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Technical Interface Specification For X.75 Service

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1. Section 1, NTI

1.1. Introduction

1.1.1. BOC/IDC Packet Networks and the X.75 Interface

Bell Operating Companies (BOCs), Information Distribution Companies (IDCs), and other Telcordia (formerly Bellcore) client companies are deploying packet switched public data networks (PSPDNs) which are generically labeled Public Packet Switched Networks (PPSNs). These same companies are also planning the introduction of Integrated Services Digital Network (ISDN) capabilities into their network offerings. Planned ISDN services include a packet switched mode.

Communication between a PPSN and other networks offering packet mode service is accomplished by means of interfaces conforming to CCITT Recommendation X.75[1]. Packet mode communication between a BOC/IDC ISDN (hereafter abbreviated as BOC/ISDN) and other packet-capable networks (including non-BOC/IDN ISDNs) is also to be accomplished by means of X.75 interfaces.

The services of the various PPSNs and BOC/ISDNs will be offered under differing tariffs and utilizating network equipment from multiple sources. Thus, the individual network or corresponding BOC/IDC should be consulted for details of the X.75 interface currently being supported. However, there are a collection of interface characteristics and capabilities, referred to as the "minimal subset," which are planned to be supported in a uniform manner on all PPSNs. This minimal subset includes conformance to the 1984 version of CCITT Recommendation X.75 and support of all non-optional features and utilities specified in that Recommendation.

1.1.2. Scope and Purpose of this Document

This document describes common characteristics of X.75 interfaces supported or planned to be supported by PPSNs and BOC-ISDNs for interconnection with other packet-capable networks. It addresses characteristics of PPSN/BOC-ISDN X.75 interfaces as viewed from connecting networks and, to a lesser extent, characteristics expected of the connecting network by the PPSN or BOC-ISDN.

Two related Telcordia (formerly Bellcore) Technical Reference (TRs) [2] [3] present requirements for PPSN and ISDN network equipment, including the support of X.75 interfaces. These two TRs address the equipment vendor perspective. Two companion TRs to this document address the X.25[4] and asynchronous[5] access interfaces supported by PPSN, respectively, from the customer perspective.

This technical reference is intended to be used as a supplement to and in conjunction with the 1984 CCITT Recommendation X.75[1] (subsequently referred to simply as “X.75” in this document).

This document does not attempt to repeat material covered in X.75. The material in this document provides information on:

- parameters and parameter values supported by PPSN/BOC-ISDNs;
- actions taken by and/or expected by PPSN/BOC-ISDNs for which X.75 offers alternatives or does not fully specify actions;
- features supported by PPSN/BOC-ISDNs that X.75 indicates are optional; and
- features supported by PPSN/BOC-ISDNs that are not addressed in X.75.

This document provides information that applies generally to X.75 interfaces between PSN/BOC. ISDNs and other packet-capable networks. It should be useful to those responsible for establishing X.75 interfaces between a PPSN or BOC-ISDN and an interexchange carrier (IC), value added network (VAN), other PSPDNs, non-BOC/IDC ISDNs, and private packet networks with points of presence within the local access and transport area (LATA) of the BOC/IDC. It should be used in conjunction with reference material provided directly by the individual BOC/IDC or PPSN/BOC. ISDN, which would supplement this interface description to address network-specific needs and characteristics. This document supersedes Bell Communications Research Technical Reference TR-NPL-000065, “Interexchange Packet Interface,” Issue 1, July 1985.

1.1.3. Terminology

Certain terms have specific meanings as used in this document. Since these terms relate to the support or availability of X.75 interface features and options, it is critical that the definition of these terms be well understood. Table 1-1 summarizes the intended meanings of these key terms and phrases relating to support and availability. It also identifies the abbreviations used in subsequent tables and figures that correspond to these terms.

The phrases associated with the first two levels of support/availability indicated in the table are abbreviated “C (current support)” and “P (planned support),” respectively. These two categories taken together correspond to the minimal subset discussed earlier. When the phrase “supported by all PPSNs” or “all PPSNs...” is used in this document, the associated capability or option is supported on all PPSN network equipment. However, the individual network should be contacted to confirm the tariffed availability at a particular time.

Some interface features are in the minimal subset, but may not be immediately available on all PPSNs. These features or options are associated with the "planned support" level. Items which not all PPSNs plan to support in the near future are in the "optional support" category.

There are several aspects of the X.75 interface for which Telcordia (formerly Bellcore) has recommended a default value or a particular procedure, but for which current network implementations may vary. These correspond to the "recommended" category. For aspects of the interface so identified, the individual network should be contacted for details on the current implementation and plans for future modifications.

The last category described in Table 1-1 relates to capabilities or option support of other networks connecting to a PPSN or BOC-ISDN via an X.75 interface. The interfacing network is assumed to conform to the non-optional elements of X.75. However, it is considered important to highlight a limited number of items as those which PPSNs may rely upon being supported by the interfacing network. If another network does not support an aspect of the X.75 interface identified as being in this "expected support" category, the interface may not operate effectively or a serious administrative problem may result. Support of such items within the near future is considered important.

The support/availability characterization specified for PPSNs is expected to apply to the packet mode of BOC-ISDNs in most cases, unless otherwise stated in the text. However, the introduction of public ISDN service is still being planned and a minimal subset has not been defined for BOC-ISDN packet mode service at this time. Any statement on support concerning BOC-ISDNs should therefore be interpreted to mean planned support.

Throughout this document, the terms DTE (data terminal equipment) and DCE (data circuit terminating equipment) will be used to refer to the end user terminal and the network connection to the user access interface, respectively. The term STE (signaling terminal) refers to the network equipment that terminates each end of an X.75 interface. Strictly speaking, these are PSPDN terms. However, they will be assumed to include their ISDN counterparts when used in this document to simplify references to the user and network ends of an access interface and the network X.75 interface termination. These terms are used in this document because they are the terms used in CCITT Recommendation X.75. For readers more familiar with ISDN terminology, Table 1-2 presents ISDN terms that are roughly equivalent to the PSPDN terms used in this document.

1.1.4. Organization of this Document

The second section of this document describes the types of X.75 interfaces supported by PPSN/ISDNs and provides a textual and tabular overview of PPSN/BOC-ISDN inter-network interfaces. Sections 3 through 5 address the physical, link, and packet layers of the X.75 protocol. Sections 3 through 5 address the physical, link, and packet layers of the X.75 protocol. Sections 6 through 8 describe CCITT, BOC/IDC-specified, and other relevant network utilities, respectively. Sections 9 and 10 discuss addressing and routing considerations. Generally applicable aspects of provisioning and maintenance for X.75 interfaces between PPSN/BOC-ISDNs and other networks are addressed in section 11. The remainder of this TR consists of a list of acronyms, two Appendices, and references.

TABLE 1-1. Interpretation of Support Phrases and Abbreviations

PHRASE IN TEXT	ABBREVIATION	INTERPRETATION
PPSN SUPPORT LEVELS		
All PPSNs . . . ; Supported by all PPSNs*	C (current support)	All PPSN equipment supports the feature, capability, parameter value, or option; availability under local tariff may vary
All PPSNs plan . . . ; Support by all PSNs planned*	P (planned support)	Some PPSNs now support, remaining PPSNs plan support; contact specific PPSN for availability schedule
Supported by some PPSNs; Some PPSNs support; Support is optional	O (optional support)	Not all PPSNs plan to support
Telcordia (formerly Bellcore) recommends ; . . . is recommended	R (recommended)	Telcordia (formerly Bellcore) recommends use of particular default value or support of a feature/option in long term; contact specific PPSN for current implementation details
BY OTHER NETWORKS		
interfacing networks are expected to . . .	E (expected support)	PPSNs may relay upon utility, capability, parameter value, or option being supported by interfacing networks. Support within near future considered important.

* These categories comprise the Minimal Subset

TABLE 1-2. Roughly Equivalent PPSN and ISDN Terms

PPSN Term(s)	ISDN Term(s)
Data Circuit-Terminating Equipment (DCE)	none; use (local) Stored Program Control Switch (SPCS), Packet Handling Function (PHF), or exchange termination (ET)
Data Terminal Equipment (DTE)	Terminal Equipment: TE, TE1, or TE1/TA; Customer Premises Equipment (CPE)
Signaling Terminal (STE)	none; use "Interexchange equipment"
network address extension (NAE)	subaddress
packet switch data transmission Service	packet mode bearer service
packet switch (PS)	SPCS/PHF

1.2. Interface Overview

1.2.1. Typical Internetwork Configuration

A BOC or IDC network provides communications service only within a local access and transport area (LATA). Thus, a PPSN/BOC-ISDN can offer direct access connections to end users within the LATA and inter-network interfaces to other packet switched networks with points of presence within the LATA. Public traffic must travel between LATAs over communication facilities operated by networks authorized to provide public interexchange services. Thus, a PPSN/BOC-ISDN must pass public inter-LATA call traffic over an X.75 interface to an IC or other network with inter-LATA capabilities.

Given the nature of PPSN/BOC-ISDN service as described above, X.75 inter-network interfaces are used for connections between PPSN/BOC-ISDN and:

- an IC
- a VAN, PSPDN, or non-BOC/IDC-ISDN with attached users and/or inter-LATA carrier capability
- possibly, a private packet network with a point of presence within the PSN/BOC-ISDN service area.

Figure 2-1 illustrates such X.75 interfaces in a diagram which spans three LATAs. The X.75 interfaces are indicated a heavy solid lines and the access interfaces between the users and networks are indicated with thin solid lines. A BOC/IDC packet mode network serves each of LATA X and LATA Y. This network may be a PSN, a BOC-ISDN, or a combination of both connected by internal trunks. For public traffic, calls between these two LATAs that originate on or are destined for a PPSN/BOC-ISDN transmit an inter-LATA carrier, such as the IC indicated. Traffic between a PPSN/BOC-ISDN and a user on a VAN directly connected to the PPSN/BOC-ISDN would be carried over the connecting X.75 interface, unless the calling party explicitly requested a different carrier routing. Such a VAN may also serve as a transit network for calls neither originating nor terminating on the VAN. Within LATA Y, a private packet network is illustrated as being directly connected to the PPSN/BOC-ISDN. [Such a private network could also choose to connect to the PPSN/BOC-ISDN via an access interface (such as X.25), is such an inter-network connection was not available or deemed necessary.]

1.2.2. X.75 Interface Characteristics

As stated above, PSN/BOC-ISDN inter-network interfaces conform to X.75 and it is expected that any interfacing network also conforms to X.75. This document details specific parameter values, options, and feature support that are more specific than or go beyond X.75. In this section, those characteristics of the PPSN/BOC-ISDN interfaces which do not directly flow from the X.75 specification are summarized. The remainder of the document addresses the same material in more detail.

Table 2-1 summarizes the attributes and configuration options at the physical, link, and packet level of PPSN/BOC-ISDN interfaces. All terms listed in the table are currently available on all PPSNs, unless the line contains an indication of a different support level in square brackets (see table legend).

TABLE 1-2. Roughly Equivalent PPSN and ISDN Terms

PPSN Term(s)	ISDN Term(s)
Data Circuit-Terminating Equipment (DCE)	none; use (local) Stored Program Control Switch (SPCS), Packet Handling Function (PHF), or exchange termination (ET)
Data Terminal Equipment (DTE)	Terminal Equipment: TE, TE1, or TE2/TA; Customer Premises Equipment (CPE)
network address extension (NAE)	subaddress
packet switch data transmission	packet mode bearer service
packet switch (PS)	SPCS/PHF

Table 2-2 summarizes the support of utilities addressed in sections 6 through 8 of this document. The table indicates the CCITT status of each utility and the PPSN/BOC-ISDN support status for each utility, on both international and domestic interfaces. [A domestic interface is one with both STEs within the U.S.] The table also lists the sections in this document that addresses each utility.

Two appendices to this document complete the summary of PPSN/BOC-ISDN X.75 interface characteristics. Appendix A highlights, in tabular form, the modification and enhancements to X.75 that are contained in the remainder of this document. This table should facilitate the use of this TR, in conjunction with CCITT Recommendation X.75.

Appendix B is a sample X.75 interface configuration worksheet. It illustrates the type of worksheet that a network might complete and submit to a PPSN/BOC-ISDN so that one or more X.75 interfaces could be provisioned and configured in a mutually acceptable fashion. This sample worksheet summarizes the remainder of this document in a format that is most useful to a packet network representative responsible for ordering/negotiating X.75 interfaces to a

PPSN/BOC-ISDN. A worksheet or similar device may be used by some PPSN/BOC-ISDNs to facilitate the provisioning of X.75 interfaces.

Figure 2-1. Illustrative Inter-Network Interface Diagram

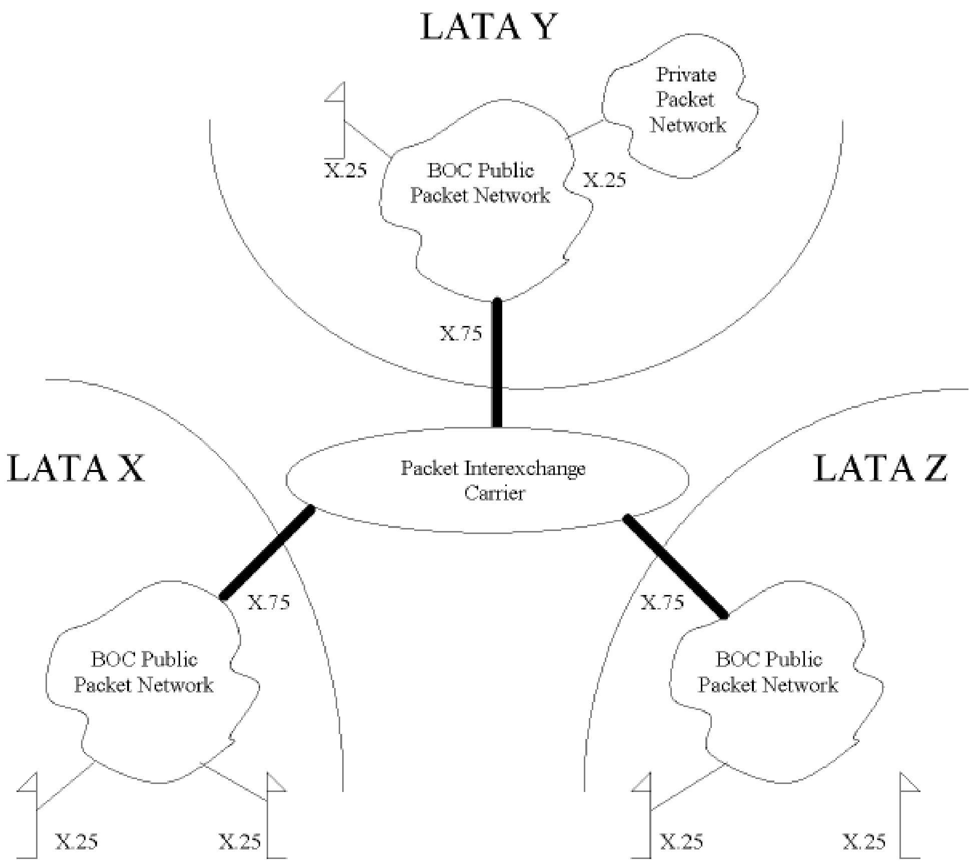

Table 2-1. Summary of PPSN/BOC-ISDN X.75 Interface Attributes & Configuration Options*

Physical Level
- Speeds: 9.6 and 56 Kbps
- Interface: DDS [C]; analog private line (9.6 Kbps only) [O]

Link Level

LAPB	
Single Link Procedure	
Multilink Procedure [O]	
Modulo 8 Frame Sequencing	
Modulo 128 Frame Sequencing [O]	
Parameter K	1-7 (modulo 8) 1-60 or 1-127 (modulo 128) [O]
Timer T1	1-10 seconds in 0.5 sec. Increments
Parameter T2	does not exceed 0.4 seconds
Timer T3	1-30 sec., or functional equiv. of T3 [P]
Parameter N1	2104 or 2120 (SLP) [C]; 2136 (MLP) [O] (ability to set to other values [O])
Parameter N2	2-15, in increments of 1
MPL Parameters MW, MN1, MT1, MT2, MT3 [O]	**

Packet Level

Virtual Call Service	
Parameter Virtual Circuit Service	
Modulo 8 Packet Sequence Numbering	
Modulo 128 Packet Sequence Numbering [O]	
Maximum Number of Logical Channels:	
9.6 kbps	64, 128 [R]
56 kbps	64, 128, 256, 512 [R]
Logical Channel Selection:	lowest unassigned or highest
Unassigned Octet-Aligned User Data Field Passed Transparently	
Enforcement of Octet Alignment (unless waived bilaterally) [R]	
Screening on up to 100 CUG interlock codes per interface [O]	
Time-out T30	180 seconds
Time-out T31	200 seconds
Time-out T32	180 seconds
Time-out T33	180 seconds
Window Sizes (VC/PVC):	1-3 [C]; 4-7 [O] (modulo 8) 1-60 or 1-127 (modulo 128) [O]
Throughput Classes (VC/PVC):	75, 150, 300, 600, 1200, 4800, and 9600 19200 and 48000 on 56 kbps interface [0]
Maximum Packet Sizes (VC/PVC):	128, 256

NOTE: * All items are [C]urrent unless explicitly marked [P]lanned, [O]ptional, or [R]ecommended: See Table 1-1 for meanings.
** MLP is optional; there are no BOC/IDC standardized ranges for associated parameters.

