QWEST Communications International Inc. Technical Publication

QWEST DIGIPAC® SERVICE INTERFACE SPECIFICATIONS FOR PUBLIC PACKET SWITCHING NETWORK

Module 3

77359, Module 3
Issue I
October **2001**

NOTICE

This Technical Publication describes the interface protocols necessary for:

- Asynchronous terminals and hosts (Module 1)
- X.25 terminals and hosts (Module 2)
- X.75 connections with Interexchange Carriers to communicate via the Packet Switched Public Data Network (PSPDN) (Module 3)
- Dial-up access for X.25 devices using the X.32 recommendation (Module 4) and
- Point of Sales terminal to host communications using T3POS protocol (Module 5).

QWEST Communications International Inc. reserves the right to revise this document for any reason, including but not limited to, conformity with standards promulgated by various governmental or regulatory agencies; utilization of advances in the state of the technical arts; or to reflect changes in the design of equipment, techniques, or procedures described or referred to herein.

Liability to anyone arising out of use or reliance upon any information set forth herein is expressly disclaimed, and no representation or warranties, expressed or implied, are made with respect to the accuracy or utility of any information set forth herein.

This document is not to be construed as a suggestion to any manufacturer to modify or change any of its products, nor does this publication represent any commitment by QWEST Communications International Inc. to purchase any specific products. Further, conformance to this publication does not constitute a guarantee of a given supplier's equipment and/or it's associated documentation.

Future issues of Technical Publication 77359 will be announced to the industry at least 45 days prior to the issuance date. This notice, which will come through our standard customer notification channels, will allow the customer time to comment on the proposed revisions.

Ordering information for QWEST Technical Publications can be obtained from the Reference Section of this document.

If further information is required, please contact:

QWEST Communications International Inc.
Manager – New Services Planning
700 W. Mineral Ave. MN-F15.15
Littleton, CO 80120
(303) 707-7107
(303) 707-9497 Fax #
E-mail: jhsmit2@qwest.com

Throughout this publication, the term QWEST signifies QWEST Communications International Inc.

COMMENTS on PUB 77359 Module 3

PLEASE TEAR OUT AND SEND YOUR COMMENTS/SUGGESTIONS TO:

QWEST Corporation
Manager – New Services Planning
700 W. Mineral Ave. MN-F15.15
Littleton, CO 80120
(303) 707-7107
(303) 707-9497 Fax #
E-mail: jhsmit2@qwest.com

Information from you helps us to improve our Publications. Please take a few moments to answer the following questions and return to the above address.

Was this Publication valuable to you in understanding The technical parameters of our service?	YES ______ NO ______
Was the information accurate and up-to-date?	YES ______ NO ______
Was the information easily understood?	YES ______ NO ______
Were the contents logically sequenced?	YES ______ NO ______
Were the tables and figures understandable and helpful?	YES ______ NO ______
Were the pages legible?	YES ______ NO ______

If you answered NO to any of the questions and/or if you have any other comments or suggestions, please explain:

____

____

____

(Attach additional sheet, if necessary)

Name ____ Date __________________

Company

____

Address

____

Telephone Number

____

E-Mail

____

CONTENTS

Chapter and Section **Page**

CONTENTS (Continued)

CONTENTS (Continued)

Tables (Continued) **Page**

CONTENTS

Chapter and Section **Page**

1. Introduction

1.1 Overview

This Technical Publication describes the interface protocols necessary for:

- Asynchronous terminals and hosts (Module 1)
- X.25 terminals and hosts (Module 2)
- X.75 connections with Inter-exchange Carriers to communicate via the Packet Switched Public Data Network (PSPDN) (Module 3)
- Dial-up access for X.25 devices using the X.32 recommendation (Module 4) and
- Point of Sales terminal to host communications using T3POS protocol (Module 5).

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 Telecommunications Union (ITU), formerly International Telegraph and Telephone Consultative Committee (CCITT), Recommendations specified in this document. All reference in this Technical Publication to ITU recommendations are per the 1988 issue "blue book", unless specified otherwise.

