE signals a reset request packet (network congestion, #52)
T31	200 sec.	p2/p3	STE X/Y issues a call request packet	STE X/Y leaves the p2/p3 state (e.g., call connected, clear request or call request packet is received)	STE X/Y enters p6/p7 state signaling a clear request packet (network congestion, #49)	STE X/Y signals a clear request packet (network congestion, #49)
T32	180 sec.	d2/d3	STE X/Y issues a reset request packet	STE X/Y leaves the d2/d3 state (e.g., a reset confirmation or reset request packet is received)	STE X/Y signals a reset request packet (network congestion, #51) again and restarts time-out T32	Nothing is signaled toward the network. Proper response is to signal reset request packet (network congestion, #51)
T33	180 sec.	p6/p7	STE X/Y issues a clear request packet	STE X/Y leaves the p6//p7 state (e.g., a clear confirmation or clear request packet is received)	STE X/Y signals a clear request packet (network congestion, #50) again, and restarts time-out T33	

Table 4-G
STE X/Y Time-Outs (Second Time)

TIME-OUT NUMBER	ACTIONS TO BE TAKEN THE SECOND TIME THE TIME-OUT EXPIRES	
	TOWARD STE X/Y	TOWARD NETWORK
T30	STE X/Y enter the r1 state Note - Further actions may be initiated at higher level	For permanent virtual circuits, STE X/Y signals a reset request packet (network congestion, #52)
T31	(Not possible; T31 is not restarted after it has expired)	
T32	For virtual calls, STE X/Y enters the p6/p7 state signaling a clear request packet (network congestion, #51) . For permanent virtual circuits, STE X/Y enters the d1 state	For virtual calls, STE X/Y signals a clear request packet (network congestion, #51) . For permanent virtual circuits, STE X/Y signals a reset request packet (network congestion, #51)
T33	STE X/Y enters the p1 state.	

Table 4-H
Support Of 1988 X.75 Utilities

1988 CCITT X.75 Utilities		Support	
Transit Network Identification		YES	
Call Identifier ¹		YES	
Throughput Class Indication		YES	
Window Size Indication ²		YES	
Packet Size Indication		YES	
Fast Select and/or Reverse Charge Indication		YES	
Closed User Group Indication		YES	
Closed User Group with Outgoing Access Indication		YES	
Called Line Address Modified Notification ³		YES	
Reasons	Call distribution within a hunt group	YES	
	Call redirection due to originally called DTE out of order	YES	
	Call redirection due to originally called DTE busy	YES	
	Call redirection due to prior request from originally called DTE for systematic call redirection	YES	
	Called DTE originated	PASSIVE	
	Call deflection by the originally called DTE	PASSIVE	
Clearing Network Identification Code		YES	
Traffic Class Indication		NO	
Transit Delay Indication		YES	
Transit Delay Selection ⁴		YES	
Tariffs ⁵		YES	
NUI		NO	
1988 CCITT X.75 Utilities		Support	
RPOA Selection ⁶		YES	
Utility Marker		YES	

Notes:

1. Will accept this utility in the Call Connected packet. If present, (and supported on call connected packets from the X.75 gateway, as defined in the X.75 UTILITY envelope) it is conveyed transparently back to the source; otherwise, the X.75 gateway inserts the original call identifier in the call connected packet before sending it through the DIGIPAC® network.
2. Because DIGIPAC® only supports modulo 8 packet sequencing the largest value that can be negotiated is seven (7).
3. Active support for the first four reasons and passive support for the last reasons for Called Line Address Modified Notification. Active support meaning that the Network can generate as well as pass the reason for Called Line Address Modified Notification. Passive support means that the Network can not generate the reason but will pass the reason transparently over the X.75 gateway.
4. Will pass this utility transparently through the X.75 interface in the call request packet.
5. Supports both the 1984 and the 1988 version of the utility. If the 1984 interface is specified, the utility will appear after the utility marker and the utility code will be Hex 06.
6. Does not support multiple instances of this utility in any packet.

Table 4-I
Support Of Bellcore X.75' Utilities

Bellcore X.75' Utilities	DIGIPAC® Support
IC Preselection Indication	YES
Call Redirection or Call Deflection Notification	NO
Access Characteristics	YES
Protocol Conversion Permissions	NO
Transit Subnetwork Count	NO
Clearing Subnetwork Identification	NO
X.75 Interface Identifier	YES

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5. X.32 Implementation

5.1 General

This chapter describes the implementation of X.32 dial-in and dial-out service on the DIGIPAC® Network. The implementation of the X.32 service on the DIGIPAC® Network conforms to Consultative Committee on International Telephone and Telegraph (CCITT) Recommendation X.32 (1988) (see Table 5-A for conformance by individual section). The version of X.25 available over these types of connections will conform to CCITT Recommendation X.25 (1984) and is consistent with the information found in Chapter 3 of this publication.

5.2 Purpose

X.32 is a service that provides access to the Packet Switched Public Data Network (PSPDN) by X.25 Data Terminal Equipment (DTE) over a switched access path established through a Public Switched Telephone Network (PSTN) or Circuit Switched Public Data Network (CSPDN). A dial-in by DTE or dial-out by PSPDN is performed to establish the switched access path. Currently the DIGIPAC® Network only provides X.32 service through the Public Switched Telephone Network (PSTN).

5.3 Physical Level

Customers using the X.32 service provided by the U S WEST DIGIPAC® Network will be required to use a modem or modems that conforms to the specifications for 9600 bps - Synchronous - Dial Access found in Chapter 8 of this publication.

5.4 Link Level

At the link layer, the LAPB link access procedures conform to the procedures found in Chapter 3 of this publication, with additions as noted in Section 5 of CCITT Recommendation X.32 (1988) (see Table 5-A for conformance to Section 5 of CCITT Recommendation X.32). The LAPB procedures found in Chapter 3 of this publication conform to CCITT Recommendation X.25 (1984).

5.5 Packet Level

The format and procedures at the packet layer conform to those found in Chapter 3 of this publication, with additions as noted in Section 6 of CCITT Recommendation X.32 (1988) (see Table 5-A for conformance to Section 6 of CCITT Recommendation X.32). The packet formats and procedures found in Chapter 3 of this publication conform to CCITT Recommendation X.25 (1984).

5.6 Functional Attributes of All X.32 Calls

5.6.1 General

Multiple Logical Channels -DIGIPAC® will support multiple sessions (calls) on an established Public Switched Telephone Network (PSTN) link based on the number of available Logical Channel Numbers (LCN). For all X.32 service available in DIGIPAC® the default value for the number of LCN's will be 10. All of these LCN's will be configured for two way service.

5.6.2 X.32 Security Feature

DIGIPAC® has the ability to offer two X.32 options at subscription time. Those options are:

- The number of unsuccessful outgoing call requests that a DTE may make.
- The total number of outgoing call requests that a DTE may make.

For the purpose of the first option above, a call request is unsuccessful if a clear indication is received as a direct response to it and the clear cause indicates that the call was not received by the called DTE.

The default setting of threshold for each of the above options will be zero (0). This will turn the threshold off. When the settings for the above thresholds is set to a value other than zero (0), the option is turned on. When one of the thresholds specified is reached, the line becomes refused. The access path will be disconnected if there are no calls established on it. If call(s) are in progress, new call requests are blocked by the PSPDN. When the last call in progress is terminated, the access path is disconnected. The call counters for each of the above options are reset every time an access path is established.

5.6.3 Billing of X.25 Calls Established on X.32 Link

For all Public Dial X.32 service, all X.25 calls that are originated by the DTE on the X.32 link will be Reverse Charged. For all Public Dial X.32 service, all X.25 incoming calls that are intended for the DTE on the X.32 link must be sent paid.

5.7 Functional Aspects of X.32 Dial-In Calls

5.7.1 General

Answering a Dial-in Call - An X.32 dial-in port responds to a dial-in call by establishing the physical connection and bringing up level-2 (link layer). The DTE can then originate X.25 calls using standard X.25 call setup procedures. The DTE may also receive calls from other X.25 DTE's (see Sections 5.6.1 and 5.6.3 for limitations).

5.7.2 Calling Addresses for PSTN Dial-in Call

The PSTN address of the calling DTE is not supplied by the PSTN when a dial-in call is physically established. For this reason, the dial-in port substitutes its own Data Network Address (DNA) into the calling address field of any X.25 call originated by the DTE; this value acts as a "temporary number" as defined in Section 3.1.3.1 of CCITT Recommendation X.32 (1988).

The default for X.32 ports on the DIGIPAC® network will be to not accept a calling address in call request packets received from the DTE that dialed in unless that calling address matches the port address. If the calling address field in the call request packet from the DTE is anything other than null or the address of the port, the call will be rejected.

The temporary number may be used to call the DTE that dialed in; such calls utilize the X.32 port handling the dial-in call and the existing switched access path through the PSTN. Call attempts specifying an X.32 port address will not be setup if there is no established switched connection to a DTE on that port.

5.7.3 Permanent Virtual Circuit Support

Permanent Virtual Circuits (PVC) are supported only for private dial-in ports. When a subscriber establishes an access path to a private dial-in port, any PVC's defined for this port will be reset. DIGIPAC® does not support PVC's for X.32 dial-out ports and public X.32 dial-in ports.

5.8 Functional Aspects of X.32 Dial-Out Calls

5.8.1 Single-Stage Addressing

Single-Stage addressing for X.32 dial-out calls is supported. The called address field of a call request packet contains the Packet Switched Network (PSN) address being called. The DIGIPAC® network locates an appropriate X.32 dial-out port based on the PSN address and uses service data to delete or insert the appropriate digits for dialing before sending the call request to the port. DIGIPAC® will only accept an E.164 address preceded by the prefix digit 1 and the escape digit 9 for PSTN calls. The actual format of the called address in the call request form the user is as follows:

1+9+1+NPA+NXXXXXXXX

1 = Prefix Digit

9 = Escape Digit

1 = Country Code (1 = North America)

NPA = Number Planning Area (Area Code)

NXXXXXXXX = 10 Digit Telephone Number

DIGIPAC® does not currently support X.121 addressing for CSPDN calls.

5.8.2 Long Distance Calls

For all Public Dial X.32 service, calls placed to PSN addresses that are not within the same Local Access Transport Area (LATA) as the originating DTE will be rejected by the DIGIPAC® network.

5.8.3 Additional Calls to Existing Connections

Additional calls to an existing connection on an X.32 port will be allowed as long as there is an available LCN on that port.

Table 5-A
CCITT Recommendation X.32 (1988) Compliance
(Page 1 of 9)

This table details the compliance of the DIGIPAC® X.32 implementation to CCITT Recommendation X.32 (1988). The DIGIPAC® implementation column is interpreted in the following manner:

Implemented as noted: DIGIPAC® implements this section as specified in the following subsections.

Implemented as specified: DIGIPAC® implements this section as specified by CCITT, clarification's are provided where necessary.

Not implemented: DIGIPAC® does not implement this section.

CCITT Part #	Description	DIGIPAC® Implementation.
2	Functional aspects	Implemented as noted.
2.1	Dial-in and dial-out considerations	Implemented as specified.
2.2	Identification	Implemented as noted.
2.2.1	Data Terminal Equipment (DTE) identity	Implemented as specified.
2.2.2	Data Circuit terminating Equipment (DCE) identity	Not implemented.
2.3	Service aspects	Implemented as noted.
2.3.1	Service attributes	Implemented as specified.
2.3.2	DTE services	Implemented as noted.
2.3.2.1	Service for unidentified DTE's	Implemented as specified Public.
2.3.2.2	Services for identified DTE's	Implemented as noted.
2.3.2.2.1	Identified DTE service	Implemented as specified Private only.
2.3.2.2.2	Customized DTE service	Not implemented.

Table 5-A
CCITT Recommendation X.32 (1988) Compliance
(Page 2 of 9)

CCITT Part #	Description	DIGIPAC® Implementation
2.4	DTE identification methods	Implemented as noted.
2.4.1	Identification prior to virtual call establishment	Implemented as noted.
2.4.1.1	Provided by public switched network	Implemented as specified for CSPDN access; not implemented for PSTN access.
2.4.1.2	By means of the link level Exchange Identification (XID) Procedure	Not implemented.
2.4.1.3	By means of packet level registration procedure	Not implemented.
2.4.2	Identification per virtual call by means of the NUI facility	Implemented as specified.
2.5	DCE identification methods	Not implemented.
2.5.1	Identification prior to virtual call establishment	Not implemented.
2.5.1.1	Provided by public switched network	Not implemented.
2.5.1.2	Provided by the link level XID procedure	Not implemented.
2.5.1.3	By means of packed level registration procedure	Not implemented.
2.5.2	Identification per virtual call	Not implemented.
2.6	Dial-in by the DTE and dial-out by the Packet Switched Public Data a Network (PSPDN) Operation.	Implemented as specified; DIGIPAC® implements both dial-in and dial-out.
2.7	DTE service requirements	Implemented as specified.
2.8	Duplex and half-duplex operation	Implemented as specified; DIGIPAC® does not implement the half duplex option for PSTN access.
2.9	Identification protocol	Not implemented.
2.10	Negotiation of values	Not implemented.

Table 5-A
CCITT Recommendation X.32 (1988) Compliance
(Page 3 of 9)

CCITT Part #	Description	DIGIPAC® Implementation
3.	DTE service descriptions	Implemented as noted.
3.1	DTE service attributes	Implemented as noted.
3.1.1	DTE identity	Implemented as specified.
3.1.2	DTE identification method	Implemented as specified; DIGIPAC® implements the Network User Identifier (NUI) identification method and (for CSPDN access) identification by the public switched network.
3.1.3	DTE address	Implemented as noted.
3.1.3.1	DTE address not provided	Implemented as specified.
3.1.3.2	DTE address provided	Implemented as specified.
3.1.4	Registered address	Implemented as noted.
3.1.4.1	Registered address not provided	DIGIPAC® provides an enhancement which enables multiple logical channels to be provided for dial-out. In this case, dial-out calls are routed to an existing switched connection if the called address fields match.
3.1.4.2	Registered address provided	Implemented as specified.
3.1.5	Registered Public Switched Network (PSN) number	Implemented as specified.
3.1.6	X.25 Subscription Set	Implemented as noted.
3.1.6.1	Network default	Implemented as specified. In addition, DIGIPAC® provides an enhancement to support multiple logical channels as a network default logical channel assignment.

Table 5-A
CCITT Recommendation X.32 (1988) Compliance
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CCITT Part #	Description	DIGIPAC® Implementation
3.1.6.2	User selectable	Implemented as specified.
3.1.7	Logical channels assignment	Implemented as noted.
3.1.7.1	Network default	Implemented as specified.
3.1.7.2	User selectable	Implemented as specified.
3.1.8	Dial-out-by-the-PSPDN availability	Implemented as noted.
3.1.8.1	Network default	Implemented as specified; DIGIPAC® provides dial-out as the network default.
3.1.8.2	User selectable	Implemented as specified.
3.1.9	Dial-out Access Type	Implemented as noted.
3.1.9.1	Network default	Implemented as specified.
3.1.9.2	User selectable	Implemented as specified: DIGIPAC® implements modem selection by registered address or by a non-CCITT DOAS facility.
3.1.10	X.32 Optional User Facilities	Not implemented.
3.1.11	DCE identify presentation	Not implemented.
3.1.12	Link level address assignment	Implemented as noted; DIGIPAC® dynamically matches the addressing used by the remote DTE.
3.1.12.1	Network default	Implemented to match any.
3.1.12.2	User Selectable	Implemented to match any.

Table 5-A
CCITT Recommendation X.32 (1988) Compliance
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CCITT Part #	Description	DIGIPAC® Implementation
3.2	DTE services summary	Implemented as specified.
3.3	Non-identified DTE service	On-line facility registration not implemented. "Avail-RQ" facilities in table 4/X.32 are not implemented. DIGIPAC® does not implement "AVAIL -OPT" facilities in table 4/X.32.
3.4	Identified DTE service	Implemented as specified.
3.5	Customized DTE service	Not implemented.
4.	Interface characteristics (physical level)	Implemented as noted.
4.1	X.21 interface	Implemented as noted.
4.1.1	DTE/DCE physical interface elements.	Implemented as specified.
4.1.2	Alignment of call control characters and error checking	Implemented as specified.
4.1.3	Procedures for entering operational phases	Implemented as specified.
4.1.4	Clearing procedures	Implemented as specified.
4.1.5	Failure detection principles and test loops	Implemented as specified.
4.1.6	Signal element timing	Implemented as specified.
4.2	X.21bis interface	Not implemented.
4.2.1	DTE/DCE physical interface elements	Not implemented.
4.2.2	Procedures for entering operational phases	Not implemented.
4.2.3	Failure detection and test loops	Not implemented.
4.2.4	Signal element timing	Not implemented.

Table 5-A
CCITT Recommendation X.32 (1988) Compliance
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CCITT Part #	Description	DIGIPAC® Implementation
4.3	V-series interface	Implemented as noted.
4.3.1	Modem characteristics	Implemented as specified; DIGIPAC® supports both V.22bis and V.32 modems.
4.3.2	Procedures for full duplex operational phases	Implemented as specified.
4.3.3	Procedures for half duplex operational phases	Not implemented.
4.3.4	Origination procedures	Implemented as specified.
4.3.5	Answering procedures	Implemented as specified.
4.3.6	Disconnecting procedures	Implemented as specified.
4.3.7	Test loops	Implemented as specified.
5.	Link access procedure across the DTE/DCE interface	Implemented as noted.
5.1	Introduction	Implemented as noted.
5.1.1	Compatibility with the ISO balanced classes of procedure	Implemented as specified.
5.1.2	Underlying transmission facility	Implemented as noted: DIGIPAC® implements only the full duplex option.
5.2	Link level address assignment	Implemented as noted: DIGIPAC® dynamically matches the addressing used by the remote DTE.
5.2.1	Depending on switched access call direction	Implemented.
5.2.2	Depending on roles of equipment as DTE and DCE	Implemented.
5.3	Use of XID frames	Not implemented.