Table 2-2. Utility Support Summary

UTILITY	TR Sect.	CCITT X.75	BOC/IDC INT'L X.75	BOC/IDC DOMEST.X.75
International Mandatory				
Transmit Network Identification	6.1	M	C,E	C,E
Call Identifier	6.2	M	C,E	C,E
Throughput Class Ind.	6.3	M	C,E	C,E
Window Size Indication	6.4	M	C,E	C,E
Packet Size Indication	6.5	M	C,E	C,E
Fast Select Indication*	6.6	M	C	C
Closed User Group Ind.	6.7	M	C,E	C,E
Called Line Address Modified Notif.	6.8	M	C,E	C,E
Transit Delay Indication*	6.9	(M,1985)	O	O
International Optional				
Closed User Group/OA Ind.	6.7	O	C	C
Reverse Charging Indication	6.10	O	C	C
Clearing Network Identif. Code	6.11	O	P	P
Transit Delay Selection	6.12	(O,1985)	O	O
Utility Market	6.13	O	P	P
National				
RPOA Selection	6.14	(N,1985)	B	P
CCITT Further Study				
Tariffs*	6.15	S	S	S
Traffic Class Indication	6.16	S	S	S
Address Extension	6.16	S	S	S
BOC/IDC-Specified				
IC Preselection Indication	7.1	-	B	O
Proposed for CCITT				
Network User Identification	8.1	-	S	S
Numbering & Addressing Plan Ind.	8.2	-	S	S

LEGEND: CCITT And TR Catagories

M = Mandatory (CCITT)

O = Optional (CCITT; or as per Sect. 1-3)

S = For further study

B = Should not use (without special bilateral agreement)

R = Telcordia (formerly Bellcore) Recommended (Sect. 1-3)

E = Support of Interfaceing Network Expected (Sect. 1-3)

C = Currently Available on PPSNs (Sect. 1.3)

* = By Bilateral Agreement for Interim Period

N = National (CCITT)

P = Planned PPSN Availability (Sect. (Sect. 1.3)

1985 = Added in 1985 X.75 Draft Revision

1.3. Physical Level

A packet-capable network may connect to a PPSN/BOC-ISDN with one or more X.75 interfaces, depending on the throughput characteristics and reliability requirements that apply to the traffic to be carried between the two networks. The specific BOC/IDC or PPSN/BOC-ISDN should be contacted directly for guidelines on determining the appropriate number and speed of X.75 interfaces.

All PPSNs support X.75 interfaces with 9.6 and 56 kbps physical level data signaling rates. BOC-ISDNs should provide such support, when deployed. All PPSN/BOC-ISDNs support digital interfaces that are compatible with the Digital Data System (DDS) Interface at both transmission speeds.[6],[7] [Interfaces operating at 64 kbps may be introduced in the future in support of ISDNs.]

Some PPSNs may also support analog private line interfaces at the 9.6 kbps data signaling rate.[8] The interconnecting network and the PPSN should mutually agree on a private line analog channel with the appropriate data conditioning and modem. [For example, type D1 high performance data conditioning on a type 3002 private line with 2096A type compatible modems.]

1.4. Link Level

The link level of the X.75 interface supported by all PPSN/BOC-ISDNs is LAPB, as specified in section 2 of X.75. All PPSN/BOC-ISDNs conform to the integral (i.e., non-optional) portions of these LAPD specifications and these specifications are not repeated in this document. It is expected that non-BOC/IDC network X.75 interfaces also conform to the integral portions of LAPB. This section discusses support of optional aspects of LAPD, parameter values and other aspects of the link level which are not specified in X.75. The material is addressed under three headings, corresponding to the three major components of the link level: frame structure and format, procedures, and parameters & configuration options.

1.4.1. Frame Structure and Format

PPSN/BOC-ISDNs support modulo 8 frame sequencing. Support of modulo 128 frame sequencing is optional. For an interim period, some networks supporting modulo 128 frame sequencing may only support the alternative (1980 version) U format (2-octet control field), as specified in Tables 4/X.75 and 6/X.75 of CCITT Recommendation X.75. Thus, during this period, support of at least this alternative may be necessary for compatibility in modulo 128 frame sequencing. The 1-octet control field U format is the standard format for modulo 128, which CCITT specifies is to be used in the absence of a bilateral agreement to use the alternative format.

1.4.2. Procedures

PPSN/BOC-ISDNs support the single link procedure (SLP) and it is expected that interfacing networks also support SLP, at least as an interface option. Support of multilink procedure (MLP) is optional.

1.4.3. Parameters & Configuration Options

1. The degree of flexibility available in setting parameters and configuration options on an X.75 interface are expected to be such that a PPSN/BOC-ISDN and the interfacing network can achieve a mutually agreeable set of compatible values. For those parameters which must match at both ends of the interface to achieve compatibility, the set of PPSN/BOC-ISDN and other network alternatives for the parameter or option must contain at least one appropriate value in common that can be selected by both ends. Link level parameters which must match for interface compatibility include: window size for each direction of transmission and frame sequencing modulo. Link level addresses assigned to the STE at each end of the interface must be complementary. Other parameters, such as T1 and T2, are related in a more complex manner for compatibility, as stated below.

2. For modulo 8 frame sequencing, PPSN/BOC-ISDNs support a link level window size, k, selectable from among the values 1-7 (in increments of one). The same value of k applies in both directions or transmission and this parameter must match at both ends of the interface.

3. If modulo 128 frame sequencing is used, the link level window size is selectable from among the values 1-60 (in increments of one). Among PPSN/BOC-ISDNs that support modulo 128 frame sequencing, some may allow window size to be selected from the range 61-127, in addition. The same value applies in both directions of transmission.

4. All PPSN/BOC-ISDNs support a timer, T1, (defined in X.75 section 2.4.8.1), which can be set to values in the range from 1-10 seconds in 0.5 second increments. Some PPSN/BOC-ISDNs may support other values for this parameter as well.

5. The response parameter T2 (defined in X.75 section 2.4.8.2) does not exceed 0.4 seconds on any PPSN/ISDN X.75 interface. The period associated with parameter T2 starts when the last bit of the frame is received and ends when the STE has completed the process necessary to generate an acknowledgment of that received frame in the next frame it transmits. For correct operation, T1 and T2 should be settable so that the conditions of sections 2.4.8.1 and 2.4.8.2 of X.75 are satisfied. Correct operation can be assured if the value of T2 is smaller than TTY the value of T1, minus twice the propagation time over the interface, minus the total frame processing time at both ends, and minus the transmission time for the acknowledgment frame (assuming the T1 timer is started at the end of the transmission of a frame).

6. All PPSN/BOC-ISDNs plan to support a timer T3 (defined in X.75 section 2.4.8.3), or an alternate mechanism with similar functionality to detect a link layer abnormality. On

expiration of the T3 timer, an indication of an observed excessively long idle channel state condition is passed on MLP (if supported), or to the packet level, for proper error recovery and disconnection. If the T3 timer is supported, Telcordia (formerly Bellcore) recommends that it be settable to all least the values from 1-30 seconds, in 1 second increments, other parameter values may also be used. If an alternate mechanism of similar functionality is supported, a serious abnormality in the link layer will be reported to a higher layer within a reasonable period of time (recommended to be less than 30 seconds). The values of parameters set for the T3 or alternate mechanism at either end of the interface are not critical for compatibility, but X.75 specifies that the T3 value should be made known to the two interfacing networks.

If a PPSN/BOC-ISDN packet level is informed of expiration of the T3 timer, Telcordia (formerly Bellcore) recommends that the packet layer assume failure of the link layer, apply the failure procedures specified in X.75 Section 3.6, and report the failure for administrative/maintenance purposes.

7. All PPSN/BOC-ISDNs can support at least the N1 value (X.75 section 2.4.8.5) of 2104 (or 2120) for SLP operation. These values can accommodate 256-octet user date field data packets with SLP operation (2120 also accommodates modulo 128 sequencing at the link and packet layers). Other values of N1 may also be supported, depending on sequencing and SLP/MLP options, and the packet size configured for the interface. In some cases, the value on N1 should also be able to accommodate a maximum size Clear Request packet which may exceed the maximum size of a data packet. For compatibility, the value of N1 should be no smaller than the maximum frame size that can be legally generated at either end of the interface given the maximum packet size, frame and packet level sequencing, SLP/MLP support, and utilities/facilities supported on the interface.

8. All PPSN/BOC-ISDNs support the parameter N2 (defined in X.75 section 2.4.8.4) with values that can be set in the range 2-15, in increments of 1. The values of N2 configured at either end of the interface need not match for compatibility.

9. Complementary frame level addresses for the PPSN/BOC-ISDN and interfacing network STEs, for a given X.75 interface, are assigned by mutual agreement.

10. If a PPSN/BOC-ISDN support MLP, it conforms to the procedure specified in the 1985 (CCITT Red Book) version of X.75. If the X.75 interface is configures as part of the MLP, it assumed that the interfacing network also supports the 1984 version of the MLP, as specified in section 2.5 of X.75.

11. If MLP is supported, six additional parameters apply. These are parameters MW, MX, and MN1 and the timers MT1, MT2, and MT3. The value of the multilink window size

MW must be agreed upon by the PPSN/BOC-ISDN and the interfacing network and it must be the same for both STEs for a given direction of transmission. Minimum supported ranges of values have not yet been established for PPSN/BOC-ISDNs for any of the six MLP parameters. If MLP is desired and the PPSN/BOC-ISDN does support this capability, a compatible set of parameter values should be negotiated by the two networks. The following are illustrative of the type of ranges that might be supported for these parameters:

MW	2-4094
MX	1-2047
MN1	0-15
MT1	1-30 sec.
MT2	1-60 sec.
MT3	1-30 sec.

The minimum set of parameter values that can be configured for a specific PPSN/BOC-ISDN that supports MLP can only be determined by contacting the PPSN/BOC-ISDN or responsible BOC/IDC.

1.5. Packet Level

All PPSN/BOC-ISDNs are, and any interfacing network is expected to be, in conformance with the integral (i.e., non-optional) features, capabilities, and procedures of the X.75 packet layer protocol (PLP), as specified in sections 3, 4, and 5 of X.75. The remainder of this section provides amplifications on the additions to the X.75 specifications that apply to connections with PPSN/BOC-ISDNs. This material is presented under five major subheadings: virtual call and PVC service, packet formats, procedures, parameters & configuration options, and transmission of X.25 user facilities. Although part of the PLP, network utilities are presented in three separate sections (6, 7, and 8) because of the volume of material that must be covered.

1.5.1. Virtual Call and PVC Service

1. All PPSN/BOC-ISDNs support virtual call service as specified in section 3.1 of X.75.

2. All PPSN/BOC-ISDNs support inter-network permanent virtual circuit (PVC) service as specified in section 3.2 of X.75 and CCITT Recommendation X.181.[9]

3. The maximum number of simultaneous virtual calls plus permanent virtual circuits that can be in use on the interface is equal to the number of logical channels configures for the interface, excluding logical channel 0. [Logical channel 0 is reserved for control packets that affect the entire interface, such as the restart request packet].

4. Telcordia (formerly Bellcore) recommends that networks be able to support up to 64, 128, 256, or 512 logical channels on a 56-kbps X.75 interface and up to 64 or 128 log-

ical channels on a 9.6 kbps X.75 interface, as configuration options. Some PPSN/BOC-ISDNs may support other values in addition. For compatibility, the PPSN/BOC-ISDN and interfacing network must agree upon the same value for the maximum number of logical channels supported on the interface.

5. All PPSN/BOC-ISDN interfaces can be configured to specify a range of logical channels as reserved for PVCs and a range as reserved for (two-way) virtual calls. Some PPSN/BOC-ISDNs may also be able to specify ranges of logical channels as reserved for incoming-only virtual calls and outgoing-only virtual calls. [Here, “incoming” and “outgoing” are relative to the STE, and thus the incoming range of STE-X is the outgoing range of STE-Y.] Telcordia (formerly Bellcore) recommends that it should be possible to define any of these ranges as null sets. Some PPSN/BOC-ISDNs may require that these ranges of logical channels be contiguous. The PPSN/BOC-ISDN and interfacing network should be able to agree upon a compatible set of such ranges for the available logical channels.

6. All PPSN/BOC-ISDN X.75 interfaces can be configured to select among logical channels on either a “lowest unassigned” or “highest unassigned” basis when allocating calls to logical channels within the appropriate range.

1.5.2. Packet Formats

The coding and arrangement of the fields composing the various packet types are consistent with X.75 section 4. The following also apply.

1. All PPSN/BOC-ISDNs will transparently pass octet-alligned user data. Furthermore, Telcordia (formerly Bellcore) recommends that octet alignment be required in the absence of a specific bilateral agreement to sort user data fields that are not octet aligned. In the absence of such a bilateral agreement, Telcordia (formerly Bellcore) recommends enforcement of octet alignment as follows. If a packet that is not octet aligned is detected, the packet level procedure associated with handling this error condition (see Annex C of X.75) is applied. In particular refer to Note 2 of Tables C-2/X.75, C-4/X.75, and C-5/X.75; Note 3 of Table C-3/X.75; and the specifications for the “ERROR” condition in each of the tables of Annex C.

2. All PPSN/BOC-ISDNs support modulo 8 packet sequencing on X.75 interfaces.

3. Some PPSN/BOC-ISDNs may also support modulo 128 packet sequencing on X.75 interfaces as a configuration option.

4. The following clarification applies to the clear request packet format. The address length field is always present when the network utility length field is present. The net-

work utility length is always present when the user facility length field is present. The user facility length field is always present when the user data field is present.

Sections 4.2.3, 4.4.3, and 4.5 of X.75 address the three types of packet in which a diagnostic code may appear. Diagnostic codes in the range 0-127 are specified in X.75 on an internationally standardized basis. Codes in the range of 128-255 are defined on a network-specific basis.

In addition to those code values already defined, use of currently unused codes in the 0-127 range may be proposed to CCITT to deal with problem conditions for which existing diagnostic codes are inadequate.

Given these considerations:

5. All PPSN/BOC-ISDNs plan to conform to the X.75 specifications for CCITT-standardized (0-127) diagnostic codes, including the numberical value interpretations presented in Annexes C, D, and E. Any exceptions to such conformance should be explicitly noted to the opposite network.

6. All PPSN/BOC-ISDNs plan to be capable of accepting and transparently passing (except for code conversions specifically required by X.75 Tables 14, 15, and 18 when the cause is “network congestions”) all diagnostic codes, including those in the network-specific range (128-225). Any exceptions to such handling of diagnostic codes should be explicitly noted to the opposite network.