The asynchronous interface is based on ITU 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 ITU Recommendation X.29 which specifies the protocol between the packet-mode DTE and the PSPDN. ITU Recommendation X.3 defines a Packet Assembly/Disassembly (PAD) facility in a PSPDN. The X.25 interface is based on ITU Recommendation X.25 which defines the protocol between the X.25 DTE and the PSPDN. The X.75 interface is based on ITU Recommendation X.75 which defines the protocol between the Inter-exchange Carriers, data service providers and the PSPDN. The X.32 interface is based on ITU 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 in Chapter 5.

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

1.2 Reason For Reissue

This document is being reissued at this time to show QWEST Communications International Inc. as the owner of this publication and the one to contact concerning the content.

Contents

Chapter and Section **Page**

Figures

Contents (Continued)

Tables **Page**

2. X.75 Interface and Interexchange Carriers

2.1 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).

2.2 Physical Level

The X.75 interface in available at a data rate of 9600 bps using a voice grade data channel or digital data channel; and at 56 kbit/s using a digital data channel. The high-speed interface of 56 kbit/s 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 4.

2.3 Link Level

2.3.1 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.

2.3.2 System Parameters (see Table 2-5 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 in 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.

2.3.3 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.

2.3.4 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.

2.3.5 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.

2.3.6 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 STEs. 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.

2.4 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 STEs, 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 2.5.5.

2.4.1 Logical Channels

The logical channels are used to enable simultaneous Virtual Calls (VC) and/or PVCs. 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 VCs or PVCs is agreed bilateral for a period of time. The assignment procedure of logical channels as new PVCs is also agreed bilaterally for a period of time.

DIGIPAC® STEs have the capability to support 1024 logical channels for VCs and PVCs on a 56 kbit/s line and 512 logical channels for VCs and PVCs on a 9.6 kbit/s 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 kbit/s lines and 64 logical channels on a 9.6 kbit/s line. Due to varying demands on memory, required by different facilities, DIGIPAC® will not simultaneously support 4095 logical channels on any single interface.

2.4.2 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 STEs 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.

2.4.3 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 STEs. 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.

2.4.4 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 PVCs and clear all the VCs at the STE X/Y interface.

2.5 X.75 Virtual and Permanent Call Service

2.5.1 General

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

2.5.2 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 VCs/PVCs 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.

2.5.3 Call Setup

This section describes the call setup procedures for a VC over the interface between two STEs (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 2-6). 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.

2.5.4 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 2-6).

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.

2.5.5 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 2.4.3, 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.

2.5.6 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 InterLATA 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).

2.5.7 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 2.6.4. 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.

2.5.8 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.

2.5.9 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 STEs. 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.

2.5.10 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 rest 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 2-6). 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 2-7). 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 STEs will consider the reset procedure as complete.

2.5.11 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 VCs putting the corresponding logical channel into the ready (P1) state. As soon as all VCs 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 STEs 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).

2.5.12 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 PVCs are reset (while all the VCs 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 VCs are handled through service provisioning for PVCs.

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".

2.6 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 2-8.

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.

2.6.1 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 2-1.

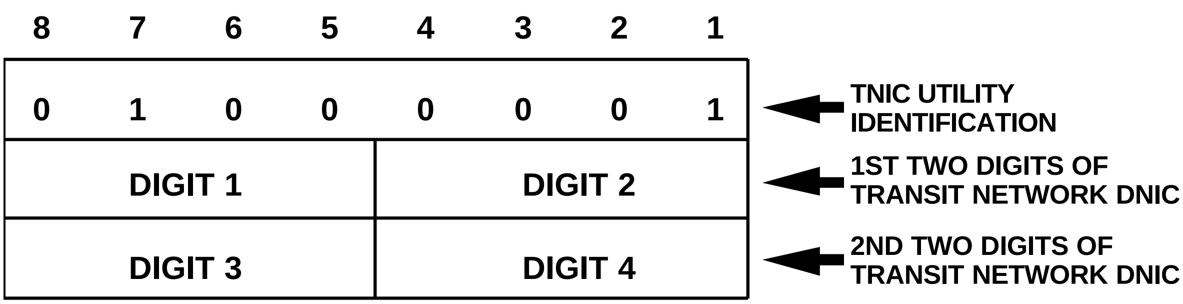


Figure 2-1 Transit Network Identification Utility (TNIC)

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.