Table 5-A
CCITT Recommendation X.32 (1988) Compliance
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CCITT Part #	Description	DIGIPAC® Implementation
5.3.1	General	Not implemented.
5.3.1.1	XID identification command	Not implemented.
5.3.1.2	XID response	Not implemented.
5.3.2	Format of XID frame	Not implemented.
5.3.3	XID procedures for identification and X.32 optional user facilities	Not implemented.
5.3.3.1	General	Not implemented.
5.3.3.2	Identification, authentication and selection of X.32 optional user facilities using XID frames	Not implemented.
5.4	Link set-up and disconnection	Implemented as noted.
5.4.1	Link set-up	Implemented as specified.
5.4.2	Disconnection	Implemented as specified.
5.5	Multilink	Not implemented.
5.6.	Half-duplex operation	Not implemented.
5.6.1	Right to transmit	Not implemented.
5.6.2	Level relationship	Not implemented.
5.6.3	State definitions	Not implemented.
5.6.4	Timer XT1	Not implemented.
5.6.5	Counter XC1	Not implemented.
5.6.6	State diagram and descriptions	Not implemented.
5.6.7	State definitions expressed in terms applicable to a modem interface	Not implemented.

Table 5-A
CCITT Recommendation X.32 (1988) Compliance
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CCITT Part #	Description	DIGIPAC® Implementation
5.6.8	Table of transitions between states expressed in terms applicable to a modem interface	Not implemented.
5.6.9	Turn around checkpoint retransmission	Not implemented.
5.6.10	Interworking with a DTE/DCE without turn around checkpoint additional procedures	Not implemented.
6.	Packet level	Implemented as noted.
6.1	Scope and field of application	Implemented as noted.
6.2	Use of registration packets for identification of DTE and/or DCE and for conveyance of X.32 optional user facilities	Not implemented.
6.3	Identification and authentication of DTE using the NUI facility in call set-up packet	Implemented as noted.
6.3.1	NUI override facility	Not implemented.
6.3.2	Operation of the per-call NUI facility	Implemented as specified; DIGIPAC® does not implement the NUI override facility.
7.	X.32 procedures, formats and facilities	Implemented as noted.
7.1	Identification protocol	Not implemented.
7.1.1	Protocol elements	Not implemented.
7.1.2	Identification protocol procedure	Not implemented.
7.1.3	Identification protocol formats	Not implemented.
7.2	Procedures for X.32 optional user facilities	Implemented as noted.
7.2.1	Secure dial-back facility	Not implemented.
7.2.2	Temporary location facility	Not implemented.
7.3	Coding of the identification protocol elements and X.32 facilities	Not implemented.

Table 5-A
CCITT Recommendation X.32 (1988) Compliance
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CCITT Part #	Description	DIGIPAC® Implementation
7.3.1	General	Not implemented.
7.3.2	Coding of the identification protocol element and X.32 facility code fields	Not implemented.
7.3.3	Coding of the identification protocol element and X.32 facility parameter fields	Not implemented.
7.3.3.1	Identity element	Not implemented.
7.3.3.2	Signature element	Not implemented.
7.3.3.3	Random number element	Not implemented.
7.3.3.4	Signed response element	Not implemented.
7.3.3.5	Diagnostic element	Not implemented.
7.3.3.6	Temporary location facility	Not implemented.
7.4	Security grade 2 method	Not implemented.
7.5	Timer T14	Implemented as specified.
7.6	Timer T15	Not implemented.

Note: Functionalities not implemented are X.32 optional functionalities.

Table 5-B
Summary of X.32 DIGIPAC® Standard (Default) Interface Attributes

PHYSICAL LEVEL

Transmission Rates	9.6 kb/s
Interface	EIA-232 Recommendation for 2.4 to 9.6 kb/s V.32 Synchronous Modems

LINK LEVEL

Procedure	LAPB/SLP
Parameter K	K = 7 (Modulo 8) = 127 (modulo 128)
Parameter N1	2120 bit (256 octets)
Parameter N2	10
Timer T1	3 Seconds
Parameter T2	0.4 seconds
Time T3	15 Seconds
Frame Address Field Convention	
Command	03
Response	01

PACKET LEVEL

Packet Types	All basic packets
Number of logical channels per link (2 way)	Default = 10
Packet Size	128 octets
Packet Window Size	W = 2
Packet Sequence Numbering	Modulo 8
Address Format	Internetwork: 4 digit DNIC + 10 digit NTN Intra-network: 10 digit NTN ISDN Addresses: 1+0+CC+N(S)N CC = Country Code (1 for North America) N(S)N = National Significant Number
Access Line Take Down	Unconditional and Conditional
Timer T10	60 Seconds
Timer T11	180 Seconds
Timer T12	60 Seconds
Timer T13	60 Seconds

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6. DIGIPAC, Support of T3POS

6.1 General

This Chapter describes the implementation of T3POS¹ protocol on the DIGIPAC Network. The T3POS PAD function will be provided by U S WEST as part of the POS TurboChargeSM service. Where there are differences in the operation of the U S WEST T3POS PAD function and the T3POS Standard it will be noted in the text. In addition, the phrase Not Offered will be used to mean the following:

- **Not Offered** indicates that the U S WEST T3POS PAD does not provide the function described and therefore the function is not offered to subscribers of the POS TurboChargeSM service.

6.2 Purpose

T3POS is a transaction switching and transport protocol that has been designed to provide Point of Sale (POS) equipment already in place, as well as future POS terminals, with efficient and economical transaction switching and transport service over an X.25-based packet network. T3POS is based on de facto standard protocols in the credit card industry that were developed by VISA International and link level control procedures obtained from the International Standards Organization (ISO).

Transaction switching and transport refers to X.25-based packet network support of reliable, real time receipt, routing and delivery of a transaction to and from a customer's premises and an Information Service Provider (ISP) (see Figure 6-1). Two types of transactions: credit authorization and data capture, each using a slightly different application layer protocol that is transparent to the packet network, are relevant to this discussion of T3POS. Credit authorization transactions are random events typically involving a message transmitted by a POS terminal and a response from an authorizing host system, after which the line is disconnected. Data capture transactions are events that involve a sizable amount of information transmitted from the terminal to the host and a response from the host system. Data capture typically takes place at the end of a business day. T3POS has been developed to give an X.25-based packet network, the flexibility to meet compatibility and performance requirements for both credit authorization and data capture transactions. A T3POS Packet Assembler/Disassembler (PAD) permits POS terminal equipment to communicate with Information Service Providers (ISP) via Virtual Circuits (VC) supported by the X.25-based packet network. The T3POS PAD converts character-oriented frames arriving from a POS terminal to a format that is capable of being carried over a packet network VC.

¹The name T3POS is a pseudo-acronym derived from the term Transaction Processing Protocol for Point -of Sale.

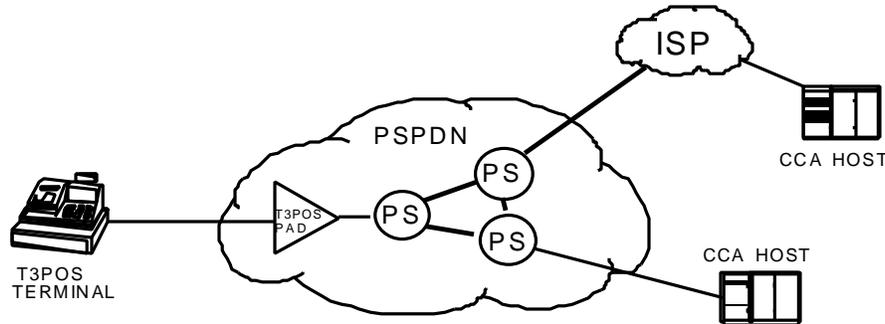


Figure 6-1
An Overview of the Transaction Switching and Transport Service Architecture

6.3 Background on T3POS

T3POS is a transaction switching and transport protocol based on VISA USA's de facto standard credit authorization and data capture protocols. T3POS is also based on the International Standards Organization's (ISO) Basic Mode Control Procedures for Data Communication Systems (ISO 1745). T3POS supports information transfer across a data link that is monitored by link control procedures, where some control characters are given a particular meaning according to the transmission phase (e.g., call establishment, data transfer, and call clearing). All necessary control information passing from the POS terminal to the PAD is carried over the link by discrete control characters selected from an internationally standardized character set. Although not internationally standardized like ISO 1745, VISA USA's authorization and data capture link level protocols are a significant factor in transaction switching and transport because of the extent of their use and the size of the embedded base of compatible equipment. For specific background information on the VISA protocols and ISO basic control procedures, refer to the following documents:

- Second Generation Authorization Terminal Link Level Protocol, Volume 3, VISA USA, September 1990.
- Information Processing -- Basic Mode Control Procedures for Data Communication Systems (ISO 1745).
- Basic Mode Control Procedures -- Conversational Information Message Transfer, ISO 2629, International Standards Organization, 1st Ed., 1973.
- Basic Mode Control Procedures -- Complements, ISO 2628, International Standards Organization, 1st Ed., 1973.

Note that the references to the VISA International documents are intended to apply to the packet network access control procedures for POS terminal transactions to any ISP or Credit Card Association (CCA), as long as the ISP or CCA conforms to the applicable interface and protocol specifications.

6.4 Support of T3POS and X.25

T3POS operates in three basic modes that provide different types of POS terminals with access to an X.25-based packet switched network that provides transaction switching and transport.

- **Transparent Mode** -- This mode enables the use of existing credit authorization and data capture link level protocols (e.g., VISA 2) with minimal modifications to the POS terminal and without any modifications to the ISP/CCA host system software. This mode requires that the PAD monitor the data stream to perform a limited set of link level procedures at the PAD/terminal interface. The PAD provides protocol conversion between the POS terminal and the host in a way that makes the protocol differences associated with the packet network unrecognizable to both the POS terminal and the ISP/CCA host system.
- **Local Mode** -- This mode eliminates the transfer of supervisory frames (e.g., ACK and NAK) across the X.25-based packet network. In this mode, the PAD assumes full responsibility for issuing supervisory frames to the POS terminal while information frames only are passed across the packet network. Modifications to the CCA host system software are required in order to function in the absence of supervisory frames.
- **Blind Mode (Not Offered)** -- This mode enables interworking with terminal equipment that supports unique protocols (e.g., X.28 asynchronous terminals) and proprietary message formats. When the PAD enters this mode typically upon receipt of an opening frame containing a special signal used for mode selection, it "blindly" passes all characters received from the POS terminal and the ISP without regard for the protocol or parity. Calls must be cleared by the ISP since the PAD can not interpret the user's call clear command (i.e., the DLE, EOT sequence) in the data stream. Since in Blind mode the PAD would be unable to recognize an opening frame, Blind mode is not to be used as the default mode of operation.

T3POS modes only apply for the duration of the virtual call. The PAD enters the appropriate mode after the opening frame has been processed. The following is a list of benefits offered by the T3POS protocol:

- Transparent mode enables a T3POS PAD to operate with a large number of existing POS terminals and host systems requiring minimal modifications to their communications software.
- Longitudinal Redundancy Check (LRC) generation and validation is used in opening message validation and in Local mode to provide local error recovery procedures. Current asynchronous interfaces based on X.3, X.28 and X.29 do not support such reliability.
- When operating in Local mode, a T3POS PAD eliminates the need to transmit particular T3POS protocol elements (e.g., ACK, NAK, etc.) across the packet network. Operating in this mode not only reduces the number of packets that must traverse the packet network -- which may lower the cost -- but also may reduce the total transaction time.
- Blind mode (**not offered**) provides a T3POS PAD with both data and protocol transparency to operate with X.28 or a proprietary POS terminal-to-host protocol.

- T3POS results in fewer PAD requirements than the traditional X.3 PAD. Although it must support the capabilities of the X.3 PAD that are associated with packet assembly and disassembly, a T3POS PAD is not required to support all PAD command signals and PAD service signals that are supported by an X.3 PAD.

6.5 Physical Connection of the POS TurboChargeSM Service Terminal to T3POS Pad

- **Data Over Voice (Supported):** The most common method of connection to the DIGIPAC network will be by way of a Data Over Voice (DOV) connection. This DOV connection enables the user to simultaneously use their telephone connection to the U S WEST voice network for both voice communications as well as POS transactions. The details of that DOV interface are beyond the scope of this document but may be found in U S WEST Technical Publication 77331, "Digital Data Over Voice Digital Access Arrangements, Network Interface Specifications". A pictorial representation of this method can be seen in Figure 6-2.
- **Direct Asynchronous Access (Not Offered):** Point of Sale (POS) terminals may be connected to the DIGIPAC network by any direct access asynchronous method detailed in Chapter 8 of this document. However, this will most likely not be the most common method of connection to DIGIPAC and is not offered at this time. The default method for this type of connection to DIGIPAC would be using the direct access asynchronous 2400/1200 bit/s connection detailed in Chapter 8, Section 8.4.3 of this document.

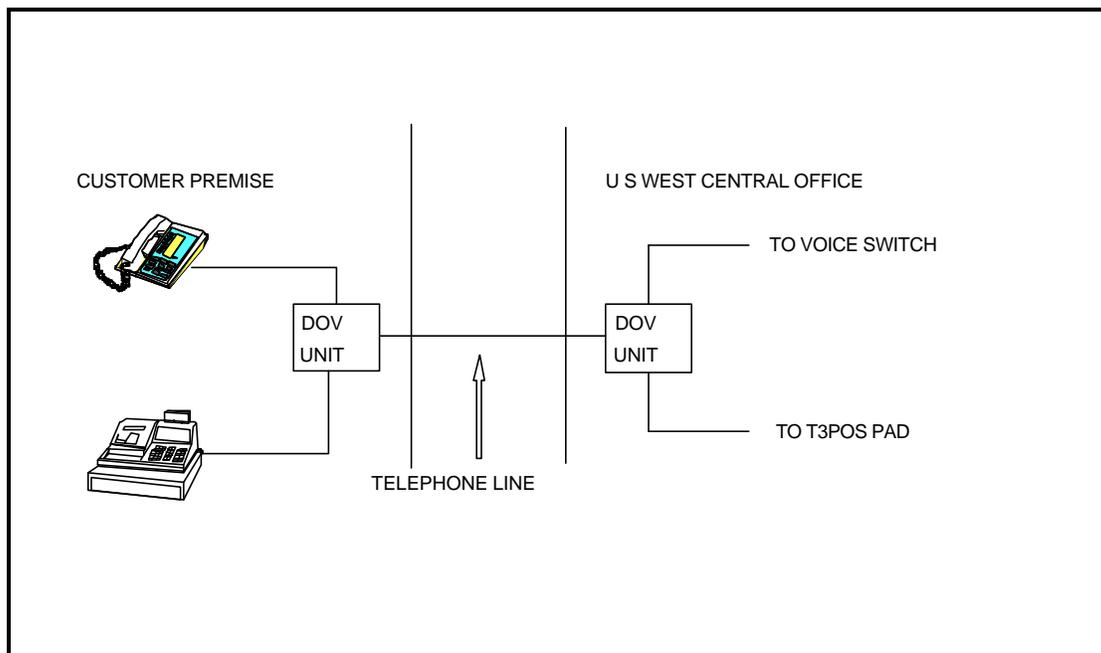


Figure 6-2
POS Terminal Connection via Data Over Voice (DOV) Unit

- **Dial Access (Not Offered):** The third method of access, may be by a dialed access to a 950-XXXX telephone number. In this method the customer places a call to a 950-XXXX number that has been provided to them by the CCA. This call will in turn connected to the T3POS PAD in the DIGIPAC Network or another PSPDN.

6.6 Character Exchange and Service Initialization

6.6.1 T3POS Character Set

The DIGIPAC T3POS PAD is capable of transmitting and receiving characters in accordance with International Alphabet No. 5 (IA5) as described in CCITT Recommendation T.50, 1988, which is very similar to the character set defined by ANSI X3.4, "American National Standard Code for Information Interchange". A T3POS PAD engaged in asynchronous transmission will transmit and accept a transmission character that consists of one start bit, followed by 7 data bits, followed by a parity bit, and ending with one stop bit (see Figure 6-3). The data bit sequence is transmitted from the least significant bit to the most significant bit (i.e., the low-order bit is in the bit 1 position).

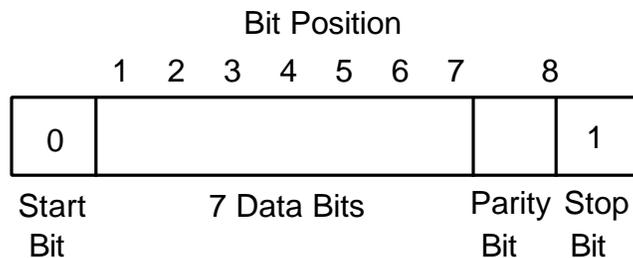


Figure 6-3
 Asynchronous Character Format

The parity bit is generated in accordance with ISO 1177, Information Processing --Character structure for start/stop and synchronous transmission, 2nd Ed., 1985, which states that the character parity sense will be odd in synchronous transmission and even in asynchronous transmission. The parity will be set by DIGIPAC at subscription time. The parity of the characters transmitted by the PAD to the host will be the same as the parity received from the POS terminal. The IA5 character set contains 128 coded characters divided into both control and graphic characters as shown in Table 6-A. The Blind Mode character format is defined as 8 bit data with no parity bit as shown in Figure 6-4.

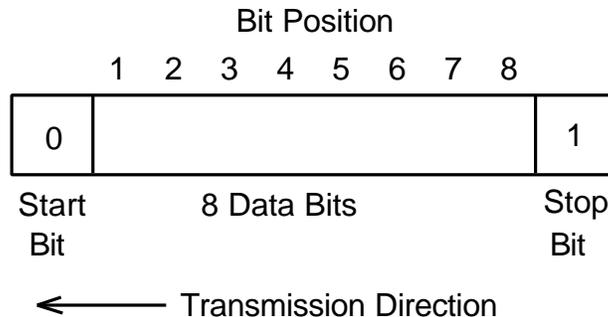


Figure 6-4
 Blind Mode Character Format

Control characters are derived from the first two columns of the IA5 character set. Specifically, the subset of control characters are those that appear in the 6-bit codes defined in Table 1 of ISO 646, Information Processing -- ISO 7-bit coded character set for information interchange, International Standards Organization, 2nd Ed., 1983; which are all supported by IA5. User data should consist of all characters in the third through the eighth columns of the IA5 character set, but may also include all control characters except the ETB (End of Block) and ETX (End of Text) control characters, which are designated as special T3POS frame delimiters.