7. Proposals may be submitted to CCITT to assign specific new diagnostic meanings to several code values in the 0-127 range that are currently unused. It is desirable for networks to be able to accommodate such code additions within a reasonable time after their adoption. Introduction of the following three diagnostic codes is part of a proposal currently being considered [the precise interpretation of each code would depend on the accompanying cause]:

    - Requested RPDA invalid/unknown or RPDA not specified
    - Requested RPDA cannot service request
    - NUI value invalid, unsupported, or absent

1.5.3. Procedures

PPSN/BOC-ISDN X.75 interfaces conform to the packet level procedures specified in section 3 of X.75. It is expected that interfacing networks also conform to these procedures.

Although the more data flag (i.e., the M bit) procedures are supported, a PPSN/BOC-ISDN may not be able to fragment and/or recombine packets. These are the capabilities to divide the same user data, respectively. These capabilities allow for inter-working between DTEs operating with different maximum packet sizes.

1.5.4. Parameters & Configuration Options

1. The degree of flexibility available in setting parameters and configuration options on an X.75 interface is expected to be such that the PPSN/BOC-ISDN and the interfacing network can achieve a mutually agreeable set of compatible values. For those parameters which must match at both ends of the interface to achieve compatibility, the set of PPSN/BOC-ISDN and other network alternatives for the parameter or option must contain at least one appropriate value in common that can be selected by both ends. Packet level parameters which must match for interface compatibility include: maximum window size, maximum packet size, and throughout class for each direction of transmission; maximum number, assignment direction, and allocation ranges of logical channels; and packet sequencing modulo.

2. All PPSN/BOC-ISDN interfaces support the packet level time-outs defined in X.75 Annex 0. It is expected that interfacing networks support these time-out or equivalent capabilities.

3. All PPSN/BOC-ISDNs support maximum packet (date field length) sizes of 128 and 256 octets as configuration options for the X.75 interface. Some PPSN/BOC-ISDNs may support other sizes in addition. Unless an alternative value is agreed upon by the two networks, a default value of 128 is assumed for the interface. The maximum packet sizes configured for the interface apply to all virtual calls, unless overriden by the Packet Size Indication utility (see section 6.5). It is possible to select different packet sizes for each direction of transmission. The configured maximum packet size should be the same as both ends of the interface for each direction of transmission.

4. Telcordia (formerly Bellcore) recommends support of maximum packet sizes of 128 and 256 octets as configuration options for each VC on an X.75 interface, independent of the virtual call maximum packet size configured for the interface. It is possible to select different packet sizes for each direction of transmission. These values should match at the two ends of the interface for each PVC configured.

5. The maximum value of the packet level window size for each direction of transmission of an X.75 interface that applies to all virtual calls on that interface is a configurable parameter on PPSN/BOC-ISDNs. The maximum window size is settable to values in the range 1-3 on all PPSN/BOC-ISDNs and to values in the range 4-7 in addition to

some PPSN/BOC-ISDNs for modulo 8 packet sequencing. If modulo 128 sequencing is supported, maximum window size is settable in the range 1-60. Some PPSN/BOC-ISDNs that support modulo 128 packet sequencing may support values in the range 61-127 in addition. The maximum window size configured for each direction of the interface should match at both interface ends. The window sizes selected for each direction of transmission for a particular virtual call should be less than or equal to the corresponding interface maximum values.

6. Telcordia (formerly Bellcore) recommends support of packet level window sizes settable in the range 1-7 for a PVC, as a configuration option, on X.75 interfaces using modulo 8 packet sequencing, independent of the packet level window size configured for the interface. If modulo 128 packet level sequencing is used on an X.75 interface, support of packet level window sizes of 1-60 as configuration options for PVCs, independent of the packet level window size configured for the interface, is recommended. PVC window sizes in the range 61-127, in addition, could also be supported on some PPSN.BOC-ISDNs. It is possible to select different window sizes for each direction of transmission. The configured window sizes for each PVC should match on the two ends of the interface.

7. All PPSN/BOC-ISDN X.75 interfaces support, as an interface configuration option, default throughout class values for each direction of transmission to apply to all virtual calls on the interface, unless overridden via the Throughput Class Indication utility on a per-call basis. It is expected that the interfacing network also supports this capability. The default values configured on the two ends of the interface should match.

8. Telcordia (formerly Bellcore) recommends that X.75 interfaces allow the throughput class for each direction of transmission on a PVC to be selected at subscription time from the range of throughput class values supported by the interface. It is possible to select different throughtput class values for each direction of transmission. The thoughput class values supported should be the same as those for the Throughput Class Indication utility (section 6.3).

9. Some PPSN/BOC-ISDNs may support screening of CUGs at the X.75 interface. If supported, the interface can be configured with up to 100 CUG interlock codes. If a PPSN/BOC-ISDN X.75 interface is configured with CUG interlock codes, any call request packet transiting the interface must indicate one of the configured interlock codes or the call will be cleared. This capability allows a PPSN/BOC-ISDN to screen calls to or from a directly connected private network upon request, for example.

1.5.5. Transmission of X.25 User Facilities

All PPSN/BOC-ISDNs plan to support the ability to transparently pass X.25 user facilities (that are not mapped into network utilities) within the facility field of the call request, call connected, or clear request packet, as appropriate. At a minimum, facilities falling into this category include all those specified in Annex G of CCITT Recommendation X.25.[10].

1.6. CCITT Utilities

With one exception, the utilities addressed in this section are addressed in section 5 of the 1984 version of CCITT Recommendation X.75. Those that are fully defined have been categorized as either “International Mandatory” or “International Optional” during CCITT meetings held in April/May 1985 (Geneva) and November 1985 (Munich).[11] The mandatory utilities (designated with a “M” below) are to be supported on all international interfaces. Internationally, the optional utilities (designated with an “0”) are supported by bilateral agreement, but are to be implemented as specified if supported.

The RPDA Selection utility was added to the list of CCITT X.75 utilities during the April/May 1985 CCITT meeting. The RPDA Selection utility has been categorized as a “National Utility (N),” and is not supported on an international basis. Thus, a network would normally not pass the RPDA selection utility over interfaces that cross national boundaries, unless a specific bilateral agreement permitting such international use where in effect.

The heading of each subsection addressing a CCITT defined utility parenthetically specifies one of these three utility categories, based on the 1985 CCITT meeting cited above. However, these CCITT categories are not equivalent to the support levels designated for PPSN/BOC-ISDN X.75 interfaces. The level of support provided for each utility on X.75 interfaces for PPSN/BOC-ISDNs is specified within the text of each utility subsection below and in Table 2-2.

In addition to the specifications provided below for individual utilities, the following apply in general.

1. Utility codes supported on PPSN/BOC-ISDNs conform to Table 20/X.75 of 1984 CCITT Recommendation X.75.

2. Each utility indicated as being international mandatory (M) in the subsection headings below is expected to be supported as specified in Recommendation X.75 by any network connecting to a PPSN/BOC-ISDN via an X.75 interface, with the following possible exceptions:

    - Fast Select Indication. This utility is expected to be supported in the long term, but it may not be supported by some networks for an interim period.

- Called Line Address Modified Notification. This utility is expected to be supported in the long term, but it may not be supported by some networks for an interim period.

- Transit Delay Indication. Support of this utility is expected to be provided in the long term. The coding of this utility was recently specified [11} and some networks may not support this utility for an interim period.

3. Utilities categorized as “International Optional” or “National” are supported by PPSN/BOC-ISDNs as specified in Table 2-2 and the text below for the corresponding utilities. Support of such utilities on X.75 interfaces to other networks is assumed to be by bilateral agreement.

4. Some of the utilities listed in Table 2-2 have been specified by CCITT on a draft basis, but have not yet been formally approved and published. Until such utilities are formally published by CCITT, their status is ambiguous. Telcordia (formerly Bellcore) recommends that prior to draft approval of any such utility by CCITT, the utility be passed after the utility market, if it is supported. Following the draft approval by CCITT, Telcordia (formerly Bellcore) recommends that it should be passed before the utility market, is supported. However, the ability to place and accept such “draft” utilities either before or after the utility marker would reduce the possibility of incompatible implementations among networks during transitional periods. Currently the utilities that fall into this category are: Transit Delay Indication, Transit Delay Selection, and RPDA Selection.

1.6.1. Transit Network Identification (M)

The Transit Network Identification (TNIC) utility is used to identify each transit network controlling a portion of the virtual call. A typical use for the information carried in this utility is to identify participating transit networks so that inter-network agreements (covering areas such as billing) can be implemented.

Most often, a PPSN/BOC-ISDN will be an originating or terminating, rather than transit, network. However, there are certain circumstances under which a PPSN/BOC-ISDN might serve as a transit network. In particular, a PPSN/BOC-ISDN might act as a transit carrier if it receives a call from a directly connected private packet network and passes the call on to an IC or directly connected PSPDN. In such a case a PPSN would insert an instance of the TNIC utility with its own Data Network Identification Code (DNIC) in the parameter field over an X.75 interface. It remains for further study what coding or method would be used if the transit network is an ISDN.

A PSTN or BOC/IDC ISDN within the same LATA is not considered to be a separate network for the purposes of determining whether the PPSN is acting as a transit network. Similarly, a

PPSN within the same LATA is not considered to be a separate network for the purposes of determining whether the BOC-ISDN is acting as a transit network.

Several PPSNs and possibly other packet networks may share a DNIC. Thus, various possibilities for extending or supplementing the standard TNIC utility to permit identification of individual operating companies or LATAs as a transit network are being considered. One possibility is introduction of a new utility to be used to supplement the DNIC when it alone cannot uniquely identify a network. The above mentioned possibilities are all for further study.

1. The transit network identification utility is supported on the X.75 interface, as specified in sections 5.3.1 and 5.4.3.1 of Recommendation X.75.

2. It is expected that any non-BOC/IDC network, connected to a PPSN/BOC-ISDN via an X.75 interface, will insert an instance of the TNIC utility identifying itself (via its DNIC) in the call request packet if it is acting as a transit network for the call being established. Instances of the utility inserted by other networks are passed transparently over subsequent X.75 interfaces by PPSN/BOC-ISDNs and this same treatment is expected of interfacing networks.

3. A PPSN/BOC-ISDN will normally not insert a TNIC utility instance sine it normally does not function as a transit network. However, for some PPSN/BOC-ISDNs there may be circumstances under which the PPSN/BOC-ISDN does insert an instance of the TNIC utility identifying it as a transit network. This may occur if the call originates on or is destined for a private packet network directly connected to the PPSN/BOC-ISDN via an X.75 interface.

4. The current specification of TNIC relies solely on the DNIC value in the parameter field of the utility to identify the corresponding transit network. Because a DNIC may be shared by numerous PPSNs and possibly other PSPDNs within the U.S., the TNIC may not be able to uniquely identify a PPSN or even an individual BOC/IDC as the transit network. Several alternative approaches to permit individual PPSNs (and ISDNs operating in the packet mode) to be distinguished from one another are currently under consideration. Any such approach is intended to apply to all utilities in which a network is to be uniquely identified (e.g., TNIC, clearing network identification code, and closed user group). Adoption of such an approach is for further study. Until such an approach is adopted and supported, a TNIC inserted by a PPSN may not unambiguously identify it if more than one transit network involved in the call shares the same DNIC. The coding or method to be used to identify an ISDN as a transit network is for further study.

1.6.2. Call Identifier (M)

The Call Identifier utility is always present in the call request packet passed over an X.75 interface. Its initial insertion is the responsibility of the originating network and it is passed transparently over subsequent X.75 interfaces during call setup. The utility carries a 24 bit parameter field, which, together with the calling address, is intended to uniquely identify a virtual call to all of the networks involved, over a reasonable period of time (see below). This unique identifier can be used by the networks participating in the call to permit meaningful comparison of billing and error reports and other call statistics.

1. The call identifier utility is supported by PPSN/BOC-ISDNs and is expected to be supported by networks connecting to PPSN/BOC-ISDNs over X.75 interfaces, as described in sections 5.3.1 and 5.4.3.2 of X.75.

2. Responsibility for first inserting the call identifier utility rests with the originating network.

3. Pending further study on the contents of the parameter field by CCITT, some networks may not pass a significant parameter field value in this utility. If the parameter field value is not significant, it cannot fulfill the intended purpose of uniquely distinguishing virtual calls and is set to all zeros by the originating network.

4. If the content of the utility parameter field is significant, Telcordia (formerly Bellcore) recommends that the value be such that it, together with the calling address, can uniquely identify the corresponding virtual call (or call attempt) over a reasonably long period of time (i.e., calls from the same calling address during the same day can be distinguished from one another). However, beyond this general requirement, there is no further constraint upon the encoding format or contents of the 24 bits.

5. For the purposes of determining responsibility for generating this utility, a PPSN is also considered to be the originating network if the call originates in the PSTN on a dial-in basis to the PPSN.

1.6.3. Throughput Class Indication (M)

The throughput class indication utility is used to request and negotiate between networks the throughput class values to apply to a virtual call for each direction of transmission. Networks may maintain or reduce the throughput class explicitly requested across an X.75 interface, but may not increase it. If the utility is not present, the default throughput class bilaterally agreed for the interface is assumed.

1. All PPSN/BOC-ISDNs support the throughput class indication utility and the utility is expected to be supported by any network connected to the PPSN/BOC-ISDN over an

X.75 interface. This support should be in accordance with sections 5.3.3 and 5.4.3 of X.75.

2. An STE through which a call transits may either accept the requested/current throughput class values of lower it. The value should not be raised. If the throughput class indication utility is not present, the network should assume the default value agreed upon by the PPSN/BOC-ISDN and the interfacing network. Reliance upon this default should be avoided if the prevailing default throughput class exceeds a value requested by a previous network or a DTE, since this condition should result in clearing of the call. Throughput classes may be different for each direction of transmission.

3. Within the constraints of the throughput class requested by the user and prevailing resource limitations applying to a given call, all PPSN/BOC-ISDNs will be capable of supporting throughput classes up to and including 9600 bps (i.e., 75, 150, 300, 600, 1200, 2400, 4800, and 9600 bps). The 19.2 and 48 kbps throughput classes might be supported by some PPSN/BOC-ISDNs on 56 kbps interfaces. [The addition of 64000 and/or 16000 bps as valid X.75 throughput class values may be proposed to CCITT in conjunction with the corresponding ISDN access speeds.]

1.6.4. Window Size Indication (M)

The window size indication utility is used to request, and negotiate among networks, the packet level window values to apply to a virtual call for each direction of transmission.

1. All PPSN/BOC-ISDNs support the window size indication utility and the utility is expected to be supported by any network connected to the PPSN/BOC-ISDN over an X.75 interface. This support should be in accordance with sections 5.3.4 and 5.4.3.4 of X.75.

2. If the X.75 interface supports modulo 8 packet level sequencing, all PPSN/BOC-ISDNs support bracket level window sizes of 1 through 3. Window size values in the 4 through 7 range may be supported by some PPSN/BOC-ISDNs. The actual range of window sizes available is subject to any maximum size configured for the PPSN/BOC-ISDN interface that applies to all virtual calls. If the window size indication is not present, a default of 2 should be assumed unless prior arrangement between the PPSN/BOC-ISDN and connecting network has assigned another default value. If extended mode (modulo 128) packet level sequencing is supported on the interface, additional window size values in the range 1-60 will be supported and values in the range 61-127 may also be supported.

1.6.5. Packet Size Indication (M)

The packet size indication utility is used to request, and negotiate among networks, the maximum date field length (i.e., packet size) to apply to a virtual call for each direction of transmission.

All PPSN/BOC-ISDNs support the packed size indication utility and the utility is expected to be supported by any network connected to the PPSN/BOC-ISDN over an X.75 interface. This support should be in accordance with sections 5.3.5 and 5.4.3.5 of X.75. All PPSN/BOC-ISDNs support maximum packet size values of 128 and 256 octets. If the packet size indication utility is not present, the default maximum packet size determined by interface configuration option is used.