2.6.2 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 2-2.

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

CALL IDENTIFIER UTILITY IDENTIFICATION (first octet)

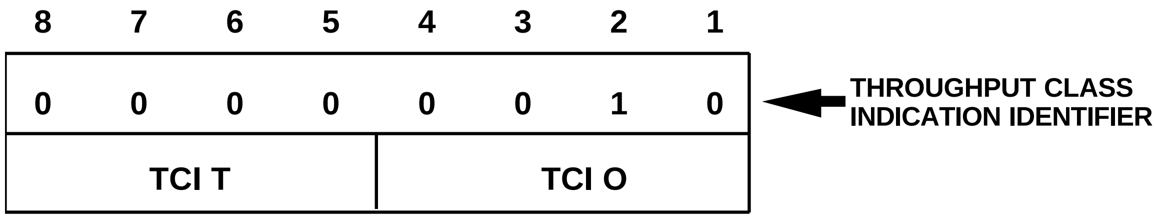
24 BIT BINARY NUMBER THAT IDENTIFIES THE VIRTUAL CALL (octets 2–4)

LOW ORDER BIT OF NUMBER (bit 1 of last octet)

Figure 2-2 Call Identifier Utility

2.6.3 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 2-3.



TCI O = THROUGHPUT CLASS INDICATION OF THE ORIGINATION 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 2-3 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 2-1.

Table 2-1 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.

2.6.4 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 2-4.

8	7	6	5	4	3	2	1	
0	1	0	0	0	0	1	1	WINDOW SIZE IDENTIFIER
0	X	X	X	X	X	X	X	WINDOW SIZE FOR CALLED STE
0	X	X	X	X	X	X	X	WINDOW SIZE FOR CALLING STE

Figure 2-4 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.

2.6.5 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 2-5.

8	7	6	5	4	3	2	1	
0	1	0	0	0	0	1	0	PACKET SIZE IDENTIFIER
0	0	0	0	X	X	X	X	PACKET SIZE FOR CALLED STE
0	0	0	0	X	X	X	X	PACKET SIZE FOR CALLING STE

Figure 2-5 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.

2.6.6 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 2-6.

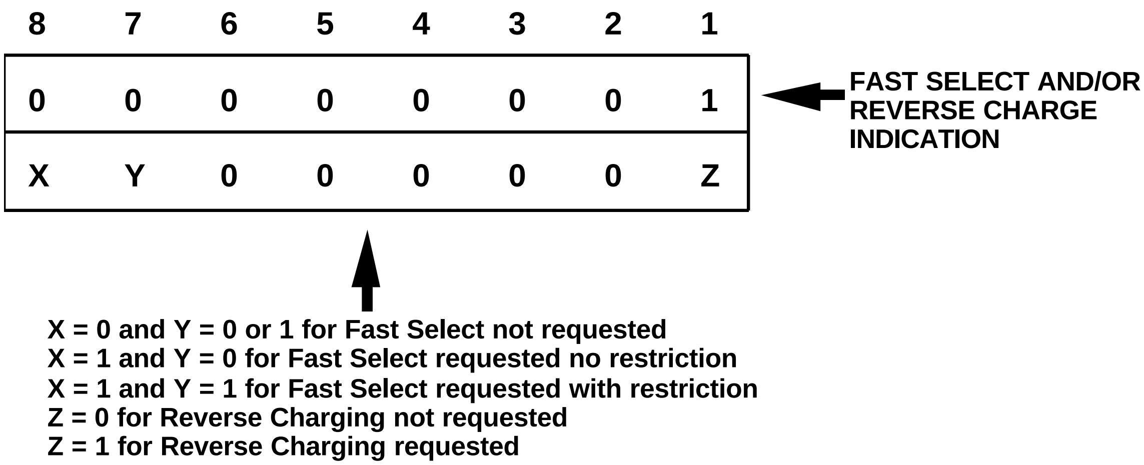


Figure 2-6 Fast Select And/Or Reverse Charge Identification

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.

2.6.7 Closed User Group Indication (Mandatory)

The *Closed User Group Indication* is a network utility used for enabling the establishment of virtual calls by DTEs which are members of international closed user groups. A pictorial representation of the *Closed User Group Indication* utility appears in Figure 2-7.