Table 6-A
IA5 Character Set

		Control Characters		Displayable Characters					
7		0	0	0	0	1	1	1	1
BIT		0	0	1	1	0	0	1	1
6		0	1	0	1	0	1	0	1
4321	5								
0000		NUL / ^@	DLE / ^P	SP	0	@	P	`	p
0001		SOH / ^A	DC1 / ^Q	!	1	A	Q	a	q
0010		STX / ^B	DC2 / ^R	"	2	B	R	b	r
0011		ETX / ^C	DC3 / ^S	#	3	C	S	c	s
0100		EOT / ^D	DC4 / ^T	\$	4	D	T	d	t
0101		ENQ / ^E	NAK / ^U	%	5	E	U	e	u
0110		ACK / ^F	SYN / ^V	&	6	F	V	f	v
0111		BEL / ^G	ETB / ^W	'	7	G	W	g	w
1000		BS / ^H	CAN / ^X	(	8	H	X	h	x
1001		HT / ^I	EM / ^Y	)	9	I	Y	i	y
1010		LF / ^J	SUB / ^Z	*	:	J	Z	j	z
1011		VT / ^K	ESC / ^[	+	;	K	[	k	{
1100		FF / ^L	FS / ^\	,	<	L	\	l	|
1101		CR / ^M	GS / ^]	-	=	M	]	m	}
1110		SO / ^N	RS / ^^	.	>	N	^	n	~
1111		SI / ^O	US / ^_	/	?	O	_	o	DEL

6.6.2 T3POS Frame Definitions

T3POS frames fall into two categories: information frames and supervisory frames. While supervisory frames are typically made up of a single control character, information frames are made up of a sequence of characters. The control characters are used either to define the nature of an information frame (i.e., an opening frame or a general frame) or to convey call control functions in the form of a supervisory frame. When control characters are received by a T3POS PAD, they instruct the PAD to take specific action. Some T3POS control characters must not be misconstrued as user data. In particular, the ETB and ETX control characters must not be included in the Message field because the PAD will treat them as Message field delimiters. The CPE must be capable of ensuring that appropriate control characters appear in the Control and Message fields of a T3POS frame.

6.7 PAD Support of the T3POS Protocol

T3POS is a character-oriented transaction switching and transport protocol designed to provide efficient credit authorization and data capture via an X.25-based packet switched network. T3POS is used for data interchange between a POS terminal and a PSPDN Access Concentrator (AC) over a single information path. Described in terms of the Open Systems Interconnection (OSI) Reference Model, T3POS on the terminal-to-PAD interface may be viewed as a Data Link layer protocol, supporting such functions as error correction, flow control, and information delimitation. T3POS also specifies timing procedures, which reflect customer requirements that must be met to ensure consistent and reliable service operation.

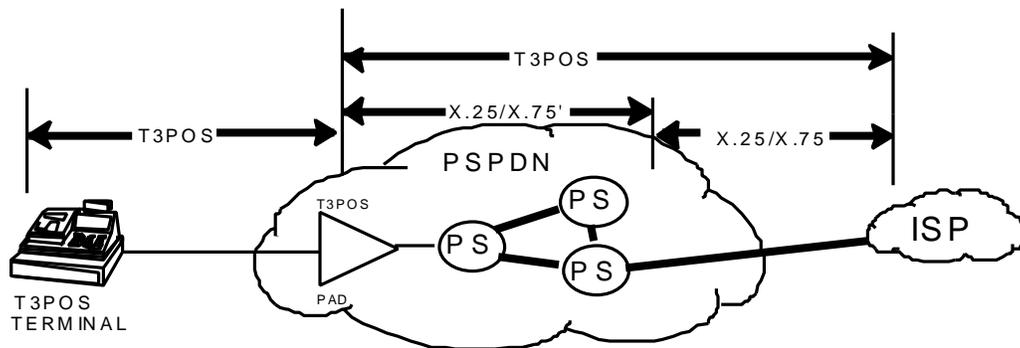


Figure 6-5
T3POS PAD Support of DIGIPAC

Figure 6-5 illustrates a POS terminal accessing an ISP via DIGIPAC using the T3POS protocol. The access portion -- from the POS terminal to DIGIPAC -- shows T3POS operating over the local loop. At the PAD, a T3POS-formatted frame is encapsulated in an X.25 packet and passed to a Packet Switch (PS) over an internal protocol, X.25 or X.75 interface. The X.25 packet destined for the ISP exits DIGIPAC over an X.25 or X.75 interface. Like most OSI Data Link layer protocols, T3POS operates independently of the Physical layer, enabling operation over several transport alternatives.

6.7.1 Frame Structures

- Information Frames

In Local and Transparent modes, a T3POS PAD receives and transmits POS messages in information frames conforming to the General Frame format in Figure 6-6. In the General Frame format, the STX (Start of Text) character preceding the POS message is defined as the opening character. The ETX/ETB character following the Message field and preceding the LRC is defined as the Message field delimiter. In Blind mode, the format of the customer information is unrecognized by the PAD, and the T3POS PAD receives and transmits information according to the guidelines of the particular Blind mode protocol.



Figure 6-6
General Frame Format

In the Control Frame format (Figure 6-7), the SOH (Start of Header) character preceding the Control field is defined as the *opening* character. The Control field is followed by a frame in the General format. That is, the Message field is preceded by an STX character and followed by an ETX/ETB character and an LRC character. The frames shown in Figures 6-6 and 6-7 do not include the bits that may be inserted for transmission timing (i.e., start and stop bits).

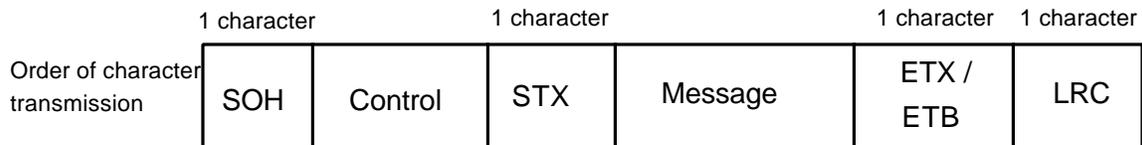


Figure 6-7
Control Frame Format

- Definition of an Opening Frame

An **opening frame** is defined as an information frame in either the General Frame format or the Control Frame format that is received immediately after a DLE, EOT sequence has been transmitted to the POS terminal from the PAD or received from the POS terminal by the PAD (i.e., the first information frame received from the terminal or host after a VC has been cleared).

- STX and ETX/ETB Delimiters

The STX character is used to indicate the start of the Message field and the end of the Control field, if present. The ETX character is used to indicate the end of the Message field and the end of a T3POS frame or a sequence of T3POS frames. In cases where a POS message must be broken up into multiple frames, the ETB character is used to indicate the end of one message block. The ETB characters are used instead of ETX for as long as the T3POS frame sequence is continued. The ETX and ETB characters are not only used to delimit a sequence of T3POS frames, but also they are used in conjunction with the LRC character as data forwarding characters. When ETX or ETB is received at the end of a T3POS frame, the PAD places the frames including the LRC in X.25 packets and forwards them.

Following the STX, all characters in columns 0 to 7 of IA5, with the exception of the ETB and ETX control characters, will be recognized by the PAD as forming part of the Message field. The PAD will always recognize the first ETX or ETB character as the Message field delimiter. In addition, the T3POS PAD used by U S WEST will not allow SOH, STX, EOT, ENQ, ACK, NAK, DEL, DC1, DC2, SYN, and BEL characters in the message field in the local mode and will clear the call.

- Message Field

The Message field of an information frame follows the STX character and precedes the ETX or ETB character. The PAD assumes that the Message field is an integral multiple of 8 bits. It is recommended that the PAD support data frames of 256 octets, and the DIGIPAC network will set the default packet size to 256 octets (see Table 6-D for all DIGIPAC defaults). The length of the Message field of an opening information frame should be at most 237 characters. The length of the Message field of a general information frame should be at most 253 characters. The maximum length of the Message field should not preclude PAD support for larger Message fields.

- Control Field

When the Control field is present in an opening frame, the SOH character is used to indicate the beginning of a frame, and the STX character appears at the end of the Control field. The Control field is intended to serve two purposes: POS terminal selection of a T3POS mode of operation and, optionally, signaling of call establishment data, such as a called address, a Fast Select facility request, or a Recognized Private Operating Agency (RPOA). The format for the Control field is as follows:

<Control field> ::= <Mode Selection signal>[X28 selection PAD command signal]

When the Control field is present, it should contain the Mode Selection signal as a minimum. However, DIGIPAC will accept an empty control field and assume that the terminal is requesting a call using the defaults set at subscription time. The Mode Selection signal is a single character in length and is used to signal the T3POS mode of operation. The Mode Selection signal also supports two other values used to indicate that the Control field contains network management data or that the terminal is an X.28 terminal. Table 6-B shows the Mode Selection signal values.

Table 6-B
Mode Selection Signal Values

T3POS Mode	IA5 Character	Description
!	2/1	Request for Transparent Mode
Space	2/0	Request for Local Mode
#	2/3	Request for Blind Mode
%	2/5	Request Contains Network Management Data (Not Supported)
J	4/10	X.28 Terminal Indicator (Not Supported)

The X.28 selection PAD command signal is an optional part of the Control field that allows for the signaling of call establishment data. The format of the X.28 selection PAD command signal will be as follows:

<X.28 selection PAD command signal>::= {fax {, fax-} dna {<D/P> user data}

Fax = facility request The facility request is one or more of the following:

F = unrestricted fast select facility

T<rpoa> = RPOA transit facility

<rpoa> = Data Network Identification Code (DNIC) of the RPOA

N<nui> = NUI facility (Not Offered)

<nui> = NUI string

dna = X.121 network address or mnemonic name of the destination host

user data = up to 12 characters, for a regular call, or 124 characters for a fast select call. The characters are alpha-numeric separated from the network address by a P (Password) or a D (Data) character.

For details of the format(s) for the X.28 *selection PAD command signal*, refer to CCITT X.28, Section 3.5.15.

A terminal that supports the full set of CCITT X.28 commands and service signals may inform the PAD of such using the X.28 Terminal Indicator code (IA5 character 4/10). The PAD may optionally recognize this code and commence to operate in accordance with the entire CCITT X.28 capabilities. "J" mode is intended to allow the X.28 terminal the benefit of other applications (i.e., electronic mail) by modifying the X.3 parameters. DIGIPAC does not currently support the "J" mode of operation.

The Control field may also contain network management information. The minimum length of the Control field should be at least 16 characters. Further specification of the Control field when network management information is present is under consideration. Therefore, DIGIPAC does not support network management information in the control field.

- Supervisory Frames

With the exception of the DLE, EOT and the DLE, EOT, ENQ sequences, the supervisory frames consist of one control character from IA5 columns zero (0) and one (1). The following is a list describing the use of the IA5 control characters by the T3POS protocol:

- ACK

The Acknowledgment character (IA5 character 0/6) is used by the PAD -- when in Local mode -- to indicate to a POS terminal that the information frame it transmitted has been received correctly. The ACK character returned to the POS terminal after the receipt of the opening frame will be delayed until the PAD is able to send the first data packet to the host. That delay is based on whether or not the PAD is configured to wait for an ENQ character before the first data packet can be delivered to the host.

- NAK

The Negative Acknowledgment character (IA5 character 1/5) is used by the PAD --when in Local mode -- to indicate to the POS terminal that the command or frame was received with a LRC error.

- SYN

The SYNchronous idle character (IA5 character 1/6) is used by the PAD or the POS terminal -- in all three modes -- to extend response timers applicable across the interface between POS terminal and the PAD. There is no limit on the number of SYN characters that are transmitted or received by the PAD. In Transparent and Blind modes, the PAD does not transmit SYN characters to the POS terminal after the first ACK received in response to the opening frame.

- ENQ

The ENquiry character (IA5 character 0/5) may be used by a remote host system as an invitation to transmit or by the PAD or terminal to request retransmission. It may also be used to request retransmission of a protocol element when an expected response or a complete frame has not been received within a specified time interval. The use of the ENQ character by the host system as an invitation to transmit is optional. In addition, the PAD uses the ENQ character as the character to inform the POS terminal that it has detected a parity error on the information last received.

- DLE, EOT

The DLE, EOT sequence (IA5 characters 1/0 and 0/4, respectively) is used by the PAD when in all modes to indicate to the POS terminal that the virtual call has been cleared. It is also used by the POS terminal to command that a virtual call be disconnected. The DLE, EOT sequence should always appear before an opening frame is received from the POS terminal unless a DLE, EOT sequence has just been transmitted by the PAD.

- DLE, EOT, ENQ (**NOT OFFERED**)

Otherwise known as the SELECT sequence, it is used by the PAD to indicate to a POS terminal that a host initiated call is being attempted. The SELECT sequence is intended to avoid collisions that might otherwise occur if the POS terminal were transmitting a frame while a host initiated call was in progress. In the event that such a collision has occurred, the network virtual call should be cleared and the POS terminal should be given priority. It is assumed that the terminal would restart transmission of the frame upon receipt of the SELECT sequence.

In addition to the supervisory frames mentioned above, the following is a list of supervisor frames that may be used in the transparent mode. These frames will not be generated by the T3POS PAD.

- BEL

BELI Character (IA5 character 0/7) Positive Acknowledgment - This character is sent by a receiver to indicate to the sender of a message that the message has been received error free. This character is not generated by the PAD.

- DC1

DC1 WACK Character (IA5 character 1/1) - This character is used by the host to expand the delay period on the DTE side while it is waiting for a response. This character is not generated by the PAD.

- DC2

DC2 WAIT Character (IA5 character 1/2) - This character is used by the host to expand the delay period on the DTE side while it is waiting for a response. This character is not generated by the PAD.

6.7.2 Frame Procedures

- T3POS PAD Functions

The T3POS PAD service performs X.25 functions on behalf of the POS terminal. A T3POS PAD extends beyond some of the capabilities of the traditional PAD and eliminates the need for others. Many of the basic functions of the traditional PAD are necessary for the operation of a T3POS PAD, such as X.25 VC control, packet assembly, and PAD/host control information exchange. The functions that extend beyond the traditional PAD are those that are associated with support of the T3POS protocol elements. The new T3POS PAD must go beyond such basic functions and support capabilities such as opening frame validation, LRC and poll stripping.

Among the capabilities eliminated are almost the entire set of X.28 command and service signals. The T3POS PAD is not required to support any of the X.28 service signals. Also, the majority of the X.28 command signals are not required for a T3POS PAD. In addition, POS terminals with connections to a T3POS PAD typically do not require the Service Request Signal (SRS) or the network herald. In most cases, the physical connection is established and the line speed is normally set at subscription time. The default for T3POS service on DIGIPAC will be 2400 bit/s (see Table 6-D for all DIGIPAC defaults).

The following list contains brief explanations of the additional functions supported by a T3POS PAD:

- **Opening Frame Validation** -

The PAD performs parity and LRC on the opening frame before attempting to establish a VC. The PAD performs local error recovery procedures until a valid opening frame is received.

- **Frame Header Stripping** -

The PAD removes the Control field from the T3POS frame and performs the appropriate functions. Virtual Calls (VC) are initiated based on the header information contained in the opening frame, or using the Direct Call information provided at subscription time. The header information is recognized by its starting and ending characters. The header information contains mode selection, and optionally the called address, and any X.28 facility request signals.

- **Longitudinal Redundancy Checking (LRC) /Generation** -

The PAD ensures accurate receipt of a T3POS opening frame by detecting an invalid LRC or a parity error. When an error is detected, the PAD responds with a NAK (IA5 character 1/5) to request retransmission. The PAD checks opening frames in the Control frame format for an LRC or parity error and generates a new LRC after stripping the Control field. The PAD checks opening frames in the General frame format but does not generate a new LRC. In Local mode, the PAD continues to check for LRC or parity errors in subsequent frames. Once transparent and Blind (not offered) modes are entered, the PAD only checks the opening frame for an LRC or parity errors and transparently passes subsequent frames without checking for LRC or parity errors.

- **Host Poll Stripping** -

The DIGIPAC T3POS PAD supports two options for ENQ (host polling) stripping:

- 1) receipt of ENQ with backup timer T3 or
- 2) No ENQ.

If option 1 is used, after the host system accepts the incoming call packet, it may respond by polling the PAD with an ENQ (IA5 character 0/5), which the PAD must remove and not transmit to the POS terminal. Upon receipt of the first ENQ immediately following the call confirm packet, the PAD enters the Data Transfer state. If timer T3 expires before the receipt of the ENQ from the host then the PAD will enter the data transfer state and send the first data packet to the host.

If option 2 is used and no ENQ is supported, the PAD enters the data transfer state immediately after receiving the call confirm packet from the host system.

- **Time-out Prevention (using SYN characters)** -

The PAD transmits a SYN (IA5 character 1/6) to the POS terminal to prevent a time-out. By transmitting the SYN, the PAD is able to extend the POS terminal's delay period. Extending the delay period may be necessary for two reasons:

- 1) The PAD is waiting for a response from the host system or
- 2) The PAD's receive buffer is occupied.

When appropriate, the POS terminal issues SYN characters according to a timer that will be less than the PAD's SYN-to-SYN timer in Table 6-C.

- **Data Transfer with Content Monitoring** -

The POS terminal may clear the call by transmitting a special character sequence. In Local and Transparent modes, the PAD monitors the data stream for a DLE, EOT (IA5 characters 1/0 and 0/4) sequence from the POS terminal. When the DLE, EOT sequence is recognized, the PAD transmits a clear request packet to the host system. Content monitoring procedures do not apply when the PAD is operating in Blind mode.