1.6.6. Fast Select Indication (M)

The fast select indication utility allows up to 128 octets of user data to be carried in the call request packet. When no restriction on response is indicated in such a call request packet, the remote STE is permitted to issue a call connected packet containing a user data field of up to 128 octets. If a response restriction is indicated in the call request packet, the remote STE is not permitted to issue a call connected packet in response. At any time, a clear request packet containing up to 128 octets of user data may be issued. The fast select mode permits information transfer during the call establishment phase and without necessarily entering the data transfer phase.

PPSN/BOC-ISDNs support the fast select indication utility, as described in sections 5.3.6 of X.75. Both “restriction on response” options are supported.

1.6.7. CUG (M) Indication and CUG/DA (O) Indication

The closed user group (CUG) indication and closed user group with outgoing access (CUG/DA) indication utilities are used to enable the establishment of virtual calls by DTEs which are members of CUGs that span networks. Associated with each CUG is a CUG interlock code which has end-to-end significance across the networks involved. This interlock code is mapped from or to a corresponding CUG index at the DTE/DCE interface which has only local access interface significance. The CUG/DA indication is passed instead of the CUG indication if outgoing access capability is being signaled for the call.

1. All PPSN/BOC-ISDNs support both the CUG indication utility and the CUG/DA indication utility. Any network connecting to a PPSN/BOC-ISDN via an X.75 interface is expected to support at least the CUG indication utility. Support of these utilities should be consistent with sections 5.3.7, 5.3.8 and 5.4.3.7 of X.75 and section 5.3.3.1.2.2 of 1984 CCITT Recommendation X.300.

2. Only one, the CUG indication or the CUG/DA indication, should be present in a call request packet.

1.6.8. Called Line Address Modified Notification (M)

The called line address modified notification (CLAMN) utility indicates that the called address in the call connected or clear request packet is different from the called address in the call request packet for that call. The utility also indicates the reason for the change in called address.

All PPSN/ISDNs plan to support the CLAMN utility. The utility should be supported as described in sections 5.3.10 and 5.4.3.8 of X.75.

1.6.9. Transit Delay Indication (M)

The transit delay indication utility was not fully specified in the 1984 version of X.75. However, it was fully defined and categorized as an international mandatory utility in 1985.

The revised specifications relating to this utility are reproduced below [emphasis omitted and editorial notes added] from the Special Rapporteur report cited earlier.[11] The coding of the utility code field remains as in the 1984 X.75 Recommendation.

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.

The transit delay is defined as [1] 3 in Recommendation X.135, and is expressed in terms of the 95% value. [See item 3 below] 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." [See item 4 below.].

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. The call will be established without this utility.

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.

The revised specifications for the coding of the utility parameter are as follows:

This parameter is two octets. Transit delay is expressed provisionally in milliseconds, binary coded, with bit 8 of octet 1 being the high order bit and bit 1 of octet 2 being the low order bit.

1. Pending official publication of the revised CCITT specifications, support of the transit delay indication utility is considered to be optional. If this utility is not supported across the X.75 interface, calls are established without it. If it is supported, it is supported in conformance to these specifications and section 5.4.2 of X.75.

2. If supported, PPSN/BOC-ISDNs will insert (if not instance of the utility yet exists) or add (if an instance of the utility already exists) an estimate of the nominal transit delay across the network to the parameter field at each outgoing X.75 interface.

3. Recent decisions within CCITT suggest that “mean value” will replace “95% value” in the above definition of transit delay.

4. During an interim period when not all networks support this utility or the X.25 Transit Delay Selection and Indication facility, a draft revision of Recommendation X.25 specifies that all bits of the parameter field be set to one to indicate that at least one transit or designation network participating in the call does not support the utility/facility. Since a transit delay longer than 65534 milliseconds is highly unlikely, possible confusion between use of “all ones” coding to indicate delay values greater than 65534 milliseconds and use to indicate network non-support is not considered to be a significant problem. The latter interpretation should normally be assumed during the interim period.

1.6.10. Reverse Charging Indication (O)

The reverse charging indication utility is used to signal that the originating user has requested charges be reversed to the destination user. In the absence of this utility, it is assumed that the call is charged to the originating user. [The use of the NUI facility is assumed not to alter the end of call held responsible for the bill.]

All PPSN/BOC-ISDNs support the reverse charging indication utility, as described in sections 5.3.9 and 5.4.3.6 of X.75.

1.6.11. Clearing Network Identification Code (O)

The clearing network identification code (CNIC) utility provides additional information about the network origin of a clear request.

1. All PPSN/BOC-ISDNs plan to support the CNIC utility, as specified in sections 5.3.11 and 5.4.3.9 of X.75.

2. A PPSN will identify itself as the source of a clear request by inserting a CNIC utility instance in the clear request packet, with its DNIC in the parameter field of the utility. The DNIC of the PPSN will be used even if the physical location of the clearing condition is within the PSTN portion of the BOC/IDC network for a dial-in call.

3. Since DNICs are shared within the U.S., the CNIC utility issued by a PPSN may not be able to uniquely identify that PPSN as the clearing network if another network sharing that DNIC is also participating in the call. Various possibilities for extending or supplementing the standard CNIC utility to permit identification of individual operating companies or LATAs as a clearing network are being considered. One possibility is introduction of a new utility to be used to supplement the DNIC when it alone cannot uniquely identify a network. These possibilities are all for further study. The coding or method to be used for identifying ISDNs as the clearing network is also for further study.

1.6.12. Transit Delay Selection (O)

The transit delay selection utility was not fully specified in the 1984 version of X.75. However, it was fully defined and categorized as an international optional utility in 1985.

The revised specifications relating to this utility are reproduced below [emphasis omitted] from the Special Rapporteur report cited earlier.[11] The coding of the utility code field in these new specifications is “01001011” with bit 8 on the left.

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.

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.

The revised specifications for the coding of the utility parameter are as follows:

This parameter is two octets. Transit delay is expressed provisionally in milliseconds, binary coded, with bit 8 of octet 1 being the high order bit and bit 1 of octet 2 being the low order bit.

1. Support of the transit delay selection utility is optional. If not supported on an X.75 interface, a virtual call is established without the utility. If supported, it will conform to the above specifications.

2. What routing action a PPSN/BOC-ISDN takes in response to the delay value carried in this utility, if any, is for further study.

1.6.13. Utility Market (O)

The utility marker is used to separate any BOC/IDC-specified and other non-CCITT supported on the X.75 interface by bilateral agreement from CCITT utilities.

1. All PPSN/BOC-ISDNs plan to support the utility market, as specified in sections 5.3.17 and 5.4.3.15 of X.75.

2. All CCITT X.75 utilities (international mandatory, international optional, and national) should precede the utility marker, if present. [Draft CCITT utilities that have not yet been formally published may appear before or after the marker during an interim period, depending on interface implementation and bilateral agreement. However, Telcordia (formerly Bellcore) recommends that such utilities appear after the market, prior to draft CCITT approval, and before the marker, following draft approval, if the placement cannot be easily switched in response to the needs of the opposite STE.]

3. All other utilities, including any non-standard versions of CCITT utilities should follow the utility marker.

1.6.14. RPDA Selection (N)

As of April 25, 1985, the RPDA selection utility has been included in CCITT Recommendation X.75. The text of this addition to the X.75 is reproduced below from the meeting report of the Special Rapporteur cited earlier.[11]

DPDA selection is a network utility that may be used to name an RPDA 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 RPDA in the originating country.

This utility can be used to carry an RPDA transit network DNIC specified by the calling DTE. When more than one transit network is specified by the calling DTE, a sequence of RPDA selection utilities may be present in the Call Request packet. In this case, the order of identification of transit networks by the RPDA selection utilities is identical to the order specified by the calling DTE.

Temporary Note – The identity of the RPDA transit network for ISDN-to-PSPDN and ISDN-to-ISDN inter-workings is currently under study.

A network receiving a Call Request packet containing one or more RPDA selection utilities will route to the next requested network, removing the RPDA 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 RPDA selection utility should not be present in the Call Connected and Clear Request packets. No indication of the RPDA selection should be present in the user facility field of the Call Request packet.

The addition to the Recommendation X.75 designates the utility code for RPDA selection to be the following class B value: “01000100” (bit 8 at the left). It also states the following on coding of the utility:

The parameter field contains the data network identification code for a requested RPDA transit network and is in the form of four decimal digits.

Temporary Note – The RPDA transit network identify coding for ISDN-to-PSPDN and ISDN-to-ISDN inter-working is currently under study.

Each digit is coded in a semi-octet in binary coded decimal with bit 5 or 1 being the low order bit of the digit. The high order digit is coded into bits 8 to 5 of the first octet of the parameter.

PPSN/BOC-ISDNs normally use this utility for internal purposes and to permit directly connected packet networks to signal that a particular interexchange carrier (IC) be used to complete a call. If the extended format of the utility is not used, an RPDA utility would not be passed to ICs across the X.75 interface.

1. All PPSN/BOC-ISDNs plan to support the RPDA selection utility, as specified above, with the following qualifications and amplifications.

2. The extended format of the utility may not be permitted in some PPSN/BOC-ISDNs.

3. Normally, the outgoing PPSN/BOC-ISDN X.75 STE deletes the (next) RPDA selection utility (associated with the interfacing network) form the X.75 call setup packet. However, some PPSN/BOC-ISDNs may support two configuration option variables associated with the handling of the RPDA selection utility. These option variables would specify, respectively, whether or not the RPDA selection utilities is to be: (1) deleted

before being passed and (2) accepted if receive, over an X.75 interface. These configuration options are used to support certain special cases (such as calls originating on private networks directly connected to the PPSN/BOC-ISDN, which require that the RPDA utility be retained on the associated inter-network interfaces). If the PPSN/BOC-ISDN X.75 interface is configures not to accept an RPDA selection received over an X.75 inter-network interface, it will clear any incoming call request containing an RPDA selection utility.

1.6.15. Tariffs Utility

In general, the Tariffs utility is intended to be used to pass information among networks to permit or facilitate billing and other financial arrangements negotiated by the interfacing networks. Because of the nature of this information, it can also be useful for other administrative applications within a network.

Neither the operation nor coding of the Tariffs utility is yet defined in X.75. It is a subject for further study. However, some PPSNs may support a PPSN-specified utility that serves a similar function and could be used, subject to bilateral agreement, across the X.75 interface. This PPSN-specified utility is typically class A and is used to pass an 8-bit class code defined by the source network: the originating network if it appears in the call request packet and the destination network if it appears in the call connected or clear request packet. For additional information on possible availability and coding of such a network-specific utility, the individual PPSN should be contacted.

1.6.16. Traffic Class Indication & Address Extension

The 1984 version of X.75 identifies two other utilities: the Traffic Class Indication utility and the Address Extension utility. At this time, both are for further study.

1.7. BOC/IDC-Specified Utilities

Some PPSN/BOC-ISDNs may support the following network-specific utility. It is introduced to address PPSN/BOC-ISDN needs that are not adequately addressed by existing CCITT utilities. As a network-specified utility, it should follow the utility marker, and it is passed between networks only by bilateral agreement.

1.7.1. IC Preselection Indication

The BOC/IDC-specified utility, IC Preselection Indication, is used to pass an indication that the originating DTE has subscribed to the IC Preselection facility. This facility permits a user to specify a default interexchange carrier (IC) to be used in all calls requiring such a carrier if an RPDA is not explicitly selected on a per-call basis. The parameter field of the utility contains the DNIC of the preselected IC. This utility differs from the RPDA Selection utility in that an explicit RPDA selection always results in routing via the designated IC, whereas routing via a preselected IC is conditional upon need (see section 10 for further details on PPSN/BOC-ISDN inter-network call routing rules). This utility would be used if:

- both the PPSN/BOC-ISDN and a packet network directly connected to the PPSN/BOC-ISDN by an X.75 interface support this utility by bilateral agreement;
- the network directly connected to PPSN/BOC-ISDN supports an IC preselection subscription option for its users; and
- that network relies upon the PPSN/BOC-ISDN for the routing logic necessary to determine if an IC is necessary to complete the call and for the physical connection to the IC.

1. Some PPSN/BOC-ISDNs may support the IC Preselection Indication utility on X.75 interfaces on an interface configuration option basis.

If supported, the following apply.

2. If the IC Preselection Indication utility is present in a call request received over an X.75 interface, the PPSN/BOC-ISDN will use the DNIC contained in the parameter field for routing in accordance with section 10. The IC Preselection Indication utility will not be passed by a PPSN/BOC-ISDN over an outgoing X.75 interface.
3. Format and coding of the IC Preselection Indication utility should follow those specified for CCITT utilities in section 5.4.1 of X.75. The class B utility code is "01100101" (bit 8 on the left). The parameter field contains the DNIC of the preselected IC. Each semi-octet encodes one of the four digits of the DNIC in BBCD, in the same order specified for the RPOA Selection utility.

1.8. Other Utilities Under Study

There are several areas for which no CCITT utility has yet been specified, but which are under consideration to meet identified PPSN/BOC-ISDN interworking needs. Proposed utilities associated with two of these areas are identified below. Both are currently for further study.

1.8.1. Network User Identification

A network user identification (NUI) utility would permit passing between networks either a portion of the X.25 NUI selection facility passed by an end user or user identification information derived from that NUI. This utility could be used to facilitate inter-network billing agreements and/or to pass customer verification information. Support of this utility assumes the existence of an agreement for passing such information between the PPSN/BOC-ISDN and the interfacing network. The need for and coding of this proposed utility is for further study.

1.8.2. Numbering and Addressing Plan Indicator

As a PSPDN, a PPSN has a native addressing system that conforms to CCITT Recommendation X.121. However, calls carried by a PPSN can originate or terminate on network that are not PSPDNs, such as a PSTN or ISDN. These other network types use addresses conforming to CCITT Recommendations E.163 and E.164. For calls which involve networks which do not have the same native numbering plan, it is necessary to be able to distinguish the type of address present. Descriptions of these numbering plans and a short-term approach to distinguish among them using escape digits are contained in Section 9.

However, a different mechanism is needed as a long-term solution. Among the reasons for a long-term solution based on a new Number and Addressing Plan Indicator (NAPI) utility is the need to avoid an address field overflow that can occur with an address party prefix or escape code approach. The need for such a long-term solution is currently being addressed within CCITT Study Group VII. Once this mechanism is defined for X.75 interfaces by CCITT, it should be supported. Until that time, it is considered to be for further study.

1.9. Addressing

1.9.1. General Comments

This section discusses network addresses, the associated numbering plans, and the passing of addresses between networks over X.75 interfaces. The rules that PPSNs and BOC-ISDNs apply in determining whether to route a call via another network and in selecting the appropriate interfacing network are discussed in the next major section.

The numbering plans from which the PPSN and BOC-ISDN addressing schemes are derived are outlined below. The conforming subsets of these reference numbering plans that are used within PPSNs and BOC-ISDNs are then described. Next, major issues related to numbering are discussed. Finally, format assumption and desirable configuration option capabilities for address handling between a PPSN/BOC-ISDN and another network over an X.75 interface are detailed.

Throughout this section ,"N" is used to present a digit in the range 2-9 and “X” is used to represent a digit in the range 0-9.

1.9.2. Reference Numbering Plan

There are separate, internationally standardized (i.e., CCITT) numbering plan Recommendations for PSPDNs and for telephone service and ISDNs. In addition, there is a more highly structured scheme that has been used within North America for telephony. [This scheme is not a CCITT numbering plan, but rather a conforming subset.] Since these reference numbering plans form the basis for the numbering plans used within PPSNs and BOC-ISDNs, they are introduced below and the key format components that are relevant on an inter-network basis are briefly described.

1.9.2.1. PSPDN Numbering Plan (X.121)

The numbering plan used within PSPDNs is specified in CCITT Recommendation X.121.[12] Although abbreviated forms of PSPDN addresses are often used within a network, a full International Data Number (IDN) is always passed over an X.75 interface between networks. An IDN consists of from five to fourteen decimal digits. The first four digits are the Data Network Identification Code (DNIC) which identifies a network or group of networks. The remaining one to ten digits are the Network Terminal Number (NTN) which identifies a specific PSPDN DTE/ DCE interface or hunt group within the network or group of networks assigned that DNIC.