8	7	6	5	4	3	2	1	Description
1	1	0	0	0	0	1	1	CLOSED USER GROUP INDICATION
0	0	0	0	0	1	0	0	UTILITY PARAMETER LENGTH
DIGIT 1				DIGIT 2				DNIC OF THE ADMINISTRATIVE NETWORK FOR THE CUG
DIGIT 3				DIGIT 4				
H	X	X	X	X	X	X	X	16 BIT BINARY NUMBER ASSIGNED BY ADMINISTRATIVE NETWORK OF CUG
X	X	X	X	X	X	X	L	

Figure 2-7 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.

2.6.8 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 DTEs which are members of international closed user groups. A pictorial representation of the *Closed User Group with Outgoing Access Indication* utility appears in Figure 2-8.

8	7	6	5	4	3	2	1	
1	1	0	0	0	1	1	1	CLOSED USER GROUP WITH OA
0	0	0	0	0	1	0	0	UTILITY PARAMETER LENGTH
DIGIT 1				DIGIT 2				DNIC OF THE ADMINISTRATIVE NETWORK FOR THE CUG
DIGIT 3				DIGIT 4				
H	X	X	X	X	X	X	X	16 BIT BINARY NUMBER ASSIGNED BY ADMINISTRATIVE NETWORK OF CUG
X	X	X	X	X	X	X	L	

Figure 2-8 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.

2.6.9 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 2-9.

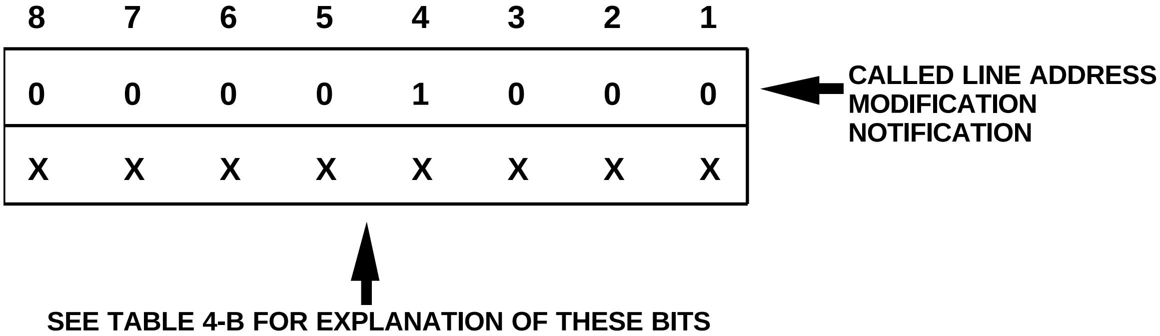


Figure 2-9 Called Line Address Modification Notification

Table 2-2 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 2-2 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.

2.6.10 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 2-10.

8	7	6	5	4	3	2	1	
0	1	0	0	1	0	1	0	← CLEARING NETWORK IDENTIFICATION UTILITY
DIGIT 1				DIGIT 2				← 1ST TWO DIGITS OF CLEARING NETWORK DNIC
DIGIT 3				DIGIT 4				← 2ND TWO DIGITS OF CLEARING NETWORK DNIC

Figure 2-10 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.

2.6.11 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 2-11.

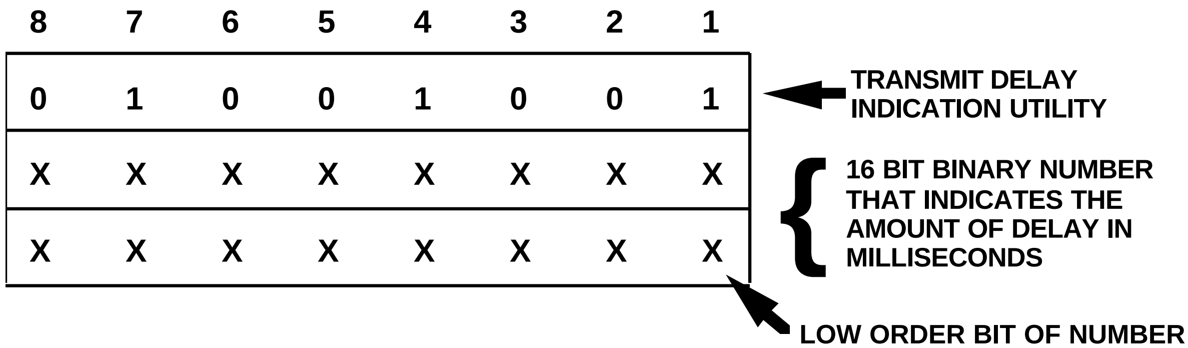


Figure 2-11 Transit Delay Indication Utility

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.