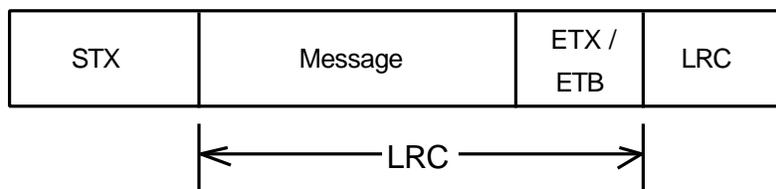
- **Call Clear Indication (using the DLE, EOT sequence)** -

The PAD uses an DLE, EOT (IA5 characters 1/0 and 0/4) to indicate to the POS terminal that a VC has been disconnected.

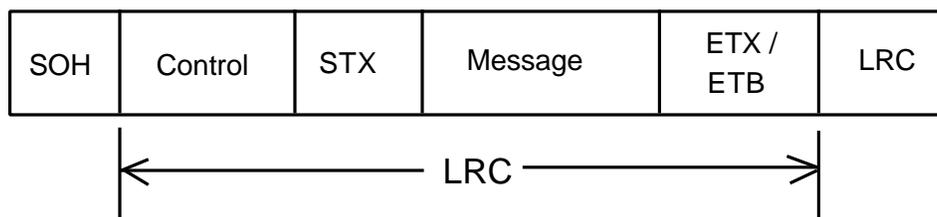
As mentioned above, a T3POS Control frame contains a Control field in which optional X.28 facility request signals may be present. Some of these optional facilities allow ISP routing (based on the Recognized Private Operating Agency's Data Network Identification Code), Fast Select calls without restrictions on the response, and Network User Identification (NUI) calls.

- Longitudinal Redundancy Checking (LRC)

Information frames contain a LRC character. The LRC character is attached to the end of the information frame to allow the PAD to detect errors in a frame received from a POS terminal. When the PAD examines the LRC character and an LRC error is detected, the PAD requests that the POS terminal retransmit the frame by transmitting a NAK character indicating a negative acknowledgment. The LRC character is composed of seven data bits and one parity bit and is performed in accordance with ISO 1155, Information Processing -
- Use of longitudinal parity to detect errors in information messages, International Standards Organization, 2nd Ed., 1978.



General Frame Format



Control Frame Format

Figure 6-8
Range of the Longitudinal Redundancy Checking (LRC) Calculation

Each of the first seven bits of the LRC character shall be the modulo 2 binary sum (i.e., XOR) of every element in the same bit 1 to bit 7 column of successive characters in the transmitted T3POS frame. The longitudinal parity of each column of the T3POS frame, including the LRC character, is even. The sense of parity bit of the LRC character is the same as for the information characters (i.e., odd for synchronous transmission, even for asynchronous transmission). The summation to obtain the LRC character is initiated by the receipt of the SOH or STX character. Summation then begins with the next character and ends with either an ETX or ETB character as shown in Figure 6-8. The LRC character immediately follows the ETX or ETB character in the frame. When an STX character is received after the LRC summation has begun (upon receipt of an SOH character), then the STX character is included in the LRC summation.

When the PAD removes the Control field from a Control frame, it generates a new LRC character for the frame before it is packetized and transmitted to the host. The PAD checks the opening frame for an LRC or parity error and generates a new LRC after stripping the Control field. In Local mode, the PAD continues to check for LRC or parity errors in all subsequent frames. Upon entering Transparent and Blind (**NOT OFFERED**) modes, the PAD checks the opening frame for an LRC or parity errors and transparently passes subsequent frames without checking for LRC or parity errors.

- Transmission Considerations

All octets of a T3POS frame shall be transmitted with the low-order bit first (for example, the first bit of the sequence number that is transmitted shall have the weight 2⁰). The LRC character is transmitted and received commencing with the summation of the first column, which is found in bit position 1 of the LRC character.

- Error Recovery Procedures

The DIGIPAC T3POS PAD supports two limit counters. These limit counters are called ENQ retry limit and NAK retry limit. The default value of each of these counters is 3 (see Table 6-D for all DIGIPAC defaults). If the PAD has to send 3 successive ENQ or NAK characters to the POS terminal the PAD will send the DLE, EOT sequence to the POS terminal. The following paragraphs describe how these counters are used during various phases of a call.

Since the opening frame may include a Control field that contains critical information (e.g., T3POS mode, called address, etc.), local error recovery procedures are supported to ensure that the opening frame is error free. When the opening frame is received, in either the Local or Transparent Mode, the PAD examines the opening frame for parity errors and an LRC error. The PAD takes the following action on the opening frame:

- If the U S WEST T3POS PAD detects a parity error in the opening frame, it will transmit an ENQ character to the POS terminal.

- If the U S WEST T3POS PAD detects a LRC error in the opening frame, it will transmit a NAK character to the POS terminal.
- If the U S WEST T3POS PAD receives n successive opening frames in error (default n = 3), due to either a parity or LRC error, it will send DLE, EOT to the terminal and disconnect the switched access connection if one exists.

In Local mode, the PAD is responsible for managing all error recovery procedures over the interface to the POS terminal. Thus in Local mode, error recovery procedures are applied to both opening frames and non-opening frames. If the PAD detects a parity error in an information frame it transmits an ENQ character to the POS terminal. If the U S WEST T3POS PAD detects an LRC error in an information frame, it transmits a NAK character to the POS terminal. If the PAD receives three (3) successive frames in error, it will clear the virtual call. Moreover, if a NAK is transmitted to the POS terminal and the terminal does not respond with retransmission of a frame or a character within T4 seconds (see Table 6-C), the PAD will issue an ENQ character. If three successive ENQ characters are sent to the POS terminal by the PAD the call will be cleared.

In Transparent mode, sole responsibility for link error recovery is given to the endpoints. Therefore in this mode, following the Call Establishment state, all time-out error recovery procedures are performed by the POS terminal and the host without the PAD's involvement.

Supervisory Frame Errors

- SYN's, ACK's and other supervisory frames received by the PAD from the POS terminal may be received with a parity error. In Local mode, if the PAD receives a supervisory frame from the POS terminal with a parity error, it will transmit an ENQ to request retransmission of the supervisory frame. If the PAD receives three (3) successive supervisory frames in error, it will clear the virtual call. In Transparent mode, all characters received after the first frame that are in error will be forwarded to the host based on the Character-to-character timer (T1).

Timer Support

- In association with the T3POS PAD functions, the PAD must also support new timers. Table 6-C contains the T3POS PAD timers that are recommended for all modes of operation. Currently DIGIPAC only supports the first six (6) timers.
- Depending on the current T3POS implementation by a particular supplier, the name of the timer or the number of timers used to perform the same function of a given timer may vary. However, for discussion purposes, timers discussed in this document will be based on the timer definitions in Table 6-C.
- The factors that these timers take into account include:
 - 1) the transmission time of the acknowledging frame
 - 2) the propagation time over the access data link

- 3) the estimated processing times at the host and POS terminal and
- 4) the time to complete the transmission of the frame(s) in the PAD transmit queue.

Table 6-C
T3POS PAD Timers

Timer Number	Timer Name	Interface State	Started by	Terminated by	Action taken when time-out expires	Default value
T1	Character-to-character timer	PAD Command and Data Transfer	Any character received from POS terminal	Next character received from POS terminal	PAD issues an ENQ character to POS Terminal	.05 sec.
T2	SYN-to-SYN timer	Call Establishment, PAD Command, ENQ Waiting and Data Transfer	SYN transmitted to POS terminal	Response from Host is received (Note: this timer may be reset by a SYN from POS terminal)	PAD issues a SYN character to POS terminal	4 sec.
T3	ENQ timer	ENQ Waiting	X.25 Call Confirm packet is received from Host	ENQ is received from the Host	PAD continues as though ENQ was received from Host	0 sec.
T4	NAK timer	PAD Command and Data Transfer	NAK or ENQ is transmitted to POS terminal	Retransmitted frame or character is received	PAD issues an ENQ character	4 sec.
T5	DLE, EOT timer	Data Transfer	ACK is received from POS terminal	Receipt of a frame from terminal or data packet from Host	PAD issues an DLE, EOT, clears the call, and goes to PAD waiting	4 sec.
T6	Blind Mode timer	Data Transfer (Blind mode only)	Data is transmitted to a Host or POS terminal	Receipt of a frame from terminal or data packet from Host	PAD issues an DLE, EOT, clears the call, and goes to PAD waiting	2.5 mins.
T7 Not Offered	Frame Arrival timer	PAD Waiting	PAD enters the PAD Waiting state	The first character of a frame is received	PAD issues an DLE, EOT and disconnects switched connections	> 60 sec.

* The T5 timer is not mandatory for leased line-type connections.

6.8 Terminal/PAD Control Information Exchange

6.8.1 Virtual Call (VC) Control

The state diagrams in Figures 6-9 and 6-10 represent the states of operation of a T3POS PAD that supports all three modes of operation as well as host initiated calls. Since DIGIPAC does not support the Blind mode the leg of the figure for Blind mode operation does not apply. These figures, along with the following text, explain the actions taken by the T3POS PAD for VC control.

6.8.2 Active Link and PAD Waiting States

When the physical transport mechanism has established a physical connection, the POS terminal and the PAD are in the Active Link state. The physical connection may be established using a switched (not offered) or a lease line-type connection. The PAD will transition from the Active Link state to the PAD Waiting state when the access information path is established. Either the host (**not offered**) or POS terminal may transmit an opening frame when the PAD is in the PAD Waiting state. The point at which the access information path is established depends on the transport mechanism used to establish the physical connection. For leased line operation the PAD is always in the PAD Waiting state when no call is in progress.

6.8.3 PAD Command State

In the PAD Command state, more timers than any other state are used to detect procedural failures and to avoid excessive use of network resources. Timers T1, T2, and T4 apply when in the PAD Command state. On receipt of the first character of an opening frame, the PAD enters the PAD Command state. The PAD will remain in this state until receipt of the ETX or ETB delimiter. While in the PAD Command state, the PAD ensures correct receipt of each character and of the entire frame from the POS terminal. In addition, the PAD determines its T3POS operating mode from either the Mode Selection signal in the Control field or from its default information. The PAD may also obtain call set-up information from the Control field.

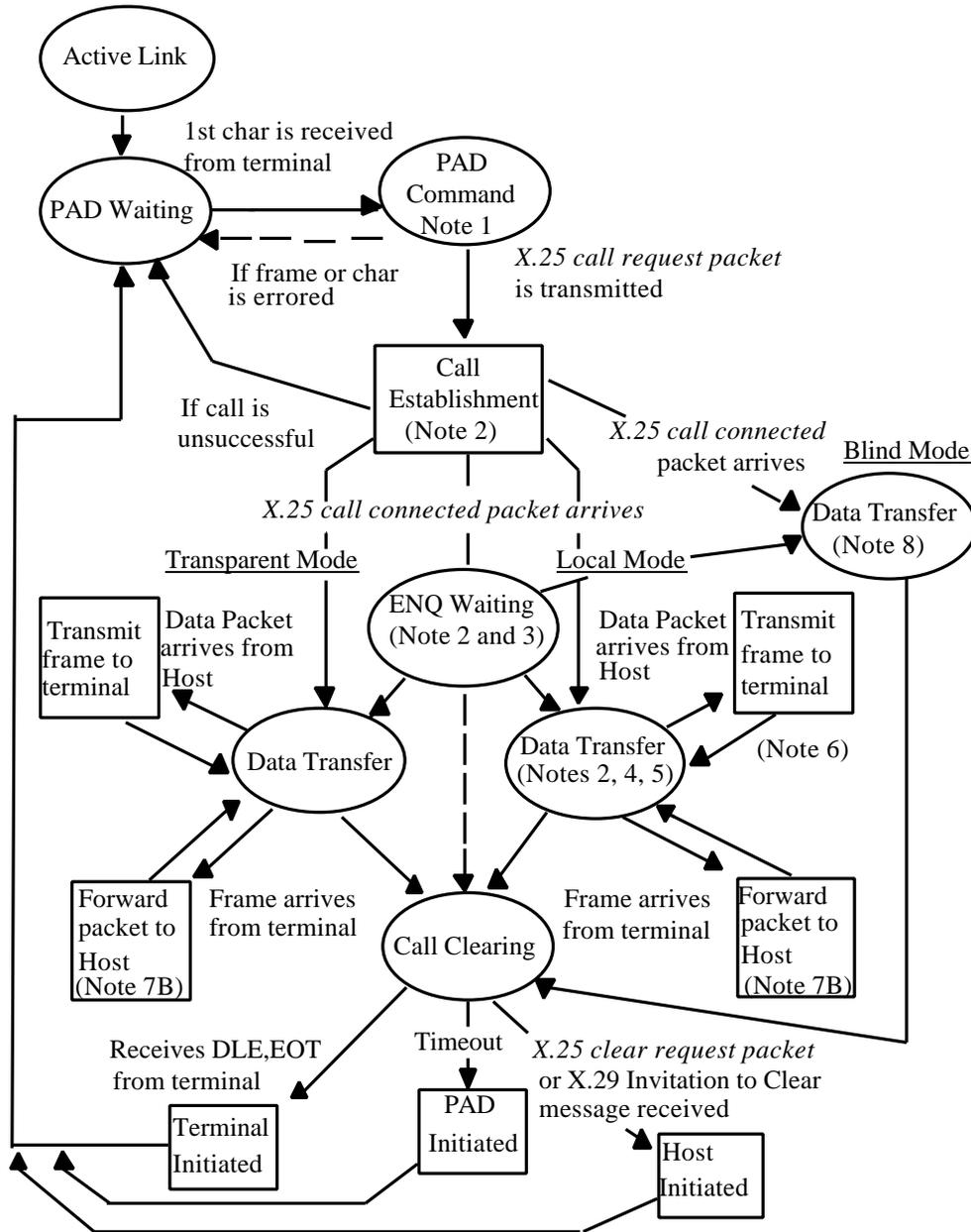


Figure 6-9
State Diagram of Terminal Initiated Virtual Call (VC)

- Note 1: PAD will enter this state N times before disconnecting.
- Note 2: PAD may issue SYN characters to indicate that the call is still connecting.
- Note 3: If ENQ is supported, PAD must wait for receipt T3 timer expiration before transitioning to *Data Transfer* state.

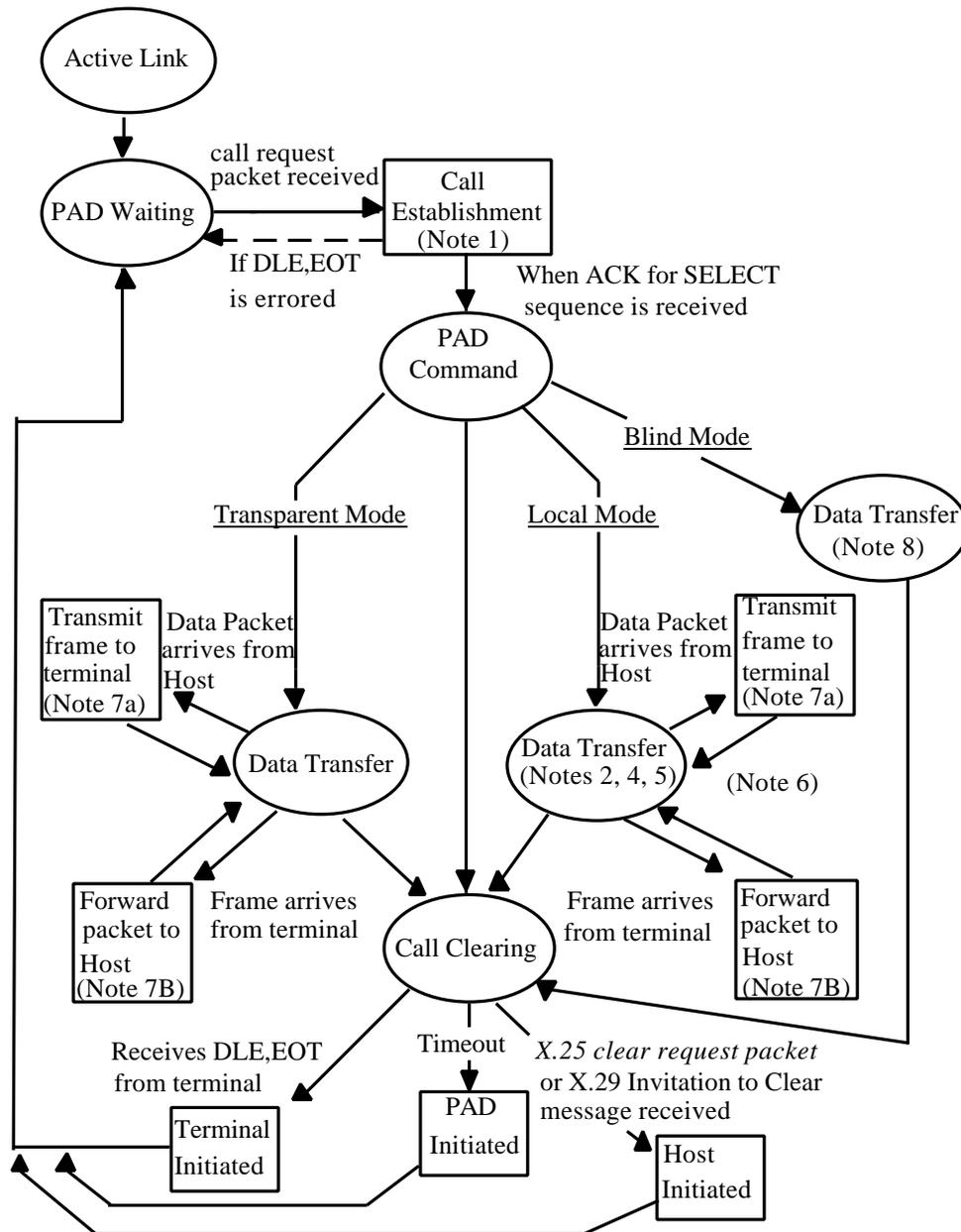


Figure 6-10
State Diagram of Host Initiated virtual Call (VC)
(NOT OFFERED)

- Note 4: PAD issues SYN characters when receive buffer is occupied.
- Note 5: After forwarding data packet, ACK is immediately issued to terminal.
- Note 6: Before forwarding more data to the terminal, and ACK must be received from terminal.
- Note 7a: The first frame transmitted to the terminal may contain a Control field with the Mode selection facility request signal.
- Note 7b: For the opening frame only, the PAD generates a new LRC before forwarding data packet to Host.
- Note 8: An ACK is immediately transmitted to POS terminal following receipt of *call connected* packet.

