

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

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

Module 4

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Communications, Inc.
Technical Publication**

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INTERFACE SPECIFICATIONS FOR
PUBLIC PACKET SWITCHING NETWORK**

Module 4

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).

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CONTENTS

Chapter and Section	Page
1. Introduction.....	1-1
1.1 Overview	1-1
2. X.32 Implementation.....	2-1
2.1 General.....	2-1
2.2 Purpose	2-1
2.3 Physical Level.....	2-1
2.4 Link Level.....	2-1
2.5 Packet Level.....	2-1
2.6 Functional Attributes of All X.32 Calls.....	2-2
2.7 Functional Aspects of X.32 Dial-In Calls	2-2
2.8 Functional Aspects of X.32 Dial-Out Calls	2-3
3. U S WEST DIGIPAC® Network Features	3-1
3.1 Network Features	3-1
4. U S WEST DIGIPAC® Physical Interface.....	4-1
4.1 Overview	4-1
4.2 Dial Access	4-1
4.3 Direct Access	4-1
4.4 Physical Interface Description	4-2
5. Definitions.....	5-1
5.1 Acronyms	5-1
5.2 Glossary	5-4
6. References.....	6-1
6.1 American National Standards Institute.....	6-1
6.2 AT&T Publication.....	6-1
6.3 Bellcore Publications	6-1
6.4 Consultative Committee International Telephone and Telegraph.....	6-1
6.5 Electronic Industries Association	6-3
6.6 Pre-Divestiture Publication	6-3
6.7 United States Telephone Association.....	6-3
6.8 U S WEST Communications, Inc. Technical Publications.....	6-4
6.9 Ordering Information	6-4
6.10 Trademarks	6-4

CONTENTS (Continued)

Tables		Page
2-1	CCITT Recommendation X.32 (1988) Compliance	2-5
2-2	Summary of X.32 DIGIPAC® Standard (Default) Interface Attributes.....	2-14
3-1	Network Features	3-1
4-1	Dial Access - Synchronous - 9600 bit/s CCITT Recommendation V.32 Compatible - (2-Wire) Using Trellis Coded Modulation.....	4-3
4-2	NC and NCI Code Combinations - Private Dial.....	4-5

CONTENTS

Chapter and Section	Page
1. Introduction.....	1-1
1.1 Overview	1-1

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 Sale 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 U S WEST wide basis.

CONTENTS

Chapter and Section	Page
2. X.32 Implementation.....	2-1
2.1 General.....	2-1
2.2 Purpose	2-1
2.3 Physical Level.....	2-1
2.4 Link Level.....	2-1
2.5 Packet Level.....	2-1
2.6 Functional Attributes of All X.32 Calls.....	2-2
2.6.1 General.....	2-2
2.6.2 X.32 Security Feature.....	2-2
2.6.3 Billing of X.25 Calls Established on X.32 Link	2-2
2.7 Functional Aspects of X.32 Dial-In Calls.....	2-2
2.7.1 General.....	2-2
2.7.2 Calling Addresses for PSTN Dial-in Call	2-3
2.7.3 Permanent Virtual Circuit Support.....	2-3
2.8 Functional Aspects of X.32 Dial-Out Calls	2-3
2.8.1 Single-Stage Addressing.....	2-3
2.8.2 Long Distance Calls.....	2-4
2.8.3 Additional Calls to Existing Connections	2-4

Tables

2-1 CCITT Recommendation X.32 (1988) Compliance	2-5
2-2 Summary of X.32 DIGIPAC® Standard (Default) Interface Attributes.....	2-14

2. X.32 Implementation

2.1 General

This chapter describes the implementation of X.32 dial-in and dial-out service on the DIGIPAC® Network. The implementation of the X.32 service on the DIGIPAC® Network conforms to Consultative Committee on International Telephone and Telegraph (CCITT) Recommendation X.32 (1988) (see Table 2-1 for conformance by individual section). The version of X.25 available over these types of connections will conform to CCITT Recommendation X.25 (1984) and is consistent with the information found in Module 2 of this publication.

2.2 Purpose

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

2.3 Physical Level

Customers using the X.32 service provided by the U S WEST DIGIPAC® Network will be required to use a modem or modems that conforms to the specifications for 9600 bps - Synchronous - Dial Access found in Chapter 4 of this publication.