2.6.12 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 2-12.

8	7	6	5	4	3	2	1	
0	1	0	0	1	0	1	1	← TRANSMIT DELAY SELECTION UTILITY
X	X	X	X	X	X	X	X	16 BIT BINARY NUMBER THAT INDICATES THE AMOUNT OF DELAY IN MILLISECONDS
X	X	X	X	X	X	X	X	

LOW ORDER BIT OF NUMBER (bit 1 of the last octet)

Figure 2-12 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.

2.6.12 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 2-13.

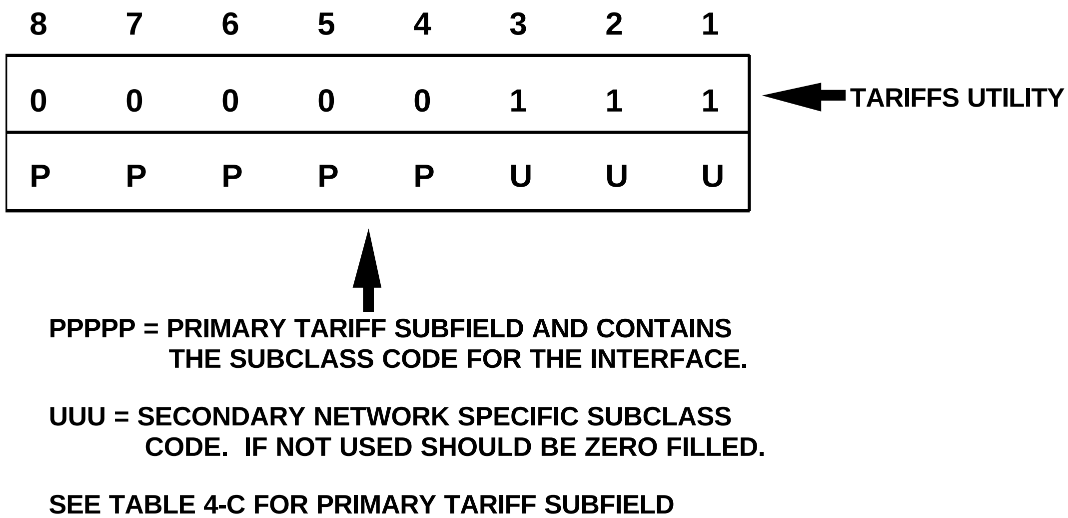


Figure 2-13 Tariffs Utility

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 2-3.

Table 2-3 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 a 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.

2.6.13 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 2-14.

8	7	6	5	4	3	2	1	
0	1	0	0	0	1	0	0	RPOA SELECTION UTILITY
DIGIT 1				DIGIT 2				1ST TWO DIGITS OF RPOA NETWORK DNIC
DIGIT 3				DIGIT 4				2ND TWO DIGITS OF RPOA NETWORK DNIC

Figure 2-14 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.

2.6.14 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 2-15.

8	7	6	5	4	3	2	1	
0	0	0	0	0	0	0	0	UTILITY MARKER
0	0	0	0	0	0	0	0	

Figure 2-15 Utility Marker

2.7 Bellcore X.75' Utilities

2.7.1 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 2-9. A more complete description of the Bellcore X.75' utilities can be found in the PPSNGR, TR-TSY-000301.

2.7.2 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 PSPDNs.

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 2-16.