6.8.4 Call Establishment State

Upon receipt of a valid opening frame, the PAD enters the Call Establishment state. In the Call Establishment state the PAD attempts to set up a VC in accordance with the call establishment procedures in X.25, X.75' or an internal protocol. In the Call Establishment state, the PAD issues SYN characters when appropriate and a DLE, EOT if an error condition occurs. When in this state, the PAD does not accept any additional opening frames. A frame will be recognized by the PAD as an opening frame if a DLE, EOT preceded the frame (see Section 6.7.1 - Frame Structure, Definition of an Opening Frame).

When the PAD correctly receives an opening frame, the PAD starts the initial time-out prevention timer and waits T2 seconds before issuing the first SYN character. Subsequent time-out prevention timers are governed by the SYN-to-SYN timer, which starts when a SYN character is transmitted to the POS terminal. Both the initial time-out prevention timer and the SYN-to-SYN timer are terminated by PAD transmission of a supervisory or information frame to the POS terminal. The PAD will forward all information frames received before the previous frame was acknowledged. The initial time-out prevention timer and the SYN-to-SYN timer are only applicable in the PAD Command, Call Establishment, and ENQ Waiting states. Specifically, in Transparent mode, the SYN-to-SYN timer will only be applicable until the first ACK is received from the host -- if terminal initiated -- or the terminal -- if host initiated. In Local mode, the SYN-to-SYN timer is always applicable. The default value for T2 will be 4 seconds (see Table 6-D for all DIGIPAC defaults).

Terminal Initiated

- The Control field information in an opening frame may be used by the POS terminal to initiate VC establishment. Call set-up information may be received in the Control field along with the T3POS Mode Selection signal.

PAD Initiated

- The DIGIPAC T3POS PAD supports PAD initiated calls on interfaces with POS equipment using the Direct Call capability. The Direct Call capability is an optional subscription time service that prevents the user from having to signal the T3POS mode of operation, the called address, and the optional facilities on each call requested. At subscription time, default mode selection is obtained from the customer and the customer interface is configured accordingly. When the opening frame in the General frame format is received, the PAD automatically generates a call request packet containing call set-up information previously subscribed to by the user. The first four (4) octets of call user data in the call request packet are Hex 01000000. If the PAD receives an opening frame that contains information other than that given at subscription time, the information contained in the Control field will override that associated with the Direct Call capability.

Host Initiated (Not Offered)

- The Control field information present in an opening frame received from the host in the first data packet may be used by the host to establish a virtual circuit. Under normal conditions, upon receipt of a call request packet, the PAD transmits a call confirm packet to the host and transmits a SELECT sequence (i.e., DLE, EOT, ENQ) to the terminal to

indicate that a host initiated virtual call has been initiated, and transmits an opening frame to the POS terminal indicating the T3POS mode of operation. If the Mode Selection signal is not present in the first frame received from the host, the PAD should operate in its default Mode, which is set at subscription time.

6.8.5 Call Clearing

The clearing of a VC may be initiated by either the POS terminal, the remote host system, or the PAD. The PAD commences with call clearing procedures as a result of a timer that has expired, error recovery, or a physical connection that has been lost. In addition, the PAD will recognize a clear request signal (i.e., DLE, EOT sequence) from the terminal and a clear request packet from host system and, following receipt of either, the PAD will proceed with call clearing procedures. Upon receipt of a clear request packet, the PAD transmits a clear indication signal to the POS terminal. The PAD will use the DLE, EOT sequence to indicate to the terminal that a virtual call has been cleared.

If a call attempt is unsuccessful for any reason other than a host initiated clear, the PAD indicates this to the terminal by means of a DLE, EOT sequence. After transmission of the DLE, EOT sequence, the PAD enters the PAD Waiting state.

Terminal Initiated

- A POS terminal can clear a VC by issuing a clear request command signal in the form of the DLE, EOT sequence, which is recognized by the PAD in both Transparent and Local modes. The PAD responds by transmitting a clear request packet to the host. The use of the DLE, EOT sequence as a command is only applicable in those states that are visited subsequent to the Call Establishment state.

PAD Initiated

- Clearing of a VC by the PAD may result from one of three possible conditions. The first condition is if the PAD receives three (3) successive frames in error the PAD will clear the call. The second condition is based on the PAD detecting loss of the physical access link on either the terminal or network side. If the link on the terminal side has failed, the PAD transmits a clear request packet to the host. If the link on the network side fails, the PAD issues a DLE, EOT sequence to the terminal to indicate that the call has been cleared. The third condition applies to the local mode only. If the PAD receives anything other than data frames from the host or terminal attempts to send anything other than data frames to the host (i.e., unexpected frames), the call will be cleared.

Host Initiated

- Upon receipt of an X.29 invitation to clear message or an X.25 clear request packet from the host, the PAD will commence with its VC clearing procedures in accordance with their respective CCITT Recommendations. The X.29 invitation to clear message is the desirable host initiated virtual call clearing method. The PAD will send a clear indication signal (i.e., DLE, EOT) to the terminal and respond to the host with a clear indication packet in accordance with the clearing procedures in the Bellcore PPSNGR. The PAD will issue a DLE, EOT sequence to the terminal in all modes.

For the Fault Conditions listed below the identified actions will be taken

- Failure to Receive an Opening Frame -

This condition only applies to non-leased line connections to the PAD and uses timer T7. DIGIPAC does not currently offer timer T7 or non-leased line types of connections.

- Failure to Establish a Virtual Call (VC) -

If the VC is unsuccessful, the PAD transmits a DLE, EOT character to the terminal.

- Invalid Clear Request from Terminal -

If the PAD receives a DLE, EOT sequence from the terminal while in the PAD Waiting state, no response to the terminal will be transmitted.

- Invalid Control Field -

If the PAD receives an invalid Control field from the POS terminal, the PAD will transmit a DLE, EOT sequence to the terminal and enter the PAD Waiting state.

- Maximum Packet Size Exceeded -

If the PAD determines that the maximum packet size has been exceeded, it will transmit multiple packets in accordance with the M (more) bit procedures in CCITT X.25, Section 4.3.4.

A reset may occur at any time following the completion of call establishment procedures, initiated by the PAD, host, or network. Upon receiving a reset, the PAD or host must confirm it. Upon detection of a reset, the U S WEST T3POS PAD sends a clear request to the host and a DLE, EOT sequence to the terminal to terminate the session.

Additionally, the function of the interrupt packet is undefined in this protocol. However, if an interrupt packet is received by the PAD or host, it is confirmed via an interrupt confirmation packet.

6.8.6 Procedures for Changing T3POS Modes

The DIGIPAC PAD supports a settable T3POS Mode Selection parameter that governs the PAD's default mode of operation (see Table 6-D for all DIGIPAC defaults). A default mode can reduce average call set-up time since mode selection on a per call basis may require frequent T3POS mode parameter changes. Selection of a Mode Selection parameter value on a per call basis may be performed by the POS terminal. As stated in Section 6.7.1 - Frame Structure, Control Field, a POS terminal may change the T3POS PAD's mode of operation using the Control field of an opening frame.

Mode change procedures may be used before entering the Call Establishment state and after entering the PAD Waiting state. Mode changes will not be possible after the PAD has entered the Call Establishment state. The PAD's Mode Selection parameter will support the flexibility to default to either of two T3POS modes of operation, local or transparent (see Table 6-D for all DIGIPAC defaults). The PAD responds to an opening frame containing a valid Mode Selection signal by issuing a positive acknowledgment (i.e., an ACK or a response message) to the POS terminal. Regardless of the operating mode, if the information in the Control field is invalid (i.e., invalid mode selection signal), the PAD will transmit a DLE, EOT and wait for retransmission of the entire opening frame, valid information in the rest of the frame notwithstanding. The format of the Control field is defined in Section 6.7.1 - Frame Structure, Control Field.

6.9 Terminal/PAD POS Data Exchange

The procedures described in this section apply during the Data Transfer state of the PAD interface to the POS terminal.

6.9.1 Data Transfer State

After receipt of the call connected packet, the PAD will enter the Data Transfer state of either Transparent, Local or Blind (**not offered**) mode, depending on the T3POS Mode Selection parameter. The PAD will remain in the Data Transfer state until the VC is cleared by the PAD, the terminal, or the host as described in Section 6.8.5. Characters received from an asynchronous POS terminal are defined as consisting of all the bits received between, but not including, the start and stop bits. Data received by the PAD for delivery to the POS terminal will be treated as contiguous octets. If the PAD is in Local mode, then after the entire opening frame is received and transmitted to the host, the PAD will immediately transmit an ACK to the POS terminal. In addition, in Local and Transparent mode the PAD will monitor the data stream for a DLE, EOT sequence from the POS terminal, and upon receipt, the PAD will clear the call. DLE, EOT monitoring is applicable in Transparent and Local modes only.

6.9.2 Data Forwarding Conditions

The conditions in which the PAD commences with the forwarding of a data packet are as follows. In Local and Transparent mode, the ETX/ETB and the LRC combination of characters are used to indicate to the PAD that a frame has ended and the information will be forwarded. The ETX/ETB and the LRC combination of characters are included in the data field of the packet before the packet is forwarded. If the PAD determines that the maximum packet size has been exceeded, it will transmit multiple packets in accordance with the M (more) bit procedures in CCITT X.25, Section 4.3.4. In all modes, the Character-to-character timer (T1) expiring results in a data packet being forwarded to the host for the PAD. The data forwarding for particular control characters when the PAD is operating in Transparent mode is supported to improve transaction time. In Transparent mode, immediate data forwarding results from receipt of the ENQ, ACK, NAK, BEL, DC1, DC2, and EOT characters in the PAD.

6.9.3 PAD Transmission of X-ON/X-OFF Characters (Not Supported)

PAD transmission of the X-ON/X-OFF characters is under consideration and is not supported in DIGIPAC .

6.10 Host/PAD Control Information Exchange

When a PAD receives an opening frame from a POS terminal, it maps the information contained in the Control field, if present, into a call request packet and sends the packet to the host. The PAD will only act on the optional X.28 call selection information if it is present. The mode selection signal will not be mapped into the call user data field of the call request packet.

If no Control field is present in the opening frame, the PAD will use the default call setup information determined at subscription time.

6.10.1 Protocol Identification (Unique T3POS Identifier Not Supported)

PAD support for a unique Protocol Identifier for T3POS is optional and not supported by US WEST. However, the protocol identifier for X.28 protocol will be placed in the first four (4) octets of the Call User Data field of the call request packet that is sent to the host. The format for the protocol identifier field will be as shown in Figure 6-11.

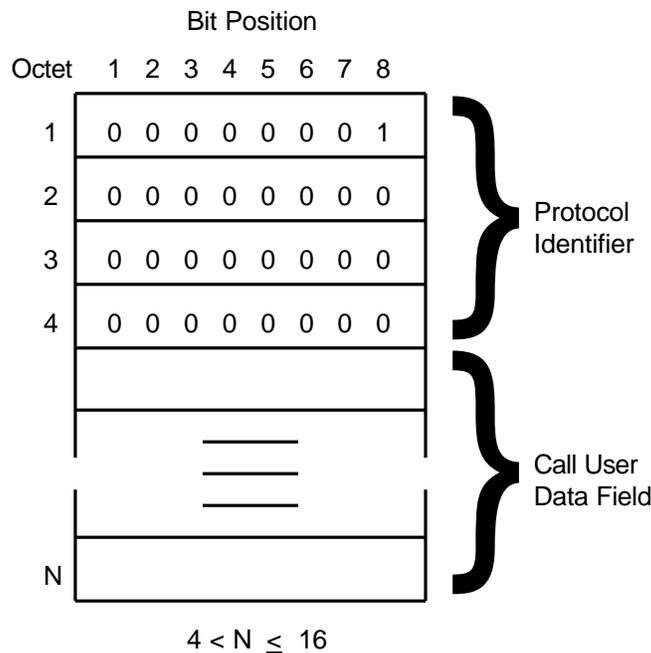


Figure 6-11
Format for the X.28 Protocol Identifier

6.10.2 Mode Signaling

US WEST does not currently offer Mode Signaling between the PAD and the Host. The information contained in the following paragraphs describes how Mode Signaling may work if and when it is supported in the future.

A T3POS PAD must be able to inform the ISP/CCA host of the mode in which it is operating; conversely, a host must be able to inform the PAD of the mode in which it is operating. There are two locations in which the PAD may support the Mode Selection facility request signal:

- the User Data field of a data packet (mandatory) or
- the Call User Data field of a call request packet (optional).

With the User Data field approach, the first data packet is used to transmit the Mode Selection signal. When the VC is terminal initiated and a frame arrives from a POS terminal in the Control frame format, the PAD maps the Mode Selection signal into the User Data field of the first data packet that is forwarded. Correspondingly, when the VC is host initiated and the first data packet arrives from the host, the PAD will be able to identify the Mode Selection signal of an opening frame in the User Data field.

Mode signaling may optionally be performed using the Call User Data field of the X.25 call request packet. When a VC is initiated from either the host or the PAD, the called party may optionally be informed of the T3POS mode selected by using the Call User Data (CUD) field of a call request packet. If the CUD field is used as the signaling mechanism, the Mode Selection signal need not be present in the Control field of an opening frame. The PAD transmits and recognizes the Mode Selection signal in the fifth octet of the Call User Data field, immediately following the Protocol Identifier (octets 1 to 4). If no Mode Selection signal is present in an opening frame from the terminal or in the CUD field from the host, the PAD will use its default mode setting for mode signaling. When the Mode Selection signal is obtained from the Control field of an opening frame (whether from the terminal or the host), the PAD will adjust its operation accordingly. If no Control field is present in the opening frame, the PAD will operate in its default mode (i.e., the PAD will use the call setup information provided at subscription time).

6.10.3 ENQ Character Support

The DIGIPAC T3POS PAD supports two options for the ENQ character. With option 1, the PAD waits for receipt of an ENQ from the host system prior to transmitting the opening frame. This option makes use of the ENQ timer (T3 -- will be set to a value of 1.5 seconds for this option), which transfers the PAD into the Data Transfer state if no ENQ is received within the T3 time period. With option 2, the PAD immediately transitions to the Data Transfer state upon receipt of a call connected packet from the host system without waiting for an ENQ character.

6.11 X.3 Parameter Profile for Point-of-Sale (POS) (Not Supported)

For interfaces with POS terminal equipment, there is a set of defined values of X.3 PAD parameters known as the POS Standard Profile. This profile may be assigned to the POS terminal PAD interface at subscription time. With the exception of parameters 4, 11 and 21, the value of all X.3 parameters that make up the POS Standard Profile will be set to zero. In all modes, the value of parameter 4 will be set to 1 at subscription time. In all modes, the value of parameter 11 (line speed) will be set appropriately at subscription time. In Local mode, the value of parameter 21 will be set to 3. In Transparent and Blind (not offered) modes, the value of parameter 21 will be set to zero. DIGIPAC does not support this profile because in the current implementations all X.3 parameters are ignored or implied based on line configuration.

Table 6-D
 DIGIPAC T3POS Default Parameter Settings

PARAMETER		DEFAULT SETTING	
Mode of Operation		Local	
Link Speed		2400 bit/s	
Packet Size		256 Octets	
ENQ Limit		3	
NAK Limit		3	
Timers	T1	.05 Seconds	
	T2	4 Seconds	
	T3	0 Seconds	No ENQ
		1.5 Seconds	Wait for ENQ
	T4	4 Seconds	
	T5	4 Seconds	
	T6	2.5 Minutes	
Wait for ENQ from HOST		No	
Direct Call		On	

¹The name T3POS is a pseudo-acronym derived from the term Transaction Processing Protocol for Point-Of-Sale.

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7. U S WEST DIGIPAC® Network Features

7.1 Network Features

Please reference the following Table 7-A

KEY: S - Supported; NS - Not Supported; NA - Not Applicable

Table 7-A
Network Features (Page 1 of 2)

FEATURE	ASYNCHRONOUS	X.25	X.75
Extended Packet Sequence Numbering Modulo 128	NA	S	S
Nonstandard Default Window Sizes	NA	S	S
Default throughput Classes Assignment	S	S	NA
Incoming Calls Barred	S	S	S
Outgoing Calls Barred	S	S	S
One-way Logical Channel Outgoing	S	S	NA
One-way Logical Channel Incoming	S	S	NA
Closed User Group	S	S	S
CUG with Outgoing Access	S	S	S
CUG with Incoming Access	S	S	NA
Incoming Calls Barred Within a CUG	S	S	NA
Outgoing Calls Barred Within a CUG	S	S	NA
Reverse Charging	S	S	S
Reverse Charging Acceptance	S	S	S
RPOA Selection	S	S	S
Nonstandard Default Packet Sizes	S	S	S
Multiple Circuits to the same DTE	NA	S	NA
Flow Control Parameter Negotiation	S	S	S
Throughput Class Negotiation	S	S	S
Fast Select	S	S	S
Fast Select Acceptance	S	S	NA
Closed User Group Selection	S	S	S
Local Charging Prevention	S	S	NA
Network User Identification	S	S	NS
Charging Information	S	S	NA
Multi-Line Hunt Group	S	S	NA
Call Redirection	S	S	NA
Call Line Address Modification Notification	S	S	NS
Call Redirection Notification	S	S	NA
Direct Call	S	NA	NA
Packet Retransmission	NS	NS	NS
Bilateral Closed User Group	NS	NS	NS

Table 7-A
Network Features (Page 2 of 2)

FEATURE	ASYNCHRONOUS	X.25	X.75
Window Size Indication	NA	NA	S
Utility Marker	NA	NA	S
Bilateral CUG with Outgoing Access	NS	NS	NS
On-line Facility Registration	NS	NS	NS
Multiple Trunks with the Same Address	S	S	S
Abbreviated Address Calling	S	NA	NA
Setting Values of PAD Parameters	S	NA	NA
Reading Values of PAD Parameters	S	NA	NA
Automatic Detection of: Data Rate Code and Operational Characteristics	S	NA	NA
PAD Recall	S	NA	NA
Echo	S	NA	NA
Selection of Data Forwarding Signal	S	NA	NA
Selection of Idle Time Delay	S	NA	NA
Ancillary Device Control	S	NA	NA
Suppression of PAD Service Signals	S	NA	NA
Selection of Operation of PAD on Receipt of Break	S	NA	NA
Discard Output	S	NA	NA
Padding After Carriage Return	S	NA	NA
Line Folding	S	NA	NA
Binary Speed (Read Only)	S	NA	NA
Flow Control of PAD by Start-Stop Mode DTE	S	NA	NA
Linefeed Insertion	S	NA	NA
Linefeed Padding	S	NA	NA
Editing Functions	S	NA	NA
Parity Functions	S	NA	NA
Standard Profile Selections	S	S	NA
Permanent Virtual Circuits	S	S	S
D-bit Modification	NS	NS	NS
Transmit Delay Selection and Notification	NS	NS	NS
Bilateral CUG Selection	NS	NS	NS
Transit Network Identification	NA	NA	S
Call Identifier	NA	NA	S

Note: Network features supported may change with updated tariff filings.