2.4 Link Level

At the link layer, the LAPB link access procedures conform to the procedures found in Module 2 of this publication, with additions as noted in Section 5 of CCITT Recommendation X.32 (1988) (see Table 2-1 for conformance to Section 5 of CCITT Recommendation X.32). The LAPB procedures found in Module 2 of this publication conform to CCITT Recommendation X.25 (1984).

2.5 Packet Level

The format and procedures at the packet layer conform to those found in Module 2 of this publication, with additions as noted in Section 6 of CCITT Recommendation X.32 (1988) (see Table 2-1 for conformance to Section 6 of CCITT Recommendation X.32). The packet formats and procedures found in Module 2 of this publication conform to CCITT Recommendation X.25 (1984).

2.6 Functional Attributes of All X.32 Calls

2.6.1 General

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

2.6.2 X.32 Security Feature

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

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

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

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

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

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

2.7 Functional Aspects of X.32 Dial-In Calls

2.7.1 General

Answering a Dial-in Call - An X.32 dial-in port responds to a dial-in call by establishing the physical connection and bringing up level-2 (link layer). The DTE can then originate X.25 calls using standard X.25 call setup procedures. The DTE may also receive calls from other X.25 DTEs (see Sections 2.6.1 and 2.6.3 for limitations).

2.7.2 Calling Addresses for PSTN Dial-in Call

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

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

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

2.7.3 Permanent Virtual Circuit Support

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

2.8 Functional Aspects of X.32 Dial-Out Calls

2.8.1 Single-Stage Addressing

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

1+9+1+NPA+NXXXXXXX

1 = Prefix Digit

9 = Escape Digit

1 = Country Code (1 = North America)

NPA = Number Planning Area (Area Code)

NXXXXXX = 10 Digit Telephone Number

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

2.8.2 Long Distance Calls

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

2.8.3 Additional Calls to Existing Connections

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

Table 2-1 CCITT Recommendation X.32 (1988) Compliance
(Page 1 of 9)

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

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

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

Not implemented: DIGIPAC® does not implement this section.

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

Table 2-1 CCITT Recommendation X.32 (1988) Compliance
(Page 2 of 9)

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

Table 2-1 CCITT Recommendation X.32 (1988) Compliance
(Page 3 of 9)

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

Table 2-1 CCITT Recommendation X.32 (1988) Compliance
(Page 4 of 9)

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

Table 2-1 CCITT Recommendation X.32 (1988) Compliance
 (Page 5 of 9)

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

Table 2-1 CCITT Recommendation X.32 (1988) Compliance
(Page 6 of 9)

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

Table 2-1 CCITT Recommendation X.32 (1988) Compliance
 (Page 7 of 9)

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

Table 2-1 CCITT Recommendation X.32 (1988) Compliance
(Page 8 of 9)

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

Table 2-1 CCITT Recommendation X.32 (1988) Compliance
 (Page 9 of 9)

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

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

Table 2-2 Summary of X.32 DIGIPAC® Standard (Default) Interface Attributes

PHYSICAL LEVEL

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

LINK LEVEL

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

PACKET LEVEL

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

CONTENTS

Chapter and Section	Page
3. U S WEST DIGIPAC® Network Features	3-1
3.1 Network Features	3-1
Table	
3-1 Network Features	3-1