8	7	6	5	4	3	2	1	
1	0	1	0	0	0	0	0	ACCESS CHARACTERISTICS
P	P	P	P	P	U	U	U	INTERFACE TYPE INFORMATION
S	S	S	S	S	S	S	S	SENSOR IDENTIFIER
S	S	S	S	S	S	S	S	

Figure 2-16 Access Characteristics

- The first octet of the parameter field consists of two subfields, encoded in binary. Table 2-4 shows the encoding of the PPPPP 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 2-4 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.

2.7.3 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 DTEs. 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 2-17.

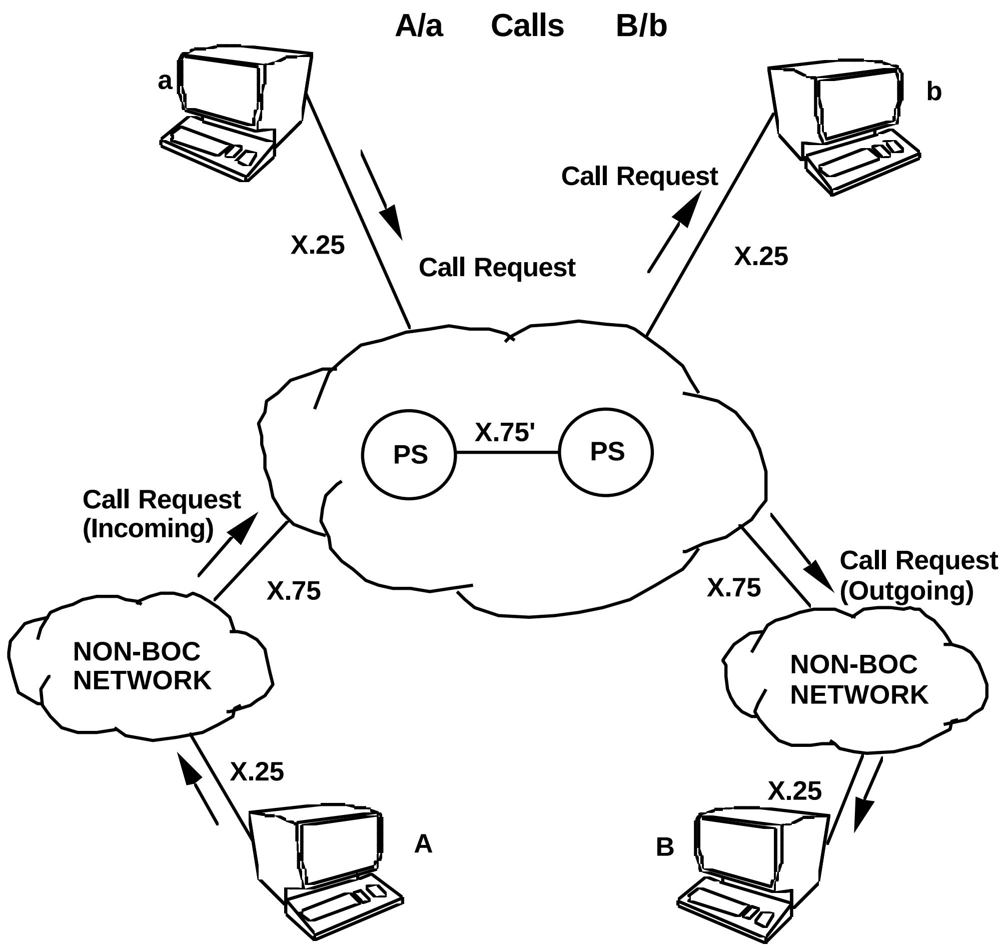


Figure 2-17 'Incoming' and 'outgoing' X.75 Interfaces Relative to a BOC Network

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 and X.75' interface if and only if that *Call Connected* packet entered the BOC network over and 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 2-18. 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.

8	7	6	5	4	3	2	1	
1	1	1	0	0	0	1	1	← X.75 INTERFACE IDENTIFIER
0	0	0	0	0	1	1	0	← UTILITY PARAMETER LENGTH
DIGIT 1				DIGIT 2				11 DIGIT X.75 INTERFACE IDENTIFIER
DIGIT 3				DIGIT 4				
DIGIT 11				0	0	0	0	

Figure 2-18 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.