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8. U S WEST DIGIPAC® Physical Interface

8.1 Overview

This Chapter describes the physical interface with the DIGIPAC® Network. Descriptions for the Line, Modem, Data Service Unit (DSU) and DIGIPAC® Network port are addressed. In this document, Modem is used generically to identify either an analog data Modem or a digital data DSU. Modems attached to the DIGIPAC® Network must be compatible with the description shown for each type of service. If not compatible, the customer provided modem will not be able to communicate with the associated DIGIPAC® modem located in the Central Office (CO).

Tables 8-A through 8-L specify the options for the modem types required to accommodate the available DIGIPAC® services. These tables provide a description of each selected option and whether the option is required or recommended for the customer. The options are intended to be generic to a given modem. The customer provided modem may have different technology or text to describe each option; with fewer or more options than addressed. Tables 8-M through 8-O list compatible Network Channel (NC) and Network Channel Interface (NCI) code combinations to assist the customer with NC and NCI selections.

A glossary section is provided behind the GLOSSARY tab to assist the customer in understanding the terminology used in this section. Your U S WEST Communications, Inc. Marketing Representative may be contacted for assistance with questions and for further clarification.

8.2 Dial Access

DIGIPAC® supports dial access ports that provide a full duplex interface, from 300 to 9600 bps. Refer to Chapter 4 for available interfaces and protocols. DIGIPAC® Public dial access ports are configured as auto reverse charge.

The DIGIPAC® Network modem and customer provided modem use an autobaud procedure to detect and implement the channel data rate. The user initiates the session by entering a service request as specified in Chapter 2, paragraph 2.2.1 and Tables 2-B or 2-C; this enables the DIGIPAC® dial port autobaud detection.

After a disconnect in the physical level by either the user or the network, the network modem prevents subsequent connections to dial port until after the user's session is cleared. This requirement prevents another user from being connected to this port and thus, being connected to the previous session.

8.3 Direct Access

DIGIPAC® supports direct access ports that provide a full duplex interface, from 1200 to 56000 bps. Refer to Chapter 4 for available interfaces and protocols. Modem transmission interfaces for analog voice grade data channels are supported for 1200 bps, 2400 bps, 4800 bps and 9600 bps. Modem transmission interfaces for digital data channels are supported for 2400 bps, 4800 bps, 9600 bps and 56000 bps.

8.4 Physical Interface Description

8.4.1 Dial Access - Asynchronous Analog

- Dial Access - Asynchronous - 300/1200 bps

Line: 2-Wire; Business/Residence; 1 party

Modem: 212A compatible; Full duplex operation

Interface specifications and operation in accordance with United States Telephone Association (USTA) document TA20, "Compatibility Criteria for Data Set 212A", September 1977.

See Table 8-A for options

Port: EIA RS-232-C; recommended EIA-232-D

- Dial Access - Asynchronous - 2400/1200 bps

Line: 2-Wire; Business/Residence; 1 party

Modem: CCITT V.22 bis/212A compatible; Full duplex operation

Interface specifications and operation in accordance with CCITT Recommendation V.22 bis - 1988 "2400 Bits Per Second Duplex Modem Using The Frequency Division Technique Standardized For Use On The General Switched Telephone Network and On Point-To-Point 2-Wire Leased Telephone-Type Circuits".

Optional CCITT V.42 error correction for 2400 bps

Error correction procedures in compliance with CCITT Recommendation V.42 - 1988 "Error Correction Procedures For Using Asynchronous To Synchronous Conversion" specifications for LAP-M and MNP® 4.

See Table 8-B for options

Port: EIA RS-232-C; recommended EIA-232-D

- Dial Access - Asynchronous - 9600 bps

Line: 2-Wire; Business/Residence; 1 party

Modem: CCITT V.32 compatible using Trellis Coded Modulation scheme

Interface specifications and operation in accordance with CCITT Recommendation V.32 - 1988 "A Family Of 2-Wire Modems Operating At Data Signaling Rates Of Up To 9600 bit/s For Use On The General Switched Telephone Network And On Leased Telephone-Type Circuits".

Optional CCITT V.42 error correction

Error correction procedures in compliance with CCITT Recommendation V.42 - 1988 "Error Correction Procedures For DCEs Using Asynchronous To Synchronous Conversion" specifications for LAP-M and MNP® 4.

See Table 8-C for options

Port: EIA RS-232-D; (CCITT V.24/V.28/V.54)

8.4.2 Dial Access - Synchronous Analog

- Dial Access - Synchronous - 9600 bps

Line: 2-Wire; Business/Residence; 1 party

Modem: CCITT V.32 compatible using Trellis Coded Modulation scheme

Interface specifications and operation in accordance with CCITT Recommendation V.32 - 1988 "A Family Of 2-Wire Modems Operating At Data Signaling Rates Of Up To 9600 bit/s For Use On The General Switched Telephone Network And One Leased Telephone-Type Circuits".

See Table 8-D for options

Port: EIA RS-232-D; (CCITT V.24/V.28/V.54)

8.4.3 Direct Access - Asynchronous Analog

- Direct Access - Asynchronous - 2400/1200 bps

Line: 2-Wire; Two-point voice grade data channel

Modem: CCITT V.22 bis/212A compatible; Full duplex operation

Interface specifications and operation in accordance with CCITT Recommendation V.22 bis - 1988 "2400 Bits Per Second Duplex Modem Using The Frequency Division Technique Standardized For Use On The Leased Telephone-Type Circuits"

Optional CCITT V.42 error correction for 2400 bps

Error correction procedures in compliance with CCITT Recommendation V.42 - 1988 "Error Correction Procedures For Using Asynchronous to Synchronous Conversion" specification for LAP-M and MNP® 4

See Table 8-E for options

Port: EIA RS-232-C; recommended EIA-232-D

- Direct Access - Asynchronous - 1200 bps

Line: 4-Wire; Two-point voice grade data channel

Modem: 202T compatible; Full duplex operation

See Table 8-F for options

Port: EIA RS-232-C

8.4.4 Direct Access - Synchronous Analog

- Direct Access - Synchronous - 2400 bps
 - Line: 4-Wire; Two-point voice grade data channel
 - Modem: 201C compatible; Full duplex operation
See Table 8-G for options
 - Port: EIA RS-232-C; recommended EIA-232-D
- Direct Access - Synchronous - 4800 bps
 - Line: 4-Wire; Two-point voice grade data channel
 - Modem: 208B compatible; Full duplex operation
See Table 8-H for options
 - Modem: CCITT V.27 bis compatible; Full duplex operation
Interface specifications and operation in accordance with CCITT Recommendation V.27 - 1988 " 4800 Bits Per Second Modem With Manual Equalizer Standardized For Use One Leased Telephone-Type Circuits".
See Table 8-H for options
 - Port: EIA RS-232-C; recommended EIA-232-D
- Direct Access - Synchronous - 9600 bps
 - Line: 2-Wire; Two-point voice grade data channel
 - Modem: CCITT V.32 compatible using Trellis Coded Modulation scheme
Interface specifications and operation in accordance with CCITT Recommendation V.32 - 1988 "A Family of 2-Wire Modems Operating At Data Signaling Rates Of Up To 9600 bit/s For Use One The General Switched Telephone Network And On Leased Telephone - Type Circuits"
See Table 8-I for options
 - Port: EIA RS-232-D; (CCITT V.24/V.28/V.54)
- Direct Access - Synchronous - 9600 bps
 - Line: 4-Wire; Two-point voice grade data channel
 - Modem: CCITT V.29 compatible; full duplex operation
Interface specifications and operation in accordance with CCITT Recommendation V.29 - 1988 "9600 Bits Per Second Modem For Use On Point-To-Point 4-Wire Leased Telephone - Type Circuits"
See Table 8-J for options
 - Port: EIA RS-232-C; recommended EIA-232-D

8.4.5 Direct Access - Synchronous Digital

- Direct Access - Synchronous - 2400 bps, 4800 bps, 9600 bps

Line: 4-Wire; Dedicated digital channel

Modem: DSU/CSU compatible

Interface specifications and operation in accordance with Pre-divestiture PUB 41021 "Digital Data System - Channel Interface Specifications", March 1973, with Addendum, October 1981; and AT&T PUB 62310, "Digital Data System Channel Interface Specification", September 1983.

See Table 8-K for options

Port: EIA RS-232-C; recommended EIA-232-D

- Direct Access - Synchronous - 56000 bps

Line: 4-Wire; Dedicated digital channel

Modem: DSU/CSU compatible

Interface specifications and operation in accordance with Pre-divestiture PUB 41021 "Digital Data System - Channel Interface Specifications", March 1973, with Addendum, October 1981; and AT&T PUB 62310, "Digital Data System Channel Interface Specification", September 1983.

See Table 8-L for options

Port: CCITT V.35 WITH V.54 recommended

Table 8-A
Dial Access - Asynchronous - 300/1200 bps
212A Compatible - (2-Wire)
(Page 1 of 2)

REQUIRED MODEM OPTIONS (DIGIPAC® and CUSTOMER)	
1.	Switched network operation.
2.	Communication protocol: 212A recommendations for 1200 bps operation.
3.	Asynchronous operation.
4.	Data rate: 1200 bps/300 bps (Dual/Autobaud operation).
5.	Character length: 10 bits per character including start and stop bits.
6.	Transmit signal level: -9.0 dBm (Permissive).
7.	Line impedance: 600 ohms.
8.	Controlled transmit carrier; dependent on the ON and OFF transition of DTE interface signal Request To Send.
9.	Received Line Signal Detector (CF) functions normally, that is, turns on and off in response to the on and off transition of received carrier.
10.	Data Terminal Ready (CD) is transitive. An OFF transition causes the modem to disconnect the data connection (go on-hook) and disable auto answer.
11.	Loss of carrier disconnect, enabled. Modem will terminate data connection when loss of received carrier is detected for more than approximately 350 ms.
12.	DTE control of data rate via the CH lead (pin 23), disabled. Terminal cannot control modem data rate.
13.	Send space disconnect, enabled. Transmits approximately 4 seconds of spaces at end of call to disconnect remote modem.
14.	Receive space disconnect, enabled. Modem disconnects upon receiving approximately 1.6 seconds of space signal from remote modem.

Table 8-A
Dial Access - Asynchronous - 300/1200 bps
212A Compatible - (2-Wire)
(Page 2 of 2)

DIGIPAC® MODEM OPTIONS	
1.	Clear To Send lead (CB) forced OFF when Received Line Signal Detector (CF) goes OFF. CB lead is common to CF lead.
2.	Ring indicator lead (CE), pin 22, is on during ringing only.
3.	Automatic answering, enabled. Calls are answered by modem.
4.	Operates as an Answer/Originate modem.
5.	Data rate indicator to DTE via the CI lead (pin 12), disabled. CI lead (pin 12) not a functional DIGIPAC® port interface lead.
6.	Data Set Ready (CC lead, pin 6) forced ON during Analog Loopback test, or continuously.
7.	DTE control of Analog Loopback via the LL lead, enabled and assigned to pin 18.
8.	Modem goes off-hook (busy) when an Analog Loopback test is invoked.
9.	DTE control of Remote Digital Loopback via pin 21, enabled.
10.	Enable modem's ability to respond to Remote Digital Loopback (RDL) signal from remote modem. The modem responds to a digital loopback signal generated by the far end modem.
11.	Test mode indication to DTE via the TM lead (pin 25), enabled.
12.	Signal quality abort, disabled. Modem does not disconnect and hang up when the received signal quality deteriorates.
13.	Frame and signal grounds separated by 100 ohms.

Table 8-B
Dial Access - Asynchronous - 2400/1200 bps
CCITT Recommendation V.22 bis/212A Compaatible - (2-Wire)
(Page 2 of 2)

DIGIPAC® MODEM OPTIONS	
1.	Clear To Send lead (CB) forced OFF when Received Line Signal Detector (CF) goes OFF. CB lead is common to CF lead.
2.	Ring indicator lead (CE), pin 22, is on during ringing only.
3.	Automatic answering, enabled. Calls are answered by modem.
4.	Operates an Answer/Originate modem.
5.	Data rate indicator to DTE via the CI lead (pin 12), disabled. CI lead (pin 12) not a functional DIGIPAC® port interface lead.
6.	Data Set Ready (CC lead, pin 6) forced ON during Analog Loopback test, or continuously.
7.	DTE control of Analog Loopback via the LL lead, enabled and assigned to pin 18.
8.	Modem goes off-hood (busy) when a Analog Loopback test is invoked.
9.	DTE control of Remote Digital Loopback via pin 21, enabled.
10.	Enable modem's ability to respond to Remote Digital Loopback (RDL) signal from remote modem. The modem responds to a digital loopback signal generated by the far end modem.
11.	Test mode indication to DTE via the TM lead (pin 25), enabled.
12.	Signal quality abort, disabled. Modem does not disconnect and hang up when the received signal quality deteriorates.
13.	Frame and signal grounds separated by 100 ohms.

Table 8-C
Dial Access - Asynchronous - 9600 bps
CCITT Recommendation V.32 Compatible - (2-Wire)
Using Trellis Coded Modulation
(Page 1 of 2)

Required Modem Options(Digipac® And Customer)	
1.	Communication Protocol Compatibility: Ccitt
2.	Switched Network Operation.
3.	Data Transmission: Asynchronous Operation.
4.	Trellis Coded Modulation, Enabled.
5.	Data Rate: 9600 Bps
6.	Character Length: 10 Bits Per Character Including Start And Stop Bits
7.	Transmit Signal Level: -9.0 dBm - Permissive.
8.	Constant Transmit Carrier. Carrier Stays On Independent Of Rts From The Dte.
9.	Line Independance: 600 Ohms.
10.	Send Space Disconnect,Enabled. Transmits 2 To 4 Seconds Of Spaces At End Of Call To Disconnect Remote Modem.
11.	Receive Space Disconnect, Enabled. Modem Disconnects Upon Receiving Approximately 2 Seconds Of Space Signal From Remote Modem.
12.	Loss Of Carrier Disconnect, Disabled. Modem Will Maintain Data Connection When Loss Of Received Carrier Is Detected.
13.	Optional Error Correction Procedures Per Ccitt Recommendation V.42, Enabled According To Service Requested.

Table 8-C
Dial Access - Asynchronous - 9600 bps
CCITT RRecommendation V.32 Compatible - (2-Wire)
Using Trellis Coded Modulation
(Page 2 of 2)

DIGIPAC® MODEM OPTIONS	
1.	Dialing mode is Dual Tone Multiple Frequency (DTMF).
2.	Asynchronous overspeed/underspeed correction limit: 2.5%
3.	Request To Send (CA/105) To Clear To Send (CB/106) delay: within 2 ms.
4.	Received Line Signal Detector, circuit CF/109 (pin 8) turns OFF and ON in response to the OFF and ON transitions of received carrier, not forced ON.
5.	Data Terminal Ready (CD) is transitive. An OFF transition causes the modem to terminate the connection (go on-hook), then return to the command mode.
6.	DTE control of data rate via circuit CH/111 (pin 23), disabled. Terminal cannot control modem data rate.
7.	Ring indicator circuit CE/125 (pin 22), is on during ringing only.
8.	Automatic answering, enabled. Modem automatically answers calls and switches to data mode.
9.	Data Set Ready (circuit CC/107) normal, indicates when modem is ready to exchange control signals with the DTE to initiate transfer of data.
10.	Data Set Ready (circuit CC/107) forced ON during Analog Loopback test.
11.	DTE control of Analog Loopback via circuit LL/141, enabled and assigned to pin 18.
12.	Modem goes off-hook (busy) when an Analog Loopback test is invoked.
13.	DTE control of Remote Digital Loopback via circuit RL/140 (pin 21), enabled.
14.	Enable modem's ability to respond to Remote Digital Loopback (RDL) signal from remote modem. The modem responds to a digital loopback signal generated by the far end modem.
15.	Test mode indication to DTE via circuit TM/142, (pin 25), enabled.
16.	Signal quality abort, enabled. Modem will initiate retrain procedures upon detection of unsatisfactory signal reception or loss or equalization.
17.	Frame and signal grounds separated by 100 ohms.

Table 8-D
Dial Access - Synchronous - 9600 bps
CCITT Recommendation V.32 Compatible - (2-Wire)
Using Trellis Coded Modulation
(Page 1 of 2)

REQUIRED MODEM OPTIONS (DIGIPAC® and CUSTOMER)	
1.	Communication protocol compatibility: CCITT
2.	Switched network operation.
3.	Data transmission: Synchronous operation.
4.	Trellis Coded Modulation, enabled.
5.	Data rate: 9600 bps.
6.	Transmitter timing source: Modem clock (INTERNAL)
7.	Transmit signal level: -9.0 dBm - Permissive.
8.	Constant transmit carrier. Carrier stays on independent of RTS from the DTE.
9.	Line impedance: 600 ohms.
10.	Send space disconnect, enabled. Transmits 2 to 4 seconds of spaces at end of call to disconnect remote modem.
11.	Receive space disconnect, enabled. Modem disconnects upon receiving approximately 2 seconds of space signal from remote modem.
12.	Loss of carrier disconnect, disabled. Modem will maintain data connection when loss of received carrier is detected.