1.9.2.2. ISDN Numbering Plan

The numbering plan used within ISDNs is specified in CCITT Recommendation E.164.[13] Related CCITT Recommendations include E.163,[14] E.160,[15] and I.330.[16] ISDN addresses consist of 15 or fewer decimal digits, made up of a Country Code (CC) and a National (Significant) Number or N(S)N. The N(S) can be broken down into two components: a National Destination Code (NDC) and a Subscriber Number (SN). The first one to three digits of the address constitute the Country Code (CC), used to specify the country or geographic area. Country Code 1 has been assigned by CCITT to World Zone 1, which thus applies to the North American Numbering Plan (see below).

The N(S)N is used to specify the individual subscriber. The first component of the N(S)N, the NDC, is of variable length and can be used to specify a network or a geographic area (or both) within the country or geographic area designated by the CC. In fulfilling this function, the NDC can be composed of a Destination Network (DN) code to specify a network, a Trunk Code (TC) to specify a geographic area, or both. The remaining (variable) number of digits of the N(S)N are the Subscriber Number (SN), which identifies the specific end user within the network.

1.9.2.3. North American Numbering Plan

The addressing used for the United States public switched telephone network (PSTN) is the North American Numbering Plan (NANP).[17] According to the NANP, a ten-digit number is used to uniquely address each telephone line. The ten-digit number is composed of three parts:

- The first three digits are referred to as the Numbering Plan Area (NPA) or area code, and designate a geographic area. The NPA is currently of the form N 0/1 X.

There are plans to expand the codes available for NPAs in the future so that the form NXX can be used.

- The following three digits are the Central Office (CO) code which identifies the end office which provides dial tone to the customer. Currently, in all but ten NPSs, the CO code format of NNX is followed. Within the ten NPAs of the exception, interchangeable CO codes[1] have been introduced.

- The last four digits are the station number which uniquely identifies the line. These four digits are in the XXX format.

1. This refers to the situation within a given NPA, in which codes of the format N 0/1 X (i.e., those codes traditionally used only as NPA codes) are used for CO codes in addition to the traditional code of the format NNX. Thus, interchangeable CO codes are of the format N 0/1 X and the full set of working CO codes having the format NXX.

Since 7-digit numbers (the home NPA assumed) are permitted, the network must be able to determine whether the first three digits of a dialed number are an NPA (10-digit number) or a CO code (7-digit number). When overlapping formats are permitted for NPAs and CO codes, it is recommended that the prefix “1” be used to indicate that a 10-digit number is being dialed. Use of the “1” prefix is not recommended for 7-digit numbers.

1.9.3. PPSN and BOC-ISDN Network Addresses

The addressing schemes used in PPSNs and BOC-ISDNs are conforming subsets of the corresponding CCITT numbering plan cited above (X.121 and E.164, respectively). These subsets reflect the NANP format to facilitate administration and so that there can be a graceful transition from the existing telephone numbering plan to ISDN services within the BOC/IDC service areas:

1.9.3.1. PPSN Numbering Plan

The PPSN numbering plan conforms to the 1984 version (Red Book) of CCITT Recommendation X.121,[12] X.110,]18] X.25,[10], X.75,[1] and X.32.[19]

There is a close correlation between the PPSN numbering plan and the NANP formats, but the PPSN numbering plan is not included within the NANP. According to the PPSN numbering plan, the ten-digit NTN is used to uniquely address each PPSN DTE/DCE interface or hunt group. Each PPSN NTN is composed of three parts which are similar in format to the NPA, CO code, and station number of the NANP:

- The first three digits are referred to as the Data Numbering Plan Area (DNPA) code, and may or may not designate a geographic area that corresponds to a telephony NPA. These digits have an NXX format.

- The following three digits are the Data Central Office (DCO) code which identifies a geographic area or an X.25, X.75, or equivalent interconnection point. These digits have an NXX format.

- The last four digits are the End Point Number (EPN) which uniquely identifies the interface or hunt group. These digits have an XXXX format.

The 4-digit DNIC always precedes the NTN as part of the IDN which is passed across X.75 interfaces and it is used to distinguish among PSPDN networks or groups of PSPDN networks.

Within PPSNs, the prefix “1” is used to differentiate between a 10-digit PPSN NTN and any of the other address formats supported within the network. Specifically, a DTE would prefix any of the following address formats with a “1” to alert the network that the 10-digit NTN format (the default format) is not being used:

- DNIC specifically indicated: 1 + DNIC + NTN

- PSTN address: 1 + 9 + TCC + TN

- ISDN address: 1 + 9 + CC + NDC +SN

However, prefixes are never passed over X.75 interfaces. If present within a network, the prefix is stripped off before being passed to another network.

For dial-in calls from the PSTN to a PPSN, some PPSNs always insert the address of the PPSN dial-in port into the calling address field. Other PPSNs insert a virtual network address derived from the contents of the NUI facility, if that facility is present. The specific PPSN should be consulted for the current implementation and long-term plans concerning the calling addressed passed for dial-in calls.

1.9.3.2. BOC-ISDN Numbering Plan

The BOC-ISDN numbering plan conforms to the 1984 version (Red Book) of CCITT Recommendation E.164.[13] Within a BOC-ISDN (including the packet mode component), network addresses are based on the NANP and three E.164 address format are supported.

- international;

- national; and

- local.

The international format for BOC-ISDN network addresses consists of the Country Code (CC) plus ten digits. The national and local formats are shortened versions of the full international number which do not include: (a) the CC or (b) the CC plus NPA, respectively. These shortened formats assume CC=1 (World Zone 1, which includes the U.S.) and the home network NPA (local format only). In the absence of a mechanism to indicate different address formats across X.75 interfaces (see the discussion of major issues in the next section of this document), only the international format may be used between networks.

All BOC-ISDN network addresses are associated with a CC of 1. The next three digits of a BOC-ISDN address is the NPA. The NPA format is currently N 0/1 X, but the expanded NXX format is planned for future applications. This is followed by the three digit CO code in the NXX format. The last four digits are the line number in the XXXX format.

Within a BOC-ISDN, the local format is the default. Prefixes are used to indicate that a national or international format follows. However, only the international format is passed between networks. Thus, prefixes never appear across X.75 interfaces.

1.9.3.3. Escaping From Numbering Plans

Escape digits are prepended to numbers to indicate that the following number does not belong to the native numbering plan (X.121 or E.164) of the network. Escape digits are originally signaled by DTEs and escapes are kept, added, deleted, or modified by networks, over X.75 interfaces encountered during call establishment, as appropriate, given bilateral agreements and the numbering plan format presumed for the interface. Although each numbering plan provides for escaping to the other, the expression “native numbering plan” as it is used here, refers to the numbering plan characteristic of end user addresses on the given network. An ISDN assumes an E.164 address unless an escape is present and a PSPDN assumes an X.121 address unless an escape is present. Since interworking between networks with different native numbering plans is anticipated (e.g., PSPDN/ISDN), escape digits (unlike prefixes) can appear at the beginning of the addresses passed over X.75 interfaces.

Within the X.121 numbering plan, an E.164/E.163 address is indicated by preceding the address with the escape digit “9.” [The escape digit “0” may be used by some non-BOC/IDC networks, but support within BOC/IDC networks of “0” for escape to E.164/E.163 is not planned.]

Within the E.164/E.163 numbering plan, an X.121 address is indicated by preceding the address with the escape digit “0.”

Several issues related to escape digits and interworking between PSPDNs and ISDNs remain open at this time. These and other major issues that impact address handling over X.75 interfaces are discussed in the next section.

1.9.4. Major Addressing Issues

There are several unresolved issues that impact the handling of addresses over X.75 interfaces. They are briefly discussed below. Their ultimate resolution may result in modification or expansion of the guidelines for address handling between PPSN/BOC-ISDNs and other networks over X.75 interfaces that are presented in the next subsection. Also included below are brief issue discussions that provide background for some of the specifications in the address handling subsection.

1. Mechanisms for escaping from one numbering plan to another for interworking between networks are based on an assumption concerning which numbering plan format applies across the interface. An escape is necessary only when the following address belongs to a numbering plan that is “not native” to the format applying across the interface. According to the 1984 (Red Book) version of the X.75 protocol, the X.121 format is assumed across the interface. Based on this assumption, an address (calling or called) would be escaped over an X.75 interface only if it was not a native X.121 (i.e., PSPDN) address, independent of the native numbering plans of the networks on either end of the interface.

However, there are plans to extend the scope of X.75 so that it explicitly addresses connections to networks other than PSPDNs (e.g., ISDNs operating in the packet mode). This extension reflects the internetwork applications planned for X.75 interfaces, as described earlier in this document. Under such an expanded definition for X.75, the escape rule stated above may be modified in the future.

The escape guidelines presented in the next subsection reflect the current CCITT Recommendation concerning numbering plan formats across X.75 interfaces for PSPDN/PSPDN and PSPDN/ISDN interworking. However, for ISDN/ISDN X.75 interfaces, Telcordia (formerly Bellcore) recommends that escaping rules conforming to the E.164/E.163 format be employed. Before these escaping conventions are finalized and until the NAPI mechanism (see below) is available, it may be advisable to implement escaping procedures with configuration option flexibility.

2. Some networks have expressed the desire to receive a service type indication, along with the called address, specifying the appropriate network/user interface type for completing the call at the receiving end. For example, in a call from an X.25 terminal on a PSPDN to an X.25 terminal served by an ISDN, the destination network may with to have an explicit indication of whether the destination end service is to be X.31 (ISDN packet mode connection) or X.32 (circuit-switched). However, this requires that the calling party be aware of the service type at the destination end, in addition to the address. Thus, Telcordia (formerly Bellcore) considers it preferable that the destination

network be able to complete the call based on its own knowledge of the appropriate service type for the called address which it serves.

3. In the long run, it is important to replace escape mechanisms and prefixes with a separate indicator that is not prepended to the address itself. Among the reasons for such a change is the need to remove the restriction placed upon current E.164 addresses by ISDN/PSPDN interworking. The calling and called addresses in X.25 and X.75 packets is restricted to be 15 digits or less. Since E.164 addresses without prefix or escape digits can be up to 15 digits, the use of these additional digits reduces the number of digits available for the E.164 address proper to be less than 15.

To address this problem, a Numbering and Addressing Plan Indicator (NAPI) has been proposed and is currently under consideration by CCITT Study Group VII. In the interim, escapes and prefixes will be used and BOC-ISDNs will restrict their network addresses to 12 digits or less. The date December 1996 (time “T”) has been selected by CCITT Study Group II as the point at which a NAPI mechanism has been approved and assumed to be implemented by networks, and a full 15-digit E.164 address can be used.

4. For ISDNs within North America, there remain questions on the integration of networks outside of the BOC/IDCs into the NANP. In particular, questions have been raised concerning the assignment of available codes from the first three digits of the 10-digit NANP number or assignment of dedicated CO codes within existing NPAs to World Zone 1 networks other than the BOC/IDCs and USTA members. Related to these questions is the possibility of supporting Destination Network (DN) codes (identifying networks) as well as NPAs (identifying geographic areas) in the first three digits of a national format E.164 number for World Zone 1. Such DN codes could be followed by a standard NANP format (NXX-XXXX).

Given the unresolved questions in this area, it is recommended that implementation of address handling for X.75 interfaces be designed so that they can accommodate or be configured to accommodate these various possibilities.

1.9.5. X.75 Interface Address Handling

Based on the above material, this subsection summarizes the working assumptions for addresses passed over X.75 interfaces connecting PPSNs and BOC-ISDNs to other networks. It also presents suggestions for address handling by other networks to provide the flexibility necessary to accommodate the anticipated standards developments and to achieve compatibility in an environment of network and equipment implementation diversity.

1. The contents of calling address and called address fields of packets passed over X.75 interfaces connecting PPSN/BOC-ISDNs and other networks should consist of an ad-

dress, possibly preceded by an escape digit. The escape digit is present if and only if the address belongs to a numbering plan that is not the “native” numbering plan, as defined below. Prefixes should not be present.

2. Currently, the X.121 numbering plan format is presumed over X.75 interfaces. However, the escape mechanism included in X.121 allows network addresses corresponding to both the PSPDNs (X.121) and PSTN/ISDNs (E.163/E.164) to be passed over X.75 interfaces. When a PPSN to other PSPDN is either (or both) of the two ends of an X.75 interface, the escaping is done in accordance with Recommendation X.121. [This is consisted with the 1984 version of X.75.] When both ends of an X.75 link are ISDNs, Telcordia (formerly Bellcore) recommends that escaping should be done in accordance with Recommendation E.164. [This reflects an anticipated change in X.75 to accommodate ISDNs.]

3. The default assumption is that any X.121 address (without escape if the native plan is X.121 and preceded by an escape digit if the native plan is E.164) consists of a full IDN (DNIC + NTN), of between 5 and 14 digits, as specified in Recommendation X.121. Those IDNs which correspond to a PPSN network address will conform to the PPSN address format described earlier.

4. The default assumption is that any E.163/E.164 address (without escape if the native plan is E.164 and preceded by an escape digit is the native plan is X.121) consists of a full international format number, as specified in Recommendation E.163 and E.164 (TCC + TN or CC + N(S)N). The address must consist of at least 7 digits. Prior to time “T” (December 1996), the total number of address digits cannot exceed 12. After time “T” the address may be up to 15 digits and the NAPI mechanism will replace the escape code mechanism. Currently, addresses on a BOC-ISDN or PSTN network are of the format 1 + NXX-NXX-XXXX (with the NPA and CO components possibly restricted to more limited formats than NXX, as described earlier). Other addresses that have a Country Code (CC) of 1 are assumed to have the same format as BOC/IDC networks or (possibly) a format in which a Destination Network (DN) code follows the CC.

5. It is expected that a Numbering and Addressing Plan Indictor (NAPI) mechanism will be adopted by CCITT in the near future. The proposed facility/utility version of this mechanism will permit numbering plans and address formats to be explicitly distinguished without the need of escape digits or prefixes within the address field itself. After a NAPI mechanism is approved by CCITT, it is suggested that it be implemented expeditiously over X.75 interfaces. After the availability of the NAPI mechanism (and by bilateral agreement during any interim period during which this mechanism is not yet universally available), escape digits would not be required and address formats other than the full IDN (X.121) or international number (E.164) would be permissible across X.75 interfaces.

6. The digit “0” is the escape digit used to indicate that an X.121 address follows, if the native numbering plan is E.163/E.164.

7. The digit “9” is the escape digit used to indicate that an E.163/E.164 address follows, if the native numbering plan is X.121. However, the digit “0” may also be used, when bilaterally agreed by the interfacing networks, to escape from the X.121 native numbering plan for service indicator purposes. While BOC/IDC networks may support the receipt from other networks of either the “9” or “0” to escape from X.121, there are no plans for these networks to distinguish destination interface service type on the basis of which of these two digits is received.

8. Normally, a PPSN will pass the escape digit signaled by the DTE, if any, across the X.75 interface. However, some PPSNs may be capable of converting the “0” escape digit to a “9” or converting the “9” escape digit to a “0” before passing an address over the X.75 interface, by bilateral agreement with the interfacing network.

9. If an invalid address format is received over the X.75 interface by a BOC/IDC network, the call will be cleared.

10. The following summarizes the address formats supported across X.75 interfaces:

All Except ISDN STE to ISDN STE Case:

X.121 IDN

or

9 + E.164/E.163 Int’l Address

or

0 + E.164/E.163 Int’l Address

ISDN STE to ISDN STE Case:

0 + X.121 IDN

or

E.164/E.163 Int’l Address

11. Addresses within PPSNs and BOC-ISDNs have the following formats:

PPSN X.121 IDN: DNIC + NXX-NXX-XXXX

BOC/IDC E.164/E.163 Int'l Address: 1 + NXX-NXX-XXXX

1.10. Routing Between PPSN/BOC-ISDNs and Other Networks

The previous section described the nature and format of addresses passed over the X.75 interface from or to a BOC/IDC network. It also discussed the currently available mechanisms used to distinguish between the two numbering plan (escape digits) and address formats (prefixes, used within the BOC/IDC network). This section discusses routing and related rules used or assumed by BOC/IDC packet mode networks that are relevant for internetwork calls. The address described in the previous section are an important input to the selections and decisions resulting from these rules.