2.8 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) (InterLATA)

- 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) (InterLATA)

- 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) (InterLATA)

- 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 2-5 Summary of X.75 DIGIPAC® Default Interface Attributes

PHYSICAL LEVEL	
Transmission Rates	9.6 and 56 kbit/s
Interfaces	EIA-232 for 9.6 kbit/s CCITT Recommendation V.35 for 56 kbit/s
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 kbit/s 64 @ 9.6 kbit/s 32 @ 4.8 kbit/s 16 @ 2.4 kbit/s
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 2-6 STE time-outs (First Time)

TIMER NUMBER	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 2-7 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 2-8 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 2-9 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

CONTENTS

Chapter and Section **Page**

Table

3. QWEST DIGIPAC® Network Features

3.1 Network Features

Please reference the following Table 3-1

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

Table 3-1 Network Features
(Page 1 of 2)

FEATURE	ASYNCHRONOUS	X.25	X.75
Extended Packet Sequence Numbering Module 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 3-1 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	S	NA	NA
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	S	NA
Standard Profile Selections	S	S	S
Permanent Virtual Circuits	NS	S	NS
D-bit Modification	NS	S	NS
Transmit Delay Selection and Notification	NS	NS	NS
Bilateral CUG Selection	NA	NA	S
Transit Network Identification	NA	NA	S
Call Identifier			

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

CONTENTS

Chapter and Section **Page**

Tables

4. QWEST DIGIPAC® Physical Interface

4.1 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 4-1 through 4-4 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 4-5 through 4-6 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 Chapter 5 to assist the customer in understanding the terminology used in this section. Your QWEST Communications, Inc. Marketing Representative may be contacted for assistance with questions and for further clarification.

4.2 Dial Access

DIGIPAC® does not support a dial access service for X.75 interfaces.

4.3 Direct Access

DIGIPAC® supports direct access ports for X.75 interfaces that provide a full duplex interface, at either 9600 or 56000 bit/s. Modem transmission interfaces for analog voice grade data channels are supported for 9600 bit/s. Modem transmission interfaces for digital data channels are supported for 9600 bit/s and 56000 bit/s.

4.4 Physical Interface Description

4.4.1 Direct Access - Synchronous Analog

- Direct Access - Synchronous - 9600 bit/s

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 4-1 for options

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

- Direct Access - Synchronous - 9600 bit/s

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 4-2 for options

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

4.4.2 Direct Access - Synchronous Digital

- Direct Access - Synchronous - 9600 bit/s

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 4-3 for options

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

- Direct Access - Synchronous - 56000 bit/s

  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 4-14 for options

  Port: CCITT V.35 WITH V.54 recommended

Table 4-1 Direct Access - Synchronous - 9600 bit/s 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 bit/s.
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 4-1 Direct Access - Synchronous - 9600 bit/s 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 4-2 Direct Access - Synchronous - 9600 bit/s CCITT Recommendation V.29 Compatible - (4-Wire)
(Page 1 of 2)

REQUIRED MODEM OPTIONS (DIGIPAC® AND CUSTOMER)	
1.	Communication protocol compatibility: CCITT V.29
2.	Synchronous operation.
3.	4-Wire Private Line operation
4.	Constant transmit carrier - PL operation.
5.	Data rate: 9600 bit/s. Fall back rate: 4800 bit/s
6.	Transmit signal level: CUSTOMER = 0.0 dBm DIGIPAC® = - 8.0 dBm
7.	Line impedance: 600 ohms.
8.	Carrier detect thresholds: Acquisition = Low (-26 to 34 dBm) Release = Low (-31 to 35 dBm)
9.	Transmitter timing source: CUSTOMER = Modem receive (SLAVE) DIGIPAC® = Modem clock (INTERNAL)
10.	Round robin retrain, enable. If receiver loses equalization, the modem interrupts the data transmission and transmits an outbound training sequence.
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 or set to Short Haul.