Table 8-D
Dial Access - Synchronous - 9600 bps
CCITT Recommendation V.32 Compatible - (2-Wire)
Using Trellis Coded Modulation
(Page 2 of 2)

DIGIPAC® MODEM OPTIONS	
1.	Dialing mode is Dual Tone Multiple Frequency (DTMF).
2.	Request To Sent (CA/105) To Clear To Send (CB/106) delay: within 2 ms.
3.	Received Line Signal Detector, circuit CF/109 (pin 8) turns OFF and ON in response to the OFF and ON transitions or received carrier, not forced ON.
4.	Data Terminal Ready (CD) is transitive. An OFF transition causes the modem to terminate the connection (go on-hook), then return to the command mode.
5.	DTE control of data rate via circuit CH/111 (pin 23), disabled. Terminal cannot control modem data rate.
6.	Ring indicator circuit CE/125 (pin 22), is on during ringing only.
7.	Automatic answering, enabled. Modem automatically answers calls and switches to data mode.
8.	Data Set Ready (circuit CC/107) normal, indicates when modem is ready to exchange control signals with the DTE to initiate transfer of data.
9.	Data Set Ready (circuit CC/107) forced ON during Analog Loopback test.
10.	DTE control of Analog Loopback via circuit LL/141, enabled and assigned to pin 18.
11.	Modem goes off-hook (busy) when an Analog Loopback test is invoked.
12.	DTE control of Remote Digital Loopback via circuit RL/140 (pin 21), enabled.
13.	Enable modem's ability to respond to Remote Digital Loopback (RDL) signal from remote modem. The modem responds to a digital loopback signal generated by the far end modem.
14.	Test mode indication to DTE via circuit TM/142, (pin 25), enabled.
15.	Signal quality abort, enabled. Modem will initiate retrain procedures upon detection of unsatisfactory signal reception or loss of equalization.
16.	Frame and signal grounds separated by 100 ohms.

Table 8-E
 Direct Access - Asynchronous - 2400/1200 bps
 CCITT Recommendation V.22 bis/212A Compatible - (2-Wire)
 (Page 1 of 2)

REQUIRED MODEM OPTIONS (DIGIPAC® and CUSTOMER)	
1.	Communication protocol compatibility: CCITT for 2400 bps 212A for 1200 bps
2.	Private Line operation
3.	Asynchronous operation.
4.	Data rate: 1200 or 2400 bps; autobaud operation.
5.	Character length: 10 bits per character including start and stop bits.
6.	Transmit signal level: -12.0 dBm. May require option: Programmable.
7.	Line impedance: 600 ohms.
8.	Constant transmit carrier - Private Line operation.
9.	Received Line Signal Detector (CF) functions normally, that is, turns on and off in response to the on and off transition of received carrier.
10.	Private Line handshake mode: CUSTOMER = Originate DIGIPAC® = Terminate
11.	Loss of carrier disconnect, enabled. Modem will terminate data connection when loss of received carrier is detected for more than approximately 350 ms.
12.	DTE control of data rate via the CH lead (pin 23), disabled. Terminal cannot control modem data rate.
13.	Send space disconnect, enabled. Transmits approximately 4 seconds of spaces at end of call to disconnect remote modem.
14.	Receive space disconnect, enabled. Modem disconnects upon receiving approximately 1.6 seconds of space signal from remote modem.
15.	Optional Error Correction Procedures per CCITT Recommendation V.42, enabled according to service requested.

Table 8-E
Direct Access - Asynchronous - 2400/1200 bps
CCITT Recommendation V.22 bis/212A Compatible - (2-Wire)
(Page 2 of 2)

DIGIPAC® MODEM OPTIONS	
1.	Clear To Send lead (CB) forced OFF when Received Line Signal Detector (CF) goes OFF. CB lead is common to CF lead.
2.	Automatic answering, enabled. Calls are answered by modem.
3.	Data rate indicator to DTE via the CI lead (pin 12), disabled. CI lead (pin 12) not a functional DIGIPAC® port interface lead.
4.	Data Set Ready (CC lead, pin 6) forced ON during Analog Loopback test, or continuously.
5.	Data Terminal Ready (CD lead, pin 20) forced ON continuously.
6.	DTE control of Analog Loopback via the LL lead, enabled and assigned to pin 18.
7.	Modem goes off-hook (busy) when an Analog Loopback test is invoked.
8.	DTE control of Remote Digital Loopback via (pin 21), enabled.
9.	Enable modem's ability to respond to Remote Digital Loopback (RDL) signal from remote modem. The modem responds to a digital loopback signal generated by the far end modem.
10.	Test mode indication to DTE via TM lead (pin 25), enabled.
11.	Signal quality abort, disabled. Modem does not disconnect when the received signal quality deteriorates.
12.	Frame and signal grounds separated by 100 ohms.

Table 8-F
 Direct Access - Asynchronous - 1200 bps
 202T Compatible - (4-Wire)
 (Page 1 of 2)

REQUIRED MODEM OPTIONS (DIGIPAC® and CUSTOMER)	
1.	4-Wire Private Line operation.
2.	Constant transmit carrier - PL operation.
3.	Transmit signal level: CUSTOMER = 0.0 dBm DIGIPAC® = - 8.0 dBm
4.	Line impedance: 600 ohms.
5.	Received Line Signal Detector (CF lead) turn-ON and turn-OFF Time constant: Acquisition time (turn-on) interval: 7 ms. Release time (turn-off) interval: 5 ms.
6.	Carrier detect threshold: Low (-30 to -33 dBm).
7.	Soft carrier Turn-OFF interval: 8 ms.
8.	Receive data squelch interval: 0 ms or OUT.
9.	Mark/Space transmit frequencies: 1200 Hz/2200 Hz.
10.	Receive data (BB lead) is clamped to a MARK when the Received Line Signal Detector (CF lead) is OFF.
11.	Request to Send normal; controlled by DTE (CA lead, pin 4).
12.	Request to Send (CA) to Clear To Send (CB) delay; 8 ms.
13.	DTE fast carrier detector (CF) reset via pin 25, disabled. Not the function of DIGIPAC® port interface lead.
14.	External control of Data Set Ready (CC) lead, pin 6, by the Data Station Terminating Equipment, disabled.
15.	Amplitude and delay compromise equalizers, disabled.

Table 8-F
Direct Access - Asynchronous - 1200 bps
202T Compatible - (4-Wire)
(Page 2 of 2)

DIGIPAC® MODEM OPTIONS	
1.	Clear To Send lead (CB) forced OFF when Received Line Signal Detector (CF) goes OFF. CB lead is common to CF lead.
2.	Data Set Ready (CC lead, pin 6) forced ON during Analog Loopback test or continuously.
3.	Anti-streaming/Anti-streaming timer, disabled. Normally disable on two point private line circuits.
4.	DTE control of Analog Loopback via the LL lead, enabled and assigned to pin 18.
5.	DTE control of Remote Digital Loopback via pin 21, enabled.
6.	Enable modem's ability to respond to Remote Digital Loopback (RDL) signal from remote modem. The modem responds to a digital loopback signal generated by from the far end modem.
7.	Frame and signal grounds separated by 100 ohms.

Table 8-G
Direct Access - Synchronous- 2400 bps
201C Compatible - (4-Wire)
(Page 1 of 2)

REQUIRED MODEM OPTIONS (DIGIPAC® and CUSTOMER)	
1.	4-Wire Private Line Operation
2.	Synchronous operation.
3.	Constant transmit operation, - PL operation
4.	Data rate: 2400 bps.
5.	Transmit signal level: CUSTOMER = 0.0 dBm DIGIPAC® = -8.0 dBm
6.	Line impedance: 600 ohms.
7.	Transmitter timing source: Modem clock (INTERNAL).
8.	Scrambler/descrambler feature, disabled.
9.	Recovered clock New Sync, disabled.
10.	External control of Data Set Ready (CC) lead, pin 6, by the Data Station Terminating Equipment, disabled.
11.	DTE control of data rate via the CH lead (pin 23), disabled. Terminal cannot control modem data rate.
12.	Amplitude and delay compromise equalizers, disabled.

Table 8-G
Direct Access - Synchronous- 2400 bps
201C Compatible - (4-Wire)
(Page 2 of 2)

DIGIPAC® MODEM OPTIONS	
1.	Carrier detect sensitivity: Acquisition = -24 dBm Release = -29 dBm.
2.	Request to Send (CA/pin 4) to Clear To Send (CB/pin 5) delay: 0 ms.
3.	Signal Quality alarm to DTE (via pin 21), disabled. Not a function of the DIGIPAC® port interface lead.
4.	Signal Quality monitor inhibit Carrier Detect (CF lead), disabled. Signal Quality monitor circuit may not inhibit Carrier Detect (force CF lead OFF).
5.	Anti-streaming/Anti-streaming timer, disabled. Normally disable on two point private line circuits.
6.	Receive signal element clock lead DD (pin 17) clamped ON when Received Line Signal Detector (CF) is OFF.
7.	Receiver is enabled when Request To Send (CA lead) is ON. Modem may receive and transmit data simultaneously; full-duplex operation.
8.	Data Terminal Ready (CD lead, pin 20) forced ON continuously.
9.	Data Set Ready (CC) lead forced ON during Analog Loopback test.
10.	Data Set Ready (CC) lead forced ON during Self-Test, Remote Terminal test and Remote Digital Loopback.
11.	DTE control of Analog Loopback via pin 25, disabled. Analog Loopback assigned to pin 18.
12.	DTE control of Analog Loop back via the LL lead, enabled and assigned to pin 18.
13.	Analog Bilateral Loopback; enabled. Analog and Voice Frequency Loopback occur when an Analog Loopback is invoked.
14.	Enable modem's ability to respond to Remote Digital Loopback (RDL) signal from remote modem.
15.	DTE control of Remote Digital Loopback via pin 21, enabled.
16.	Frame and signal grounds separated by 100 ohms.

Table 8-H
Direct Access - Synchronous - 4800 bps
CCITT Recommendation V.27 OR 208B Compatible - (4-Wire)
(Page 2 of 2)

DIGIPAC® MODEM OPTIONS	
1.	Request to Send normal; controlled by DTE (CA lead, pin 4).
2.	Request To Send (CA/pin 4) to Clear To send (CB/pin 5) delay: 8ms.
3.	Signal Quality alarm to DTE (via pin 21), disabled. Not a function of the DIGIPAC® port interface lead.
4.	Train-On-Data, enabled. When receiver loses equalization, normally due to deteriorated signal quality, the receiver adaptive equalizer will attempt to retrain on incoming data.
5.	Receive signal element clock lead DD (pin 17) state not dependent on Carrier Detect state. Receive clock output not clamped ON when Received Line Signal Detector (CF) is off.
6.	Anti-streaming/Anti-streaming timer, disabled. Normally disable on two point private line circuits.
7.	One-second adaptive equalizer and carrier detect holdover during receive carrier breaks. Modem receiver and equalizer will override receive line signal breaks on one second or less.
8.	Data Set Ready (CC) lead forced ON during Analog Loopback test.
9.	Data Set Ready (CC) lead (pin 6) state, independent of Data Terminal Ready (CD) lead state (pin 20).
10.	Errors are not injected into the transmitted test pattern during Self-Test.
11.	DTE control of Analog Loopback via the LL lead, enabled and assigned to pin 18.
12.	Analog Bilateral Loopback; enabled. Analog and Voice Frequency Loopback occur when an Analog Loopback is invoked.
13.	Enable modem's ability to respond to Remote Digital Loopback (RDL) signal from remote modem. The modem responds to a digital loopback signal generated by the far end modem.
14.	DTE control of Remote Digital Loopback via pin 21, enabled.
15.	Frame and signal grounds separated by 100 ohms.

Table 8-I
Direct Access - Synchronous - 9600 bps
CCITT Recommendation V.32 Compatible - (2-Wire)
Using Trellis Coded Modulation
(Page 1 of 2)

REQUIRED MODEM OPTIONS DIGIPAC® and CUSTOMER	
1.	Communication protocol compatibility: CCITT
2.	Private line operation.
3.	2-Wire facility operation.
4.	Data transmission: Synchronous operation.
5.	Trellis Coded Modulation, enabled.
6.	Data rate: 9600 bps.
7.	Transmitter timing source: CUSTOMER = Modem receive (SLAVE) DIGIPAC® = Modem clock (INTERNAL)
8.	Transmit signal level: -12.0 dBm
9.	Constant transmit carrier. Carrier stays on independent of RTS from the DTE.
10.	Line impedance: 600 ohms.
11.	Private line handshake mode: CUSTOMER = Originate DIGIPAC® = Terminate
12.	Loss of carrier disconnect, disabled. Modem will maintain data connection when loss of received carrier is detected.

Table 8-I
Direct Access - Synchronous - 9600 bps
CCITT Recommendation V.32 Compatible - (2-Wire)
Using Trellis Coded Modulation
(Page 2 of 2)

DIGIPAC® MODEM OPTIONS	
1.	Automatic answering enabled. Modem automatically answers calls and switches to data mode.
2.	Send space disconnect, enabled. Transmits 2 to 4 seconds of spaces at end of call to disconnect remote modem.
3.	Receive space disconnect, enabled. Modem disconnects upon receiving approximately 2 seconds of space signal from remote modem.
4.	Request to Send (CA/105) To Clear To Send (CB/106) delay: within 2 ms.
5.	Receive Line Signal Detector, circuit CF/109 (pin 8) turns OFF and ON in response to the OFF and ON transitions of received carrier, not forced ON.
6.	Data Terminal Ready (CD) is transitive. An OFF transition causes the modem to terminate the connection (go on-hook), then return to the command mode.
7.	DTE control of data rate via circuit CH/111 (pin 23), disabled. Terminal cannot control modem data rate.
8.	Data Set Ready (circuit CC/107) normal, indicates when modem is ready to exchange control signals with the DTE to initiate transfer of data.
9.	Data Set Ready (circuit CC/107) forced ON during Analog Loopback test.
10.	DTE control of Analog Loopback via circuit LL/141, enabled and assigned to pin 18.
11.	Modem goes off-hook (busy) when an Analog Loopback test is invoked.
12.	DTE control of Remote Digital Loopback via circuit RL/140 (pin 21), enabled.
13.	Enable modem's ability to respond to Remote Digital Loopback (RDL) signal from remote modem. The modem responds to a digital loopback signal generated by the far end modem.
14.	Test mode indication to DTE via circuit TM/142, (pin 25), enabled.
15.	Signal quality abort, enabled. Modem will initiate retrain procedures upon detection of unsatisfactory signal reception or loss of equalization.
16.	Frame and signal grounds separated by 100 ohms.

Table 8-J
Direct Access - Synchronous - 9600 bps
CCITT REcommendation V.29 Compatible - (4-Wire)
(Page 2 of 2)

DIGIPAC® MODEM OPTIONS	
1.	Request to Send (CA/pin 4) to Clear To Send (CB/pin 5) delay: 15 ms.
2.	Signal Quality alarm to DTE (via pin 21), disabled. Not a function of the DIGIPAC® port interface lead.
3.	Train-On-Data. enabled. When receiver loses equalization, normally due to deteriorated signal quality, the receiver adaptive equalizer will attempt to retrain on incoming data.
4.	Anti-streaming/Anti-streaming timer, disabled. Normally disable on two point private line circuits.
5.	One-second adaptive equalizer and carrier detect holdover during receive carrier breaks. Modem receiver and equalizer will override receive line signal breaks of one second or less.
6.	Data Set Ready (CC) lead forced ON during Analog Loopback test.
7.	Analog Bilateral Loopback; enabled. Analog and Voice Frequency Loopback occur when an Analog Loopback is invoked.
8.	Digital Bilateral Loopback; enabled. A digital loopback occurs towards the facility and DTE when a Digital Loopback is invoked.
9.	Errors are not injected into the transmitted test pattern during Self-Test.
10.	DTE control of Analog Loopback via the LL lead (pin 18), enabled. A V.54 function that allows an Analog Loopback test to be performed remotely for fault isolation.
11.	Enable modem's ability to respond to Remote Digital Loopback (RDL) signal from remote modem. The modem responds to a digital loopback signal from the far end modem for fault isolation; a V.54 function.
12.	DTE control of Remote Digital Loopback via pin 21, enabled. A V.54 function that allows the remote modem to be placed into a digital loopback for fault isolation.
13.	Frame and signal grounds separated by 100 ohms.

Table 8-K
Direct Access - Synchronous - 2400/4800/9600 bps
Digital - CSU/DSU Compatible - (4-Wire)
(Page 1 of 2)

REQUIRED CSU/DSU OPTIONS (DIGIPAC® and CUSTOMER)	
1.	Data transmission: Synchronous operation.
2.	Data rate: 2400, 4800 or 9600 bps, according to service requested.
3.	Line impedance: 600 ohms.
4.	Transmitter timing source: CUSTOMER = Modem receive (SLAVE) DIGIPAC® = Modem clock (INTERNAL)
RECOMMENDED MODEM OPTIONS (CUSTOMER)	
1.	Enable modem's ability to respond to Remote Digital Loopback (RDL) signal from remote modem. The modem responds to a digital loopback signal from the far end modem for fault isolation; a V.54 function.