This section consists of five subsections. The first outlines the ability of PPSNs and BOC-ISDNs to screen (and possibly block) incoming and outgoing calls at an X.75 interface (STE) on the basis of the first digits of the called address. The second subsection discusses the number of digits that may need to be examined to make network routing decisions, given the existing BOC/IDC numbering plans. The third describes the actual path selection criteria and rules. The fourth discusses alternate routes and path diversity. The final subsection discusses the ability to reconnect a path that has experienced some failure, without clearing the call.

1.10.1. Screening

Some PPSN X.75 interfaces may be configured with lists of DNIC values which are permitted to be received in the called address of incoming call requests. If the DNIC of the called address of any incoming call request is not on such a list, the call is cleared. If the interface is not configured with such a list, this screening does not take place. Such lists normally include the PPSN's DNIC, the DNICs of networks for which the PPSN is allowed to act as a transit network (e.g., directly connected private networks), and one or more codes of the form 91XX, where XX are the first two digits of the NPA(s) assigned to the LATA containing the PPSN and reachable by PPSN/BOC-ISDN interworking or via a dial-out port on that PPSN.

Some PPSN X.75 interfaces may be configured with lists of DNIC values which are not permitted to be sent in the called address of outgoing call requests. If the DNIC of the called address of any outgoing call request is on such a list, the call is cleared. If the interface is not configured with such a list, this screening does not take place. These lists could be used to block calls to networks with which the BOC/IDC does not have a billing agreement, for example.

1.10.2. Digit Requirements for Routing

Based on the nature of the numbering plans used by PPSNs and BOC/IDC ISDNs and PSTNs, other networks must inspect a minimum number of digits of the called address before an individual BOC/IDC network can be uniquely identified for routing purposes. For X.1121 addresses, it is necessary to examine either the DNIC plus the next three digits or the DNIC plus the next six digits of the X.121 address to determine the specific PPSN to which the address belongs. For World Zone 1 E.163/E.164 addresses, either the first three digits or the first six digits of the national format must be examined to establish the specific BOC-ISDN or PSTN to which the address belongs.

1.10.3. BOC/IDC Path Selection Criteria and Rules

This subsection discusses those aspects of Telcordia (formerly Bellcore) recommended routing procedures for PPSNs and BOC-ISDNs that are of relevance to interfacing networks. Implementation of these procedures is planned for all PPSNs.

First, recommended general routing capabilities and network information storage needs are described. Next, the criteria and rules recommended for use by BOC/IDC networks in routing calls to other networks and within the network (when received from other networks) are described in detail. Rules for routing to destinations within the BOC/IDC network are included so that interfacing networks can correctly populate the called address field (and possibly, the RPDA selection and/or IC Preselection utilities) to reach the desired BOC/IDC network destination.

1.10.3.1. General Routing Capabilities

Telcordia (formerly Bellcore) recommends that:

1. A PPSN be capable of routing to networks directly connected to itself or to a BOC-ISDN within the same LATA that is reachable from this PPSN on the basis of:

    - a DNIC or pseduo-DNIC as the RPDA selection or IC preselection; or

    - a DNIC, 9+CC, or 9+TCC plus the following zero, three, or six digits of the called address.

   A pseduo-DNIC, as used here, is the four digits of the RPDA selection or IC preselection which does not correspond to a regular PSPDN DNIC. [Later, the term “pseudo-DNIC” will also be used to refer to four digits consisting of escape digit 9, the country code 1, and the following first two digits of an E.163/E.164 address (“91XX”).]

2. A BOC-ISDN be capable of routing to networks directly connected to itself or to a PPSN within the same LATA that is reachable from this ISDN, on the basis of:

    - a DNIC or pseudo-DNIC as the RPDA selection or IC preselection;

    - DNIC plus the following zero, three or six digits of an X.121 number; or

- the first three or six digits of an E.163/E.164 NANP number.

3. A PPSN be capable of distinguishing a destination within the PPSN from destinations on other networks which share the same DNIC on the basis of the first three to six digits of the NTN.

4. A PPSN be capable of routing, on the basis of the first three to six digits of World Zone 1 E.163/E.164 national addresses, to the BOC/IDC PSTN or ISDN in the same LATA, and to other ISDNs connected directly to the PPSN or to a BOC-ISDN within the LATA.

5. A BOC-ISDN be capable of distinguishing a destination within that network from destinations on other World Zone 1 ISDNs and PSTNs on the basis of the first three to six digits of the E.163/E.164 national address. The same digits can be used to distinguish which of the ISDNs that are directly attached to the BOC-ISDN or the PPSN in the same LATA is the appropriate destination.

6. A BOC-ISDN be capable of routing, on the basis of the first three to six digits of the NTN of an X.121 address with the same DNIC as the PPSN within the same LATA, to that PPSN or to any packet network that is directly connected to the BOC-ISDN or the PPSN in the same LATA.

1.10.3.2. Routing Rules Used by BOC/IDC Networks

Calls are routed primarily on the basis of three pieces of information contained in the call request packet: the RPDA selection (if present); the called address; and the preselected IC (if configured/present). Until the NAPI mechanism is available, address fields are examined for the presence of escape digits to determine the corresponding numbering plan and the appropriate escape digit to use, if any, on outgoing X.75 interfaces. Routing logic recommended for use by a BOC/IDC network can be separated into two major cases: (a) RPDA selection specified and (b) RPDA selection not specified.

1. If an RPDA Selection Has Been Specified:

   A. For incoming inter-LATA calls, some BOC/IDC X.75 interfaces may be configured not to accept an RPDA selection in the incoming call request. This configuration option can be used to prevent the network from serving a purely transit network function. If this is the case, the incoming call attempt will be cleared if an RPDA selection utility is present.

   B. If an RPDA selection is received from a DTE on the network or in an incoming call request from another network (if permitted), and the specified four-digit value matches a DNIC or pseudo-DNIC (e.g., “9XXX”) contained in the network routing tables as belonging to the BOC/IDC network(s) in the LATA or a network directly connected to these, then the call should be routed to the specified network (however, see the exception for special DNIC values described in item “3”).

C. In all cases of a call reaching an outgoing X.75 interface, if that interface is configured with a list of DNICs and pseudo-DNICs (e.g., “91XX”) that are not allowed in the called address field, then the first four digits of the called address is compared against this list. [These four digits include the “9” escape digit, if present before an E.163/E/164 address, but not the “0” escape digit before an X.121 address.] If there is a match, the call is cleared. This capability can be used in cases for which the BOC/IDC does not have a billing agreement with the corresponding destination network, for example.

D. If the four-digit value specified in the RPDA selection does not match a DNIC or pseudo-DNIC in the network routing tables, then the call should be cleared.

E. Some PPSN/BOC-ISDNs may support a special class of DNIC value, which will be handled in a different way when it appears in a RPDA selection. Normally, a valid RPDA selection supersedes all other criteria (i.e., called address and IC preselection) for routing. However, if a four-digit value is specified as being of this special type by the network, its presence in an RPDA selection received from a network user will be ignored if the call can be completed on an intra-LATA basis. This special class could be used for transit networks that either do not which to or are not permitted to handle intra-LATA traffic, for example.

2. If an RPDA Selection Has Not Been Specified:

A. For incoming calls from another network, if the X.75 interface is configured with a list of called address DNICs and pseudo-DNICs that are permitted for incoming calls, the first four digits of the called address are compared to this list. [The first four digits include the escape digit “9” before an E.163/E.164 address, but not a “0” escape digit before an X.121 address.] If there is such a list configured and there is no match, the incoming call is cleared.

B. If the first digits of the called address are contained in the routing tables for other BOC/IDC networks in the LATA or networks directly connected to a BOC/IDC network in the LATA, the call is routed accordingly.

C. For X.121 PSPDN addresses, if the first four digits of the called address are the home DNIC of the BOC/IDC network, and the next three to six digits are contained in the BOC/IDC routing tables for the home DNIC, the call is routed accordingly. For E.164/E.163 World Zone 1 addresses, if the first three to six digits of the national number are contained in the BOC/IDC routing tables, the call is routed accordingly.

D. If none of the above hold then IC preselection in investigated. If a call originates on an access interface within the network that is configured with a preselected IC or, for an incoming call, if the X.75 interface is configured to accept the IC Preselection utility and this utility is present in the incoming call request, then the preselection value is used to route in the same manner as the RPDA selection was used when present (see case 1 above).

E. In all cases of a call reaching an outgoing X.75 interface, if that interface is configured with a list of DNICs and pseudo-DNICs that are not allowed in the called address field, then the first four digits of the called address is compared against this list. If there is a match, the call is cleared.

F. If the call amount be routed according to any of the above, the call is cleared.

Figure 10-1 is a flowchart which summarizes the routing logic described in more detail above. This flowchart only includes major decision branches for routing capabilities and options that are planned to be implemented on a majority of the BOC/IDC networks.

1.10.4. Gateway/Route Diversity

Some PPSN/BOC-ISDNs will be able to connect to another network with multiple X.75 interfaces. When available, this capability is used to provide additional traffic capacity, enhanced connection reliability, and/or reduced path lengths. Even when alternate routing capabilities are present, a PPSN/BOC-ISDN will not route a call to a network other than the specified by the RPDA selection, destination address, or IC preselection (in that order of precedence).

1.10.5. Reconnect Capability

Some PPSNs/BOC-ISDNs may support the ability to reconnect existing virtual calls, for which a virtual circuit component within the network fails, along an alternate route, without resetting.

1.11. Interface Provisioning and Maintenance

Procedures and responsibilities associated with requesting, provisioning, configuring, “turning up,” and maintaining an X.75 interface between a PPSN/BOC-ISDN and another network are established by mutual agreement of the two networks. The representative of a network which wishes to establish one or more X.75 interfaces to a PPSN/BOC-ISDN should directly contact that PPSN/BOC-ISDN or the responsible BOC/IDC for details.

One maintenance capability that is supported on many PPSN/BOC-ISDNs is X.75 interface takedown. This permits an X.75 interface to be taken out of service upon PPSN/BOC-ISDN operator request for maintenance action, to conduct diagnostic tests, and for similar purposes. It is assumed that most interfacing networks have a similar capability to temporarily remove an X.75 interface from service from its end for maintenance purposes.

As stated above, the administrative procedures and responsibilities associated with removing an active X.75 interface from service are established through mutual agreement between the PPSN/BOC-ISDN and the interfacing network. However, the technical capabilities associated with two forms of interface takedown that are planned for PPSN/BOC-ISDNs are outlined below. The two forms are labeled unconditional and conditional.

1. Unconditional takedown allows a craftsperson to take an individual X.75 interface out of service so that existing virtual calls associated with the interface are cleared and PVCs are reset immediately.

2. Conditional takedown allows a craftsperson to take an individual interface out of service more gracefully (i.e., the interface will be taken out of service only after all existing virtual calls associated with the interface have been cleared by DTE request or other cause).

3. When an unconditional X.75 interface takedown request is issued by a craftsperson, the STE executes the following actions:

    A. A restart procedure is initiated for the specific X.75 interface, which results in the clearing of all active virtual calls and the resetting of all PVCs that pass over the interface. All Restart Request, Clear Request, and Reset Request packets generated as a result of this restart procedure should contain the cause “network congestion” and the diagnostic code “maintenance action” (#122).

    B. After the restart procedure is completed, the STE should initiate a link level disconnect procedure for the X.75 interface. The STE should consider the interface unavailable for normal traffic and in the disconnected mode at the link level until the interface is restored to service by craftsperson command.

C. Following a craftsperson request to restore the interface to normal service, the interface should be re-initialized at the link level; PVCs should be reset and restored to operational status; and new call requests should once again be permitted to pass over the interface in the normal manner. At the packet level, a Restart Request with cause “network operational” may be used as part of this service restorial.

4. When a conditional X.75 interface takedown request is issued by a craftsperson, the STE first does all of the following before executing the actions associated with an unconditional takedown (item 3 above):

   A. Prevent any new virtual calls from being established over the interface by routing call requests over alternate facilities or immediately issuing a Clear Request in response to a Call Request that can only be routed over the facility to be taken out of service. The Clear Request should contain a cause code of “network congestion” and a diagnostic code of “maintenance action” (#122). Existing virtual calls and PVCs should not be affected at this point.

   B. When the STE detects that all virtual calls thought the X.75 interface have been cleared, the STE than applies the same procedure associated with the unconditional interface takedown, as described above. However, no virtual calls that must be actively cleared by the STE should at this time still be active for the conditional takedown case.

5. Some BOC/IDC networks may also support the ability of the craftsperson to abort a conditional takedown and restore the interface to normal service or “upgrade” the conditional takedown to an unconditional takedown if conditions or elapsed time justifies the action.

1.12. Acronyms

BOC - Bell Operating Company

BOC-ISDN - BOC/IDC ISDN

kbs - bits per second

CC - Country Code

CCITT - International Telegraph and Telephone Consultative Committee

CLAMN - Called Line Address Modified Notification (utility)

CNIC - Clearing Network Identification Code (utility)

CO - Central Office

CUG - Closed User Group

DCE - Data Circuit Terminating Equipment

DCO - Data Central Office

DDS - Digital Data System

DN - Destination Network (code)

DNIC - Data Network Identification code

DNPA - Data Numbering Plan Area

DTE - Data Terminating Equipment

EPN - End Point Number

IC - Interexchange Carrier

IDN - International Data Number

IDC - Information Distributing Company

ISDN - Integrated Services Digital Network

kbps - kilobits per second

LAPB - Link Access Procedure - Balanced

LATA - Local Area and Transport Area

LC - Logical Channel

M - Mandatory (utility)

MLP - Multilink Procedure

N - National (utility)

N - digit with value 2 through 9

NANP - North American Numbering Plan

NAPI - Numbering and Addressing Plan Indicator

NDC - National Destination Code

NNX - see “N” and “X”

NPA - Numbering Plan Area

N(S)N - National (Significant) Number

NTN - Network Terminal Number

NUI - Network User Identification

NXX - see “N” and “X”

O - Optional (utility)

OA - Outgoing Access

PAD - Packet Assembler/Disassembler

PLP - Packet Layer Protocol

PPSN - Public Packet Switched Network

PS - Packet Switch

PSPDN - Packet Switched Public Data Network

PSTN - Public Switched Telephone Network

PVC - Permanent Virtual Circuit

RPDA - Recognized Private Operating Agency

SLP - Single Link Procedure

SN - Station Number

STE - Signaling Terminal

TC - Trunk Code

TCC - Telephone Country Code

TN - Telephone Number

TNIC - Transit Network Identification (utility)

TR - (Bell Communications Research) Technical Reference

USTA - United States Telephone Association

VAN - Value Added Network

VC - Virtual Call

X - Digit with value 0 through 9

1.13. Appendix A: Summary of CCITT Modifications & Enhancements

CCITTsect	Trsect	Description	CCITT Spec.	TR Spec.
1	3	Transmission speeds	64, 48 kbps, other	9.6, 56 kbps
1	3	Interface type	V-Series Recommendation	DDS avail.; analog private line opt.
2.1.5	4.1	Frame sequencing modulo	8 or 128	8 avail.; 128 opt.
2.3.2.1.3	4.1	U format 128 modulo 2-octet control field	bilat., interim	recom., interim
2.3.5.3 Annex C	5.2	Octet alignment	opt.	recom., except by bilat.
2.4.8.1	4.3	Configuration T1 values	N.S.	1-10 sec. In 0.5 incr. Avail.
2.4.8.2	4.3	Value of 12	T2 < T1	T2 <= 0.4 sec.
2.4.8.3	4.3	T3 timer	reg.	T3 or equiv., plan.
2.4.8.3	4.3	Configurable T3 values	N.S.	T3, if used; 1-30 sec. recom.
2.4.8.4	4.3	Configurable N2 values	N.S.	2-15 avail.
2.4.8.5	4.3	Min. set of configurable N1 values	N.S.	SLP: 2104 or 2120 avail.
2.4.8.6	4.3	Modulo 128 link level window size (k)	1-127	If modulo 128 supported: 1-60 avail.; 61-127 opt.
2.5	4.2	Support of MLP	impl.	opt.
3,4.1	5.1	Max. no. of logical Channels	N.S. (<4096)	64, 128 recom. (and for 56 kbps link: 26, 512 also recom.)
3.3.3	5.4	Max. packet sizes	128 reg.; 16, 32, 64, 256, 512 & 1024 opt.	128, 256 avail.