Table 4-2 Direct Access - Synchronous - 9600 bit/s 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 4-3 Direct Access - Synchronous - 9600 bit/s 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 bit/s, 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 4-3 Direct Access - Synchronous - 9600 bit/s Digital - CSU/DSU Compatible - (4-Wire)
(Page 2 of 2)

DIGIPAC® MODEM OPTIONS	
1.	Request To Send circuit C/l05 (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 4-4 Direct Access - Synchronous - 56000 bit/s 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 bit/s.
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 4-4 Direct Access - Synchronous - 56000 bit/s 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 4-5 NC and NCI Code Combinations - Voice Grade Analog Channel

SPEED (bit/s)	SERVICE	MODEM OPERATION	NC CODE			NCI CODE CKL 1-PS	NCI CODE CKL 2-CS
			VG6	VG10	VG36		
9600	Synch	CCITT V.32	N/A	LN1-	UG- -	02DM2.9PS.PT	02DA2..PX
		CCITT V.32	N/A	LN1-	UG- -	02DM2.9PS.PT	DIGITAL**
		CCITT V.29	LG- -	LN1-	UG- -	04DM2.6P.PX	04DA2..PI
		CCITT V.29	LG- -	N/A	N/A	04DM2.6P.PX	04DB2..-X
		CCITT V.29	LG- -	LN- -	UG- -	04DM2.6P.PX	DIGITAL**

Table 4-6 NC and NCI Code Combinations - Digital Data Channel

SPEED (bit/s)	SERVICE	ACCESS PORT		NC CODE		NCI CODE CKL 1-PS	NCI CODE CKL 2-CS
		PSSP	PSN	ACCESS	NON-ACCESS		
9600	Synch	YES YES	YES YES	XG-P	US- -	04DU5.96 04DU5.96	04DU5.96 DIGITAL**
56000	Synch	YES YES	YES YES	XH-P	US- -	04DU5.56 04DU5.56	04DU5.56 DIGITAL**

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

See appropriate QWEST Technical Publication for additional information on Digital Channel Interface Codes.

CONTENTS

Chapter and Section **Page**

5. Definitions

5.1 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	Signaling 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

5.2 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.

CONTENTS

Chapter and Section **Page**

6. References

6.1 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.

6.2 AT&T Publication

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

6.3 Telcordia Publications

TR-NPL-000011 Bellcore, *Asynchronous Terminal and Host Interface Reference,* Issue 1

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

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

6.4 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 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 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.32*bis*	A family of 2-Wire duplex modems operating at data signaling rates of up to 14400 bit/s for use on the general switched telephone network and on leased telephone-type circuits.
CCITT Recommendation V.34	A family of 2-Wire duplex modems operating at data signaling rates of up to 28800 bit/s for use on the general switched telephone network and on leased telephone-type circuits.
CCITT Recommendation V.35	Modems for Synchronous Data Transmission using 60-108 KHz Group Band Circuits (Replaced by V.36)
CCITT Recommendation V.36	Data Transmission at 48 Kilobits per second using 60-108 KHz Group Band Circuits
CCITT Recommendation V.42	Error-correction procedures for DCEs using 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. 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.

6.5 Electronic Industries Association

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

6.6 Pre-Divestiture Publication

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

6.7 United States Telephone Association

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

6.8 QWEST Technical Publications

PUB 77331	*"Digital Data Over Voice Digital Access Arrangements, Network Interface Specifications"*, Issue E, September 2001

6.9 Ordering Information

All documents are subject to change and their citation in this document reflects the most current information available at the time of printing. Readers are advised to check status and availability of all documents.

Employees of QWEST Communications International Inc. may order publications by submitting form RG 31-0033 to:

Central Distribution Center (CDC)
1005 17th St., S-30
Denver, CO 80202
Phone: (303) 896-9446
Fax: (303) 965-8652

Most QWEST publications are available to QWEST employees on the company network (E*MEDIA). Call the (303) 624-4796 or email: emedia@qwest.com for further information.

Telcordia documents from:

Telcordia Customer Relations
8 Corporate Place, PYA 3A-184
Piscataway, NJ 08854-4156
Fax: (908) 336-2559
Phone: (800) 521-CORE (2673) (U.S. and Canada)
Phone: (908) 699-5800 (Others)
Web: www.telcordia.com

QWEST Technical Publications from:

http://www/qwest.com/techpub

6.10 Trademarks

DIGIPAC®	Registered Trademark of QWEST Communications International Inc.
MNP	Trademark of Microcom, Inc.
QWEST®	Registered Trademark of QWEST Communications International Inc.