Table 8-K
Direct Access - Synchronous - 2400/4800/9600 bps
Digital - CSU/DSU Compatible - (4-Wire)
(Page 2 of 2)

DIGIPAC® MODEM OPTIONS	
1.	Request To Send circuit C/105 (pin 4) to Clear To Send, circuit CB/106 (pin 5) delay: 10 ms.
2.	System status, OFF. During reception of out-of-service code or no signal reception, Data Set Ready operate normally; not turned OFF.
3.	Circuit assurance, off. During reception of out-of service code or no signal reception (DCD Low), Clear-To-Send operate normally; not turned OFF.
4.	Test mode indication to DTE via circuit TM/142, (pin 25), enabled.
5.	DTE control of Remote Terminal Test via circuit CI/112 (pin 12), disabled. Circuit CI/112 (pin 12) not functional DIGIPAC® port interface lead.
6.	Data Set Ready circuit CC/107 (pin 6) forced ON during Analog Loopback test.
7.	Analog and Voice Frequency Loopback occur when an Analog Loopback is invoked. During Analog Loopback, the signal on the receive VF line will be looped back over the transmit VF line.
8.	DTE control of Analog Loopback via circuit LL/141 (pin 18), enabled. A V.54 function that allows an Analog Loopback test to be performed remotely for fault isolation.
9.	Enable modem's ability to respond to remote Digital Loopback (RDL) signal from remote modem. The modem responds to a digital loopback signal from the far end modem for fault isolation; a V.54 Function.
10.	DTE control of Remote Digital Loopback via circuit RL/140 (pin 21), enabled. A V.54 function that allows the remote modem to be placed into a digital loopback.
11.	Bilateral remote terminal testing, enabled. Remote Terminal test, bilateral digital loopback occurs (digital loopback occurs towards the facility and DTE).
12.	Frame and signal grounds separated by 100 ohms.

Table 8-L
 Direct Access - Synchronous - 56000 bps
 Digital - CSU/DSU Compatible - (4-Wire)
 (Page 1 of 2)

REQUIRED CSU/DSU OPTIONS (DIGIPAC® and CUSTOMER)	
1.	Data transmission: Synchronous operation.
2.	Data rate: 56000 bps.
3.	Line impedance: 600 ohms.
4.	Transmitter timing source: CUSTOMER = Modem receive (SLAVE) DIGIPAC® = Modem receive (SLAVE)
RECOMMENDED MODEM OPTIONS (CUSTOMER)	
1.	Enable modem's ability to respond to Remote Digital Loopback (RDL) signal from remote modem. The modem responds to a digital loopback signal from the far end modem for fault isolation; a V.54 function.

Table 8-L
Direct Access - Synchronous - 56000 bps
Digital - CSU/DSU Compatible - (4-Wire)
(Page 2 of 2)

DIGIPAC® MODEM OPTIONS	
1.	Request to Send circuit CA/105 (pin C) to Clear to Send, circuit CB106 (pin D) delay: 10 ms.
2.	System status, off. During reception of out-of-service code or no signal reception, Data Set Ready operate normally; not turned OFF.
3.	Circuit assurance, off. During reception of out-of service code or no signal reception (DCD low), Clear-To-Send operate normally; not turned OFF.
4.	Test mode indication to DTE via circuit TM/142, (pin K), enabled.
5.	Data Set Ready circuit CC/107 (pin E) forced ON during Analog Loopback test.
6.	Analog and Voice Frequency Loopback occur when an Analog Loopback is invoked. During Analog Loopback, the signal on the receive VF line will be looped back over the transmit VF line.
7.	DTE control of analog Loopback via circuit LL/141 (pin L), enabled. A V.54 function that allows an Analog Loopback test to be performed remotely for fault isolation.
8.	Enable modem's ability to respond to Remote Digital Loopback (RDL) signal from remote modem. The modem responds to a digital loopback signal from the far end modem for fault isolation; a V.54 function.
9.	DTE control of Remote Digital Loopback via circuit RL/140 (pin BB), enabled. A V.54 function that allows the remote modem to be placed into a digital loopback.
10.	Bilateral remote terminal testing, enabled. Remote Terminal test, bilateral digital loopback occurs (digital loopback occurs towards the facility and DTE).
11.	Frame and signal grounds separated by 100 ohms.

Table 8-M
 NC and NCI Code Combinations - Private Dial

SPEED (bps)	SERVICE	MODEM OPERATION	CHANNEL TYPE	NC CODE	NCI CODE CKL 1-PS	NCI CODE CKL 2-CS
2400	Async	CCITT V.22 bis	VG32	UC--	02DM.8PA.NW	O2LO3..SS
		CCITT V.22 bis & V.42	VG32	UC--	02DM.8PB.NW	O2LO3..SS
9600	Async	CCITT V.32	VG32	UC--	02DM.9PA.NW	O2LO3..SS
		CCITT V.22 & V.42	VG32	UC--	02DM.9PB.NW	O2LO3..SS
	Synch	CCITT V.22 bis	VG32	UC--	02DM.9PS.NW	O2LO3..SS

Table 8-N
 NC and NCI Code Combinations- Voice Grade Analog Channel

SPEED (bps)	SERVICE	MODEM OPERATION	NC CODE			NCI CODE CKL 1-PS	NCI CODE CKL 2-CS
			VG6	VG10	VG36		
1200	Async	212A	N/A	LN1-	UC--	02DM2.2P.PT	02DA..PX
		202T	LG--	LN1-	UC--	04DM2..3P.PX	04DA..PI
		202T	LG--	LN--	UC--	04DM2.3P.PX	DIGITAL**
2400	Async	CCITT V.22 bis	N/A	LN1-	UC--	02DM2.8PA.PT	02DA..PX
		CCITT V.22 bis	N/A	LN1-	UC--	02DM2.8PA.PT	DIDITAL**
	Synch	CCITT V.22 bis	N/A	LN1-	UC--	02DM2.8PS.PT	02DA2..PX
		CCITT V.22 bis	N/A	LN1-	UC--	02DM2.8PS.PT	DIGITAL**
		201C	LG--	LN1-	UC--	04DM2.4P.PX	04DA2..PI
201C	LG--	LN--	UC--	04DM2.4P.PX	DIGITAL**		
4800	Synch	208A	LG--	LN1-	UC--	04DM2.5P.PX	04DA2..PI
		208A	LG--	LN--	UC--	04DM2.5P.PX	DIGITAL**
		CCITT V.27	LG--	LN1-	UC--	04DM2.7P.PX	04DA2..PI
		CCITT V.27	LG--	LN--	UC--	04DM2.7P.PX	DIGITAL**
9600	Synch	CCITT V.32	N/A	LN1-	UC--	02DM2.9PS.PT	02DA2..PX
		CCITT V.32	N/A	LN1-	UC--	02DM2.9PS.PT	DIGITAL**
		CCITT V.29	LG--	LN1-	UC--	04DM2.6P.PX	04DA2..PI
		CCITT V.29	LG--	N/A	N/A	04DM2.6P.PX	04DB2..X
		CCITT V.29	LG--	LN--	UC--	04DM2.6P.PX	DIGITAL**

** "Digital" indicates a digital channel interface code.

See appropriate U S WEST Technical Publication for additional information on Digital Channel Interface Codes.

Table 8-O
NC and NCI Code Combinations - Digital Data Channel

SPEED (bps)	SERVICE	ACCESS PORT		NC CODE		NCI CODE CKL 1-PS	NCI CODE CKL 2-CS
		PSSP	PSN	ACCESS	NON-ACCESS		
2400	Synch	YES	YES	XA-P	US--	04DU5.24	04DU5.24
		YES	YES			04DU5.24	DIGITAL**
4800	Synch	YES	YES	XB-P	US--	04DU5.48	04DU5.48
		YES	YES			04DU5.48	DIGITAL**
9600	Synch	YES	YES	XG-P	US--	04DU5.96	04DU5.96
		YES	YES			04DU5.96	DIGITAL**
56000	Synch	NO	YES	XH-P	US--	04DU5.56	04DU5.56
		NO	YES			04DU5.56	DIGITAL**

** "Digital" indicates a digital channel interface code.

See appropriate U S WEST Technical Publication for additional information on Digital Channel Interface Codes.

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9. Definitions

9.1 Acronyms

AC	Access Concentrator
AMA	Automatic Message Accounting
ANSI	American National Standards Institute
ASCII	American Standard Code for Information Interchange
BCD	Binary Coded Decimal
BOC	Bell Operating Company
bps	Bits per Second
CCA	Credit Card Association (CCA)
CCITT	International Telegraph and Telephone Consultative Committee
CO	Central Office
CPE	Customer Provided Equipment
CSU	Channel Service Unit
CUD	Call User Data
CUG	Closed User Group
DCE	Data Circuit-Terminating Equipment
DDD	Direct Distance Dialing
DDS	Digital Data System
DISC	Disconnect
DM	Disconnect Mode
DNIC	Data Network Identification Code
DNPA	Data Numbering Plan Area
DOV	Data Over Voice
DSU	Data Service Unit
DSP	Display System Protocol
DTE	Data Terminal Equipment
DVM	Data/Voice Multiplexer
EIA	Electronic Industries Association
F	Final bit
FCS	Frame Checking Sequence
FRMR	Frame Reject
HDLC	High Level Data Link Control

I	Information
IA5	International Alphabet No. 5
IC	Interexchange Carrier
INIC	ISDN Network Identifier Code
ISDN	Integrated Services Digital Network
ISO	International Standards Organization
ISP	Information Service Provider
Kbps	Kilobits per second
LAPB	Link Access Procedure Balanced
LATA	Local Access and Transport Area
LC	Logical Channel
LCN	Logical Channel Number
LRC	Logical Channel Number
MLHG	Multi-line Hunt Group
MNP®	Microcom Networking Protocol
MTCE	Maintenance
NPA	Numbering Plan Area
N(R)	Receive Sequence Number
N(S)	Send Sequence Number
NTN	Network Terminal Number
NUI	Network User Identification
OOS	Out of Service
OSI	Open Systems Interconnection
OTC	Operating Telephone Company
P	Poll
PAD	Packet Assembler/Disassembler
PDN	Public Data Network
PHF	Packet Handler Function
POS	Point-Of-Sale
PPSN	Public Packet Switching Network
PPSNGR	Public Packet Switching Network Generic Requirement

PS	Packet Switch
PSDN	Packet Switched Data Network
PSPDN	Packet Switched Public Data Network
PSTN	Public Switched Telephone Network
PVC	Permanent Virtual Circuit
RC	Recent Change
RCVS	Recent Change and Verify Subsystem
REJ	Reject
RES	Reset
RNR	Receive Not Ready
RPOA	Recognized Private Operating Agency
RR	Receive Ready (packets or frames)
SABM	Set Asynchronous Balanced Mode
SABME	Set Asynchronous Balanced Mode Extended
STE	Signalling Terminal Equipment
SVC	Switched Virtual Calls
UA	Unnumbered Acknowledgment
USTA	United States Telephone Association
VC	Virtual Call
V(R)	Receive State Variable
V(S)	Send State Variable
XID	Exchange Identification

9.2 Glossary

Asynchronous Transmission

Data transmission in which the time of occurrence of a specified significant instant in each byte, character, word, block or other unit of data (usually the leading edge of a start signal) is arbitrary, and occurs without necessarily being dependent on preceding signals on the channel.

Baud

Denotes a unit of signaling speed. It is the reciprocal of the time duration in seconds of the shortest signal element (mark or space) within a code signal. The rates specified are the number of signal elements per second.

Bit

An abbreviation of binary digit; one of the members of a set of two in the binary numeration system, e.g., either of the digits 0 or 1. Also, a unit of information; one bit of information is sufficient to specify one of two equally like possibilities, usually meaning yes or no.

Bits Per Second (BPS)

Unit of data transmission rate (see baud).

Carrier Detect (DCD)

See Received Line Signal Detector.

Character

Letter, numeral, punctuation, control figure or any other symbol contained in a message.

Clear To Send (CTS)

An EIA-232 interface control signal that indicates to the DTE whether or not the modem is ready to transmit data.

Conditioning

Denotes an enhancement to the transmission performance of a voiceband channel. Parameter(s) affected are attenuation distortion, envelope delay, distortion and noise.

Consultative Committee International Telephone and Telegraph (CCITT)

An international association that sets international telecommunications standards.

Data Communications Equipment (DCE)

The equipment that provides the functions required to establish, maintain and terminate data transmission connection; e.g., a modem, as well as the signal conversion, and coding required for communications between data terminal equipment and data circuit.

Data Set Ready (DSR)

An EIA-232 interface control signal that indicates to the DTE the status of the local modem; e.g., modem is connected to communications channel and is not in the test or dial mode.

Data Terminal Equipment (DTE)

Customer owned equipment used to transmit and receive data.

Data Terminal Ready (DTR)

An EIA-232 interface control signal that indicates to the modem the DTE is ready to transmit or receive data.

Dial Access

Access to the packet switch is via the voice Public Switched Network.

Digital Service Unit (DSU)

A DCE device that converts EIA-232-D or CCITT V.35 signals (from the packet switch) to baseband bipolar line signals suitable for transmission over a telephone channel.

Direct Access

Access to the packet switch is via a dedicated channel between the End-User and the packet switch.

Full Duplex

Simultaneous transmission in both directions between two points.

Half Duplex

Data transmission in either direction, but not simultaneously.

Line

The transport facility (cable pair or carrier) between the Central Office and Network Channel Interface.

Link Access Procedure For Modems (LAP-M)

An error correction procedure defined in CCITT Recommendation V.42-1988.

Loopback

A test procedure that causes a received signal to be returned to the source.

Modem

A DCE device that converts EIA-232-D or CCITT V.35 signals (from the packet switch) to voiceband signals suitable for transmission over a telephone channel.

Port

An EIA-232 or CCITT V.35 I/O interface of a packet switch, computer or modem.

Received Line Signal Detector

An EIA-232 interface control signal that indicates to an attached DTE device that the modem is receiving a signal from a remote modem.

Request to Send (RTS)

An EIA-232 interface control signal that indicates the DTE has data to transmit and conditions the modem for data transmission.

Ring Indicator

An EIA-232 control interface signal which indicates to the DTE that a ringing signal is being received on the communications channel.

Start Bit

In asynchronous transmission, the first bit in each character, normally a space, which prepares the receiving equipment for the reception and registration of the character.

Stop Bit

In asynchronous transmission, the last bit, used to indicate the end of a character, normally a mark condition, which serves to return the line to its idle or rest state.

Switch Network

Data transmission and access to DIGIPAC® is via the voice Public Switched Network.

Synchronous Transmission

Transmission in which the occurrence of a specified event (e.g., byte, character, word, block or other unit of data, such as the leading edge of a start signal), occurs in a specified time relationship with a preceding signal in the channel, in accordance with a specified timing pulse, or in accordance with a specified time frame.

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10. References

10.1 American National Standards Institute

ANSI X3.4 Denotes the code character set to be used for the general interchange of information among information-processing systems, communications systems and associated equipment.

10.2 AT&T Publication

**PUB 62310 "Digital Data System Channel Interface Specification", September 1983.

10.3 Bellcore Publications

**TR-NPL-000011 "Asynchronous Terminal and Host Interface Specifications", Issue 1

**TR-TSY-000301 "Public Packet Switched Network Generic Requirements", Issue 2

**TR-TSY-000448 "ISDN Routing and Digit Analysis", Issue 1, Revision 1

10.4 Consultative Committee International Telephone And Telegraph

CCITT Recommendation V.3 International Alphabet No. 5

CCITT Recommendation V.22 bis 2400 Bits per second duplex modem using the 1988 frequency division technique standardized for use on the general switched telephone network and on point-to-point 2-Wire leased telephone-type circuits.

CCITT Recommendation V.24 Defines physical and electrical connection between data terminal equipment and data communications equipment.

CCITT Recommendation V.26 2400 BPS modem standardized for use on 4-Wire leased telephone-type circuits.

CCITT Recommendation V.27 4800 BPS with manual equalizer standardized for use on leased telephone-type circuits.

CCITT Recommendation V.29 9600 BPS modem standardized for use on leased telephone-type circuits.

CCITT Recommendation V.32 A family of 2-Wire duplex modems operating at 1988 data signalling rates of up to 9600 bit/s for use on the general switched telephone network and on leased telephone-type circuits.

- CCITT Recommendation V.35 Specifies a group band modem with a preferred mode for 48 kbps, synchronous.
- CCITT Recommendation V.42 Error-correction procedures for DCEs using 1988 Asynchronous-Synchronous conversion.
- CCITT Recommendation V.54 Loop back interface option associated with V.24.
- CCITT Recommendation X.1 International user classes of service in Public Data Networks.
- CCITT Recommendation X.2 International user services and facilities in Public Data Networks.
- CCITT Recommendation X.3 Packet Assembly/Disassembly (PAD) facility in a Public Data Network.
- CCITT Recommendation X.4 General Structure of Signals of International Alphabet No. 5 Code for data transmission over Public Data Networks.
- CCITT Recommendation X.21 Use on Public Data Networks of DTEs which are designed for interfacing to synchronous CCITT series V. recommendation modems.
- CCITT Recommendation X.25 Interface between DTE and DCE for terminals operating in the packet mode on Public Data Networks.
- CCITT Recommendation X.28 DTE/DEC Interface for start-stop mode data terminal equipment accessing the PAD facility in a Public Data Network situated in the same country.
- CCITT Recommendation X.29 Procedures for the exchange of control information and user data between a PAD facility and a packet mode DTE or another PAD.
- CCITT Recommendation X.32 Interface between data terminal equipment and data circuit terminating equipment for terminals operating in the Packet mode and accessing a packet switch Public Data Network through a public switched telephone network or an Integrated Services Digital Network or a circuit switch Public Data Network.
- CCITT Recommendation X.75 Terminal and transit call control procedures and data transfer system on international circuits between packet switched data networks.
- CCITT Recommendation X.87 Principles and procedures for realization of international facilities and network utilities in Public Data Networks.

CCITT Recommendation X.92 Hypothetical reference connections for public synchronous data networks.

CCITT Recommendation X.96 Call progress signals in Public Data Networks

CCITT Recommendation X.110 Routing principles for international public data services through Switched Public Data Networks of the same type.

CCITT Recommendation X.121 International numbering plan for Public Data Networks.

10.5 Electronic Industries Association

EIA RS-232-C Defines physical and electrical connection between data terminal equipment and data communications equipment.

10.6 Pre-Divestiture Publication

**PUB 41021 "Digital Data System - Channel Interface Specifications",
March 1973 and Addendum, October 1981

10.7 United States Telephone Association

***USTA document TA20 Compatibility Criteria for Data Set 212A, September 1977

10.8 U S WEST Communications, Inc. Technical Publications

PUB 77331 "Digital Data Over Voice Digital Access Arrangements,
Network Interface Specifications", Issue B, December
1992.

10.9 Ordering Information

Ordering Information for Employees of U S WEST Communications, Inc.

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