LEGEND

N.S. = not specified
N.A. = not applicable/covered
bilat. = by bilateral agreement
impl = implied by CCITT X.75
req. = required

util. = utility
avail = available
equiv. = equivalent
incr. = increment

opt. = optional
recom. = Bellcore recommended
plan. = planned availability
interim = for interim period

CCITTsect	Trsect	Description	CCITT Spec.	TR Spec.
3.4.1.1	5.4	Supported VC packet window sizes	1-7 or 1-127	Mod 8: 1-3 avail., 4-7 opt.; mod 128: 1-60 avail., 61-127 opt.
3.4.1.1	5.4	Supported PVC packet window sizes	1-7 or 1-127	Mod 8: 1-7 avail.; mod 128: 1-60 recom., 61-127 opt.
3.4.1.2	5.2	Packet sequencing modulo	8 or 128	8 avail.; 128 opt.
5.3.7	5.4	CUG screening on X.75 interface	N.S.	Up to 100 interlock codes,. Opt.
5.3.8	6.7	CUG/OA indication util.	bilat.	avail.
5.3.9	6.10	Reverse charging indication util.	bilat.	avail.
5.3.10	6.8	Called Line Address Modif. Notif. Util.	reg.	plan.
5.3.11	6.11	Clearing network identification code util.	bilat.	plan.
5.3.13	6.9	Transit delay indication util.	reg. (1985)	defined, opt., before/ after marker
5.3.14	6.12	Transit delay selection util.	opt. (1985)	defined, opt., before/ after marker
5.3.17	6.13	Utility marker	bilat.	plan.
Annex E	5.2	Transparent passing of diag. Codes 128-255	impl.	plan.
—	6.14	RPOA selection util.	1985 national	plan., before/after marker; extended format opt.
—	7.1	IC preselection util.	N.A.	opt.

LEGEND

N.S. = not specified
N.A. = not applicable/covered
bilat. = by bilateral agreement
impl = implied by CCITT X.75
req. = required

util. = utility
avail = available
equiv. = equivalent
incr. = increment

opt. = optional
recom. = Bellcore recommended
plan. = planned availability
interim = for interim period

1.14. Appendix B: Sample X.75 Interface Configuration Worksheets

This appendix illustrates the type of information that would be supplied and the values that would be mutually agreed upon in establishing X.75 interfaces between a BOC/IDC network and another network. It is intended to be a convenient summary of the salient configuration option material contained in the body of this document, from the perspective of a person responsible for ordering/negotiating actual X.75 interfaces to PPSNs and BOC/IDC ISDNs. Although ranges of values and defaults provided are consistent with those specified elsewhere in this document, the specific BOC/IDC should be contacted directly for values pertaining to the PPSN or ISDN in question when actual interfaces are to be arranged. Similarly, the actual forms and procedures used by a particular BOC/IDC must be obtained from that specific company. Details of a business nature (e.g., billing arrangements, segment size) are not addressed in this document.

This appendix consists of an overview on using this appendix and the five tables:

- B-1 - Guide to the Use of Configuration Worksheet Tables
- B-2 - SLP Physical and Link Level Worksheet
- B-3 - MLP Link Level Worksheet
- B-4 - Interface/MLP Packet Level Worksheet
- B-5 - Permanent Virtual Circuit Worksheet

Table B-1 summarizes the use of the other (i.e., worksheet) tables for the various types of interface additions or modifications that might be requested/negotiated. An X.75 interface must be fully specified before any PVC can be specified for that interface. If one or more SLPs (interface link level) are to be coordinated through an MLP, then an MLP worksheet must be specified and the appropriate cross references between the MLP and each SLP it coordinates should be provided. Modifications to existing arrangements are specified through revisions to the table(s) used to request the original interface, MLP, or PVC. Simple deletions are specified by reference to the relevant identification code assigned to the interface, MLP, or PVC.

Table B-1: Guide to the Use of Configuration Worksheet Tables

	Worksheet Table			
	B-2	B-3	B-4	B-5
Establish/Modify a X.75 Interface (SLP Link Level)	X		X	
Establish/Modify an SLP Component of an MLP	X	CR		
Establish/Modify an MLP	CR	X	X	
Establish/Modify a PVC with SLP link layer	CR		CR	X
Establish/Modify a PVC with MLP link layer	CR	CR	CR	X
Add/Remove SLP(s) in MLP	CR	X		

X = Specify or Modify
CR = Cross-reference this other table

Table B-2: SLP Physical and Link Level Worksheet

Unique Interface ID Code: I- ________________

Part of MLP?: _____ Yes _____ No If yes, MLP ID Code: M-____________________

______ New ________ Modification

Non-BOC/IDC Requester is: ______ PSPDN ____ Private Packet Network ____ ISDN
Non-BOC/IDC STE Identification: ___________________________
Non-BOC/IDC Link ID: ____________________ ____ Terrestrial ____ Satellite

BOC/IDC STE: ____ PPSN ____ ISDN (D)NPA/(D)CO Code:______-______

Physical Level Item	Possible Values	Notes/Constraints	Requested
Transmission Speed	9.6, 56 kbps		
Interface Type	DDS, analog*	analog only 9.6 kbps	
Private line type	[ask BOC/IDC]	analog only	
Line conditioning	[ask BOC/IDC]	analog only	
Modem type	[ask BOC/IDC]	analog only	

SLP Link Level Item	Possible Values	Notes/Constraints	Requested
Link address of non-BOC/IDC STE	SLP: A,B; MLP: C,D	Pick a letter	
Frame sequencing modulo	8, 128*		
U format control field length (mod. 128)	1,2 octet	1 is standard	
Window size k, both STEs	Modulo 8: 1-7; modulo 128: 1-60, 61-127*		
Timer T1 of non-BOC/IDC STE	1-10 sec. In 0.5 steps (+)		
Parameter T2 of non-BOC/IDC STE	<<T1	BOC/IDC value < 0.4 sec.	
Non-BOC/IDC timer T3 or equiv.*	< 60 sec. Or N.A.	BOC/IDC T3: 1-30 sec.	
N1 of non-BOC/IDC STE	> max. legal frame size	BOC/IDC N1: 2104 Or 2120 for SLP, 2136 for MLP (256 packet size)	
N2 of Non-BOC/IDC STE	2-15 suggested	two ends need not Match	

* = Not available on all BOC/IDC networks
(+) = Additional values are often supported
N.A. = not applicable

Table B-3: MLP Link Level Worksheet*

Unique MLP ID Code: M-__________________

______ New _______ Modification

How Many SLPs?: _____________ For each, specify Interface ID:

I-______________________ I-____________________
I-______________________ I-____________________
I-______________________ I-____________________
I-______________________ I-____________________
I-______________________ I-____________________
I-______________________ I-____________________

All of above must apply to the same STE-X/STE-Y pair:

Non-BOC/IDC Requester is: ____ PSPDN ____ Private Packet Network ____ ISDN
Non-BOC/IDC STE Identification: ______________________

BOC/IDC STE: ____ PPSN ____ ISDN (D)NPA/(D)CO Code: ______-______

SLP Link Level Item	Possible Values	Notes/Constraints	Requested
Link address of non-BOC/IDC STE	SLP: A,B; MLP: C,D	Pick a letter	
Frame sequencing modulo	8, 128*		
U format control field length (mod. 128)	1,2 octet	1 is standard	
Window size k, both STEs	Modulo 8: 1-7; modulo 128: 1-60, 61-127*		
Timer T1 of non-BOC/IDC STE	1-10 sec. In 0.5 steps (+)		
Parameter T2 of non-BOC/IDC STE	<<T1	BOC/IDC value < 0.4 sec.	
Non-BOC/IDC timer T3 or equiv.*	< 60 sec. Or N.A.	BOC/IDC T3: 1-30 sec.	
N1 of non-BOC/IDC STE	> max. legal frame size	BOC/IDC N1: 2104 Or 2120 for SLP, 2136 for MLP (256 packet size)	
N2 of Non-BOC/IDC STE	2-15 suggested	two ends need not Match	

* = Note that MLP may not be supported at all by a specific BOC/IDC network.
** = Numerical values cited as possibilities are only illustrative for MLP.

Table B-4: Interface/MLP Packet Level Worksheet

Applies to: _____ SLP _____ MLP; SLP/MLP ID Code: [I/M] -_____________________

____ New ____ Modification

Non-BOC/IDC Requester is: ______ PSPDN ____ Private Packet Network ____ ISDN
Non-BOC/IDC STE Identification: ___________________

BOC/IOC STE: ____ PPSN ____ ISDN (D)NPA/ (D)CO Code: ______-______

Packet Level Item	Possible Values	Notes/Constraints	Requested
Max. Logical Channel No.	64, 128, 256, 512 (+)	256, 512 at 56 kbps only	
Range of LCs for 2-way calls	X-Y, Null	Specify X > 0, Y <=Max	
Range of LCs for PVCs	X-Y, Null	no overlap/gaaps with VCs	
Range of LCs for incoming (to non-BOC/IDC STE) VCs	X-Y*, Null	no overlap/gaps	
Range of LCs for outgoing (from non-BOC/IDC STE) VCs	X-Y*, Null	no overlap/gaps	
Non-BOC STE LC assignment rule	lowest or highest avail.		
Octet alignment enforced by Non-BOC/IDC?	Yes, No*		
Packet sequencing modulo	8, 128*		
Maximum packet size for VCs, To BOC/IDC	128, 256 (+)	128 default	
Maximum packet size for VCs, from BOC/IDC	128, 256 (+)	128 default	
Max. packet window for VCs, to BOC/IDC	1-3, 4-7*; if mod. 128 1-60, 61-127*	2 default for mod. 8	
Max. packet window for VCs from BOC/IDC	1-3, 4-7*; if mod. 128 1-60, 61-127*	2 default for mod. 8	
Default throughout class for VCs, to BOC/IDC	75, 150, 300, 600, 1200, 2400, 4800, 9600 + at 56 kbps: 19.2k*, 48k*		
Default throughput class for VCs, from BOC/IDC	75, 150, 300, 600, 1200, 2400, 4800, 9600 + at 56 kbps: 19.2k*, 48k*		

(Continued)

* = Not available on all BOC/IDC networks
(+) = Additional values are often supported

Table B-4 (Continued): Interface/MLP Packet Level Worksheet

Packet Level Item	Possible Values	Notes/Constraints	Requested
Screening of CUG interlock codes by BOC/IDC?*	Yes, No	If yes, specify no. of codes needed, up to 100	
T30 restart timer		CCITT: 180 sec.	
T31 call req. timer		CCITT: 200 sec.	
T32 reset req. timer		CCITT: 180 sec.	
T33 clear req. timer		CCITT: 180 sec.	
CCITT diagnostic codes (9-127) in full conformance to X.75?	Yes, No	If no, specify any exceptions	
Does network generate and pass network specific diagnostic codes (128-255)?	Yes, No	If yes, specify Values and meanings	
Does network transparently pass X.25 facilities?*	Yes, No	If no, provide details or exceptoins	

* = Not available on all BOC/IDC networks
(+) = Additional values are often supported

Table B-4 (Continued): Interface/MLP Packet Level Worksheet

Utility	Notes	NON-BOC/IDC SUPPORT (see Codes)	
		To BOC/IDC	From BOC/IDC
Transit Network Identification	Mandatory		
Call Identifier	Mandatory (Specify) if contents to BOC/IDC significant)		
Throughput Class Indication	Mandatory		
Window Size Indication	Mandatory		
Packet Size Indication	Mandatory		
Fast Select Indication	Mandatory (indicate if either of two response options not supported)		
CUG Indication	Mandatory		
CUG/DA Indication	Optional		
Called Line Address Modified Notif.*	Mandatory		
Transit Delay Indication*	1985 Mandatory; If support, indicate before or after marker		
Reverse Charging Indication	Optional		
Clearing Network Identification Code*	Optional		

(Continued)

* = Not currently supported by all BOC/IDC networks

SUPPORT CODES

Gen/Pass: Can generate utility or pass from prior network (to BOC/IDC)
Pass: Can pass utility from prior network but will not generate (to BOC/IDC)
Use: Will accept and make use of utility received (from BOC/IDC)
Accept: Will accept but not make use of utility received (from BOC/IDC)
No: Not supported (either direction)

Table B-4 (Continued): Interface/MLP Packet Level Worksheet

Utility (Cont.)	Notes	NON-BOC/IDC SUPPORT (see Codes)	
		To BOC/IDC	From BOC/IDC
Transit Delay Selection*	1985 Optional; if support, indicate before or after marker		
Utility Marker*	Optional		
RPDA Selection*	1985 National; if support, indicate before or after marker and if extended format		
Tariffs Utility*	Not yet defined; If support network-specific version provide details		
IC Preselection*	BOC/IDC-specified; toward BOC/IDC only		
Non-BOC/IDC network specific	If any such will be passed, provide details		

* = Not currently supported by all BOC/IDC networks

SUPPORT CODES

Gen/Pass: Can generate utility or pass from prior network (to BOC/IDC)
Pass: Can pass utility from prior network but will not generate (to BOC/IDC)
Use: Will accept and make use of utility received (from BOC/IDC)
Accept: Will accept but not make use of utility received (from BOC/IDC)
No: Not supported (either direction)

Table B-4 (Continued): Interface/MLP Packet Level Worksheet

Addressing/Routing Item	Notes/Alternatives	VALUE
DNIC of Non-BOC/IDC as Transit Network		
DNIC of Non-BOC/IDC Network Addresses	Non-ISDNs only	
Range of first 3-6 digits after DNIC (or "All") that characterizes all addresses on non-BOC/IDC network	Non-ISDNs only	
CC & range of first –6 following digits that characterizes all addresses on non-BOC/IDC network	ISDNs only	
Escape digit sent to BOC/IDC before X.121 address	none or 0	
Escape digit expected from BOC/IDC before X.121 address	none or 0	
Escape digit sent to BOC/IDC before E.163/E.164 address	none, 0, 9, or either	
Escape digit expected from BOC/IDC before E.163/E.164 address	none, 0, 9, or either	
Can the Non-BOC/IDC act as an inter-LATA carrier?	Yes or No	
Can the Non-BOC/IDC act as an intra-LATA carrier?	Yes or No	

Table B-5: Permanent Virtual Circuit* (PVC) Worksheet

Unique PVC ID Code: P-________________

______ New ______ Modification

Link Level: _____ SLP ______ MLP

ID Code of Interface/MLP to which PVC Assigned: [I/M]-________________________

All of above must apply to the same STE-X/STE-Y pair:

Non-BOC/IDC Requester is: ____ PSPDN ____ Private Packet Network ____ ISDN
Non-BOC/IDC STE Identification: ______________________

BOC/IDC STE: ____ PPSN ____ ISDN (D)NPA/(D)CO Code: ______-______

PVC Configuration Item	Possible Values	Notes	Requested
Max. packet size, to BOC/IDC	128, 256 (+)	128 default	
Max. packet size, from BOC/IDC	128, 256 (+)	128 default	
Packet level window size to BOC/IDC	Modulo 8: 1-7; Modulo 128: 1-60, 61-127*		
Packet level window size from BOC/IDC	Modulo 8: 1-7; Modulo 128: 1-60, 61-127*		
Throughput class to BOC/IDC	75, 150, 300, 600, 1200, 4800, 9600; 56 kbps interfaces: 19200*, 48000*		
Throughput class from BOC/IDC	75, 150, 300, 600, 1200, 4800, 9600; 56 kbps interfaces: 19200*, 48000*		

* = Not currently available on all BOC/IDC networks
(+) = Additional values are often supported

1.15. References

1. "Terminal and Transit Call Control Procedures and Data Transfer System on International Circuits Between Packet-Switched Data Networks," The International Telegraph and Telephone Consultative Committee (CCITT) Recommendation X.75, Red Book, Volume VIII, Fascicle VIII. 4, 1984.

2. Public Packet Switched Network (PPSN) Generic Requirements, Issue 1, Bell Communications Research Technical Reference TR-TSY-000301, September 1986.

3. ISDN Basic Access Call Control Switching and Signaling Requirements, Issue 1, Bell Communications Research Technical Reference TR-TSY-000268, June 1986.

4. “Public Packet Switched Network (PPSN) X.25 Interface Description,” Telcordia (formerly Bellcore) Technical Reference TR-TSY-000462, June 1987.

5. “Public Packet Switched Network (PPSN) Asynchronous Interface Description,” Telcordia (formerly Bellcore) Technical Reference TS-TSY-000486, forthcoming.

6. “Digital Data System Channel Interface Specification,” PUB 62310, September 1983.

7. “Digital Data Special Access Service Transmission Parameter Limits and Interface Combinations,” PUB 62507, December 1983. Release of a revised version of this document (TR-NPL-000341) is pending. Contact the Information Operations Center of Bell Communications Research for current status of the revised document.

8. “Data Communications Using Voiceband Private Line Channels,“ PUB 41004, October 1973.

9. “Administrative Arrangements for the Provision of International Permanent Virtual Circuits (PVCs),” CCITT Recommendation X.181, Red Book, Volume VIII, Fascicle VIII.4, 1984.

10. “Interface Between Data Terminal Equipment (DTE) and Data Circuit Terminating Equipment (DCE) for Terminals Operating in the Packet Mode and Connected to Public Data Networks by Dedicated Circuit,” CCITT Recommendation X.25, Red Book, Volume VIII, Fascicle VIII.3, 1984.

11. Meeting Report of Special Rapporteur Group on Q.22/VII (Nov. 4-8, 1985), Munich, CCITT COM VII-No. M 72-E.

12. “International Numbering Plan for Public Data Networks,” CCITT Recommendation X.121, Red Book, Volume VIII, Fascicle VIII.4, 1984.

13. “The Numbering Plan for the ISDN Era.” CCITT Recommendation E.164, Red Book, Volume II, Fascicle II.2, 1984.

14. “Numbering Plan for the International Telephone Service,” CCITT Recommendation E.163, Red Book, Volume II, Fascicle II.2, 1984.

15. “Definitions Relating to National and International Numbering Plan,” CCITT Recommendation E.160, Red Book, Volume II, Fascicle II.2, 1984.

16. “ISDN Numbering and Addressing Principles,” CCITT Recommendation I.330, Red Book, Volume III, Fascicle III.5, 1984.

17. “Notes on the BOC Intra-LATA Networks – 1986,” Bell Communications Research Technical Reference TR-NPL-000275, Issue 1, April 1986.

18. “International Routing Principals and Routing Plan for Public Data Networks,” CCITT Recommendation X.110, Red Book, Volume VIII; Fascicle VIII.4, 1984.

19. “Interface Between Data Terminal Equipment (DTE) and Data Circuit-Terminating Equipment (DCE) for Terminals Operating in the Packet Mode and Accessing a Packet Switched Public Data Network Through a Public Switched Telephone Network or a Circuit Switched Public Data Network,” CCITT Recommendation X.32, Red Book, Volume VIII, Fascicle VIII.3, 1984.

NOTE

Readers are advised to check current status and availability of all documents; all documents are subject to change.

Document may be ordered from Ameritech by contacting the Document Order Center at (847) 248-4324.

2. Section 2, BBN

2.1. Introduction

2.1.1. BOC/IDC Packet Networks and the X.75 Interface

Bell Operating Companies (BOCs), Information Distribution Companies (IDCs), and other Telcordia (formerly Bellcore) client companies are deploying packet switched public data networks (PSPDNs) which are generically labeled Public Packet Switched Networks (PPSNs). These same companies are also planning the introduction of Integrated Services Digital Network (ISDN) capabilities into their network offerings. Planned ISDN services include a packet switched mode.

Communication between a PPSN and other networks offering packet mode service is accomplished by means of interfaces conforming to CCITT Recommendation X.75[1]. Packet mode communication between a BOC/IDC ISDN (hereafter abbreviated as BOC/ISDN) and other packet-capable networks (including non-BOC/IDN ISDNs) is also to be accomplished by means of X.75 interfaces.

The services of the various PPSNs and BOC/ISDNs will be offered under differing tariffs and utilizating network equipment from multiple sources. Thus, the individual network or corresponding BOC/IDC should be consulted for details of the X.75 interface currently being supported.

However, there are a collection of interface characteristics and capabilities, referred to as the “minimal subset,” which are planned to be supported in a uniform manner on all PPSNs. This minimal subset includes conformance to the 1984 version of CCITT Recommendation X.75 and support of all non-optional features and utilities specified in that Recommendation.

2.1.2. Scope and Purpose of this Document

This document describes common characteristics of X.75 interfaces supported or planned to be supported by PPSNs and BOC-ISDNs for interconnection with other packet-capable networks. It addresses characteristics of PPSN/BOC-ISDN X.75 interfaces as viewed from connecting networks and, to a lesser extent, characteristics expected of the connecting network by the PPSN or BOC-ISDN.

Two related Telcordia (formerly Bellcore) Technical Reference (TRs) [2] [3] present requirements for PPSN and ISDN network equipment, including the support of X.75 interfaces. These two TRs address the equipment vendor perspective. Two companion TRs to this document address the X.25[4] and asynchronous[5] access interfaces supported by PPSN, respectively, from the customer perspective.

This technical reference is intended to be used as a supplement to and in conjunction with the 1984 CCITT Recommendation X.75[1] (subsequently referred to simply as “X.75” in this document).

This document does not attempt to repeat material covered in X.75. The material in this document provides information on:

- parameters and parameter values supported by PPSN/BOC-ISDNs;
- actions taken by and/or expected by PPSN/BOC-ISDNs for which X.75 offers alternatives or does not fully specify actions;
- features supported by PPSN/BOC-ISDNs that X.75 indicates are optional; and
- features supported by PPSN/BOC-ISDNs that are not addressed in X.75.

This document provides information that applies generally to X.75 interfaces between PSN/BOC. ISDNs and other packet-capable networks. It should be useful to those responsible for establishing X.75 interfaces between a PPSN or BOC-ISDN and an interexchange carrier (IC), value added network (VAN), other PSPDNs, non-BOC/IDC ISDNs, and private packet networks with points of presence within the local access and transport area (LATA) of the BOC/IDC. It should be used in conjunction with reference material provided directly by the individual BOC/IDC or PPSN/BOC. ISDN, which would supplement this interface description to address network-specific needs and characteristics. This document supersedes Bell Communications

Research Technical Reference TR-NPL-000065, “Interexchange Packet Interface,” Issue 1, July 1985.

2.1.3. Terminology

Certain terms have specific meanings as used in this document. Since these terms relate to the support or availability of X.75 interface features and options, it is critical that the definition of these terms be well understood. Table 1-1 summarizes the intended meanings of these key terms and phrases relating to support and availability. It also identifies the abbreviations used in subsequent tables and figures that correspond to these terms.

The phrases associated with the first two levels of support/availability indicated in the table are abbreviated “C (current support)” and “P (planned support),” respectively. These two categories taken together correspond to the minimal subset discussed earlier. When the phrase “supported by all PPSNs” or “all PPSNs...” is used in this document, the associated capability or option is supported on all PPSN network equipment. However, the individual network should be contacted to confirm the tariffed availability at a particular time.

Some interface features are in the minimal subset, but may not be immediately available on all PPSNs. These features or options are associated with the “planned support” level. Items which not all PPSNs plan to support in the near future are in the “optional support” category.

There are several aspects of the X.75 interface for which Telcordia (formerly Bellcore) has recommended a default value or a particular procedure, but for which current network implementations may vary. These correspond to the “recommended” category. For aspects of the interface so identified, the individual network should be contacted for details on the current implementation and plans for future modifications.

The last category described in Table 1-1 relates to capabilities or option support of other networks connecting to a PPSN or BOC-ISDN via an X.75 interface. The interfacing network is assumed to conform to the non-optional elements of X.75. However, it is considered important to highlight a limited number of items as those which PPSNs may rely upon being supported by the interfacing network. If another network does not support an aspect of the X.75 interface identified as being in this “expected support” category, the interface may not operate effectively or a serious administrative problem may result. Support of such items within the near future is considered important.

The support/availability characterization specified for PPSNs is expected to apply to the packet mode of BOC-ISDNs in most cases, unless otherwise stated in the text. However, the introduction of public ISDN service is still being planned and a minimal subset has not been defined for BOC-ISDN packet mode service at this time. Any statement on support concerning BOC-ISDNs should therefore be interpreted to mean planned support.

Throughout this document, the terms DTE (data terminal equipment) and DCE (data circuit terminating equipment) will be used to refer to the end user terminal and the network connection to the user access interface, respectively. The term STE (signaling terminal) refers to the network equipment that terminates each end of an X.75 interface. Strictly speaking, these are PSPDN terms. However, they will be assumed to include their ISDN counterparts when used in this document to simplify references to the user and network ends of an access interface and the network X.75 interface termination. These terms are used in this document because they are the terms used in CCITT Recommendation X.75. For readers more familiar with ISDN terminology, Table 1-2 presents ISDN terms that are roughly equivalent to the PSPDN terms used in this document.

2.1.4. Organization of this Document

The second section of this document describes the types of X.75 interfaces supported by PPSN/ISDNs and provides a textual and tabular overview of PPSN/BOC-ISDN inter-network interfaces. Sections 3 through 5 address the physical, link, and packet layers of the X.75 protocol. Sections 3 through 5 address the physical, link, and packet layers of the X.75 protocol. Sections 6 through 8 describe CCITT, BOC/IDC-specified, and other relevant network utilities, respectively. Sections 9 and 10 discuss addressing and routing considerations. Generally applicable aspects of provisioning and maintenance for X.75 interfaces between PPSN/BOC-ISDNs and other networks are addressed in section 11. The remainder of this TR consists of a list of acronyms, two Appendices, and references.

TABLE 1-1. Interpretation of Support Phrases and Abbreviations

PHRASE IN TEXT	ABBREVIATION	INTERPRETATION
PPSN SUPPORT LEVELS		
All PPSNs . . . ; Supported by all PPSNs*	C (current support)	All PPSN equipment supports the feature, capability, parameter value, or option; availability under local tariff may vary
All PPSNs plan . . . ; Support by all PSNs planned*	P (planned support)	Some PPSNs now support, remaining PPSNs plan support; contact specific PPSN for availability schedule
Supported by some PPSNs; Some PPSNs support; Support is optional	O (optional support)	Not all PPSNs plan to support
Telcordia (formerly Bellcore) recommends ; . . . is recommended	R (recommended)	Telcordia (formerly Bellcore) recommends use of particular default value or support of a feature/option in long term; contact specific PPSN for current implementation details
BY OTHER NETWORKS		
interfacing networks are expected to . . .	E (expected support)	PPSNs may relay upon utility, capability, parameter value, or option being supported by interfacing networks. Support within near future considered important.

* These categories comprise the Minimal Subset

TABLE 1-2. Roughly Equivalent PPSN and ISDN Terms

PPSN Term(s)	ISDN Term(s)
Data Circuit-Terminating Equipment (DCE)	none; use (local) Stored Program Control Switch (SPCS), Packet Handling Function (PHF), or exchange termination (ET)
Data Terminal Equipment (DTE)	Terminal Equipment: TE, TE1, or TE1/TA; Customer Premises Equipment (CPE)
Signaling Terminal (STE)	none; use “Interexchange equipment”
network address extension (NAE)	subaddress
packet switch data transmission Service	packet mode bearer service
packet switch (PS)	SPCS/PHF

2.2. Interface Overview

2.2.1. Typical Internetwork Configuration

A BOC or IDC network provides communications service only within a local access and transport area (LATA). Thus, a PPSN/BOC-ISDN can offer direct access connections to end users within the LATA and inter-network interfaces to other packet switched networks with points of presence within the LATA. Public traffic must travel between LATAs over communication facilities operated by networks authorized to provide public interexchange services. Thus, a PPSN/ BOC-ISDN must pass public inter-LATA call traffic over an X.75 interface to an IC or other network with inter-LATA capabilities.

Given the nature of PPSN/BOC-ISDN service as described above, X.75 inter-network interfaces are used for connections between PPSN/BOC-ISDN and:

- an IC
- a VAN, PSPDN, or non-BOC/IDC-ISDN with attached users and/or inter-LATA carrier capability
- possibly, a private packet network with a point of presence within the PSN/BOC-ISDN service area.

Figure 2-1 illustrates such X.75 interfaces in a diagram which spans three LATAs. The X.75 interfaces are indicated a heavy solid lines and the access interfaces between the users and networks are indicated with thin solid lines. A BOC/IDC packet mode network serves each of LATA X and LATA Y. This network may be a PSN, a BOC-ISDN, or a combination of both connected by internal trunks. For public traffic, calls between these two LATAs that originate on or are destined for a PPSN/BOC-ISDN transmit an inter-LATA carrier, such as the IC indicated. Traffic between a PPSN/BOC-ISDN and a user on a VAN directly connected to the PPSN/BOC-ISDN would be carried over the connecting X.75 interface, unless the calling party explicitly requested a different carrier routing. Such a VAN may also serve as a transit network for calls neither originating nor terminating on the VAN. Within LATA Y, a private packet network is illustrated as being directly connected to the PPSN/BOC-ISDN. [Such a private network could also choose to connect to the PPSN/BOC-ISDN via an access interface (such as X.25), is such an inter-network connection was not available or deemed necessary.]

2.2.2. X.75 Interface Characteristics

As stated above, PSN/BOC-ISDN inter-network interfaces conform to X.75 and it is expected that any interfacing network also conforms to X.75. This document details specific parameter values, options, and feature support that are more specific than or go beyond X.75. In this section, those characteristics of the PPSN/BOC-ISDN interfaces which do not directly flow from the X.75 specification are summarized. The remainder of the document addresses the same material in more detail.

Table 2-1 summarizes the attributes and configuration options at the physical, link, and packet level of PPSN/BOC-ISDN interfaces. All terms listed in the table are currently available on all PPSNs, unless the line contains an indication of a different support level in square brackets (see table legend).

TABLE 1-2. Roughly Equivalent PPSN and ISDN Terms

PPSN Term(s)	ISDN Term(s)
Data Circuit-Terminating Equipment (DCE)	none; use (local) Stored Program Control Switch (SPCS), Packet Handling Function (PHF), or exchange termination (ET)
Data Terminal Equipment (DTE)	Terminal Equipment: TE, TE1, or TE2/TA; Customer Premises Equipment (CPE)
network address extension (NAE)	subaddress
packet switch data transmission	packet mode bearer service
packet switch (PS)	SPCS/PHF

Table 2-2 summarizes the support of utilities addressed in sections 6 through 8 of this document. The table indicates the CCITT status of each utility and the PPSN/BOC-ISDN support status for each utility, on both international and domestic interfaces. [A domestic interface is one with both STEs within the U.S.] The table also lists the sections in this document that addresses each utility.

Two appendices to this document complete the summary of PPSN/BOC-ISDN X.75 interface characteristics. Appendix A highlights, in tabular form, the modification and enhancements to X.75 that are contained in the remainder of this document. This table should facilitate the use of this TR, in conjunction with CCITT Recommendation X.75.

Appendix B is a sample X.75 interface configuration worksheet. It illustrates the type of worksheet that a network might complete and submit to a PPSN/BOC-ISDN so that one or more X.75 interfaces could be provisioned and configured in a mutually acceptable fashion. This sample worksheet summarizes the remainder of this document in a format that is most useful to a packet network representative responsible for ordering/negotiating X.75 interfaces to a

PPSN/BOC-ISDN. A worksheet or similar device may be used by some PPSN/BOC-ISDNs to facilitate the provisioning of X.75 interfaces.

Figure 2-1. Illustrative Inter-Network Interface Diagram