3. U S WEST 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			
Default throughput Classes Assignment	NA	S	S
Incoming Calls Barred	S	S	NA
Outgoing Calls Barred	S	S	S
One-way Logical Channel Outgoing	S	S	S
One-way Logical Channel Incoming	S	S	NA
Closed User Group	S	S	NA
CUG with Outgoing Access	S	S	S
CUG with Incoming Access	S	S	S
Incoming Calls Barred Within a CUG	S	S	NA
Outgoing Calls Barred Within a CUG	S	S	NA
Reverse Charging	S	S	NA
Reverse Charging Acceptance	S	S	S
RPOA Selection	S	S	S
Nonstandard Default Packet Sizes	S	S	S
Multiple Circuits to the same DTE	S	S	S
Flow Control Parameter Negotiation	NA	S	NA
Throughput Class Negotiation	S	S	S
Fast Select	S	S	S
Fast Select Acceptance	S	S	S
Closed User Group Selection	S	S	NA
Local Charging Prevention	S	S	S
Network User Identification	S	S	NA
Charging Information	S	S	NS
Multi-Line Hunt Group	S	S	NA
Call Redirection	S	S	NA
Call Line Address Modification Notification	S	S	NA
Call Redirection Notification	S	S	NS
Direct Call	S	S	NA
Packet Retransmission	S	NA	NA
Bilateral Closed User Group	NS	NS	NS
	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 Break	S	NA	NA
Discard Output	S	NA	NA
Padding After Carriage Return	S	NA	NA
Line Folding	S	NA	NA
Binary Speed (Read Only)	S	NA	NA
Flow Control of PAD by Start-Stop Mode DTE	S	NA	NA
Linefeed Insertion	S	NA	NA
Linefeed Padding	S	NA	NA
Editing Functions	S	NA	NA
Parity Functions	S	NA	NA
Standard Profile Selections	S	S	NA
Permanent Virtual Circuits	S	S	S
D-bit Modification	NS	S	NS
Transmit Delay Selection and Notification	NS	S	NS
Bilateral CUG Selection	NS	NS	NS
Transit Network Identification	NA	NA	S
Call Identifier	NA	NA	S

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

CONTENTS

Chapter and Section	Page
4. U S WEST DIGIPAC® Physical Interface.....	4-1
4.1 Overview	4-1
4.2 Dial Access	4-1
4.3 Direct Access	4-1
4.4 Physical Interface Description	4-2
4.4.1 Dial Access - Synchronous Analog.....	4-2

Table

4-1 Dial Access - Synchronous - 9600 bit/s CCITT Recommendation V.32 Compatible - (2-Wire) Using Trellis Coded Modulation.....	4-3
4-2 NC and NCI Code Combinations - Private Dial.....	4-5

4. U S WEST 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).

Table 4-1 specifies the options for the modem types required to accommodate the DIGIPAC® X.32 service. This table provides 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 texts to describe each option; with fewer or more options than addressed. Table 4-2 lists 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 U S WEST Communications, Inc. Marketing Representative may be contacted for assistance with questions and for further clarification.

4.2 Dial Access

DIGIPAC® supports dial access X.32 ports that provide a full duplex interface at 9600 bit/s.

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

4.3 Direct Access

Since X.32 is a dial access interface for X.25 the Direct Access for X.25 services is described in Module 2 of this publication.

4.4 Physical Interface Description

4.4.1 Dial Access - Synchronous Analog

- Dial Access - Synchronous - 9600 bit/s

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

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

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

See Table 4-1 for options

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

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

Table 4-1 Dial Access - Synchronous - 9600 bit/s CCITT Recommendation
V.32 Compatible - (2-Wire) Using Trellis Coded Modulation
(Page 2 of 2)

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

Table 4-2 NC and NCI Code Combinations - Private Dial

SPEED (bit/s)	SERVICE	MODEM OPERATION	CHANNEL TYPE	NC CODE	NCI CODE CKL1-PS	NCI CODE CKL2-CS
9600	Synch	CCITT V.32	VG32	UC- -	02DM2.9PS.NW	02LO3..SS

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

CONTENTS

Chapter and Section	Page
5. Definitions.....	5-1
5.1 Acronyms	5-1
5.2 Glossary	5-4

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	Signalling Terminal Equipment
SVC	Switched Virtual Calls
UA	Unnumbered Acknowledgment
USTA	United States Telephone Association
VC	Virtual Call
V(R)	Receive State Variable
V(S)	Send State Variable
XID	Exchange Identification

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
6.1 American National Standards Institute.....	6-1
6.2 AT&T Publication.....	6-1
6.3 Bellcore Publications	6-1
6.4 Consultative Committee International Telephone And Telegraph.....	6-1
6.5 Electronic Industries Association	6-3
6.6 Pre-Divestiture Publication	6-3
6.7 United States Telephone Association.....	6-3
6.8 U S WEST Communications, Inc. Technical Publications.....	6-4
6.9 Ordering Information	6-4
6.10 Trademarks	6-4

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 Bellcore 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 signaling 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 U S WEST Communications, Inc. Technical Publications

PUB 77331 *"Digital Data Over Voice Digital Access Arrangements, Network Interface Specifications"*, Issue D, July 1995.

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.

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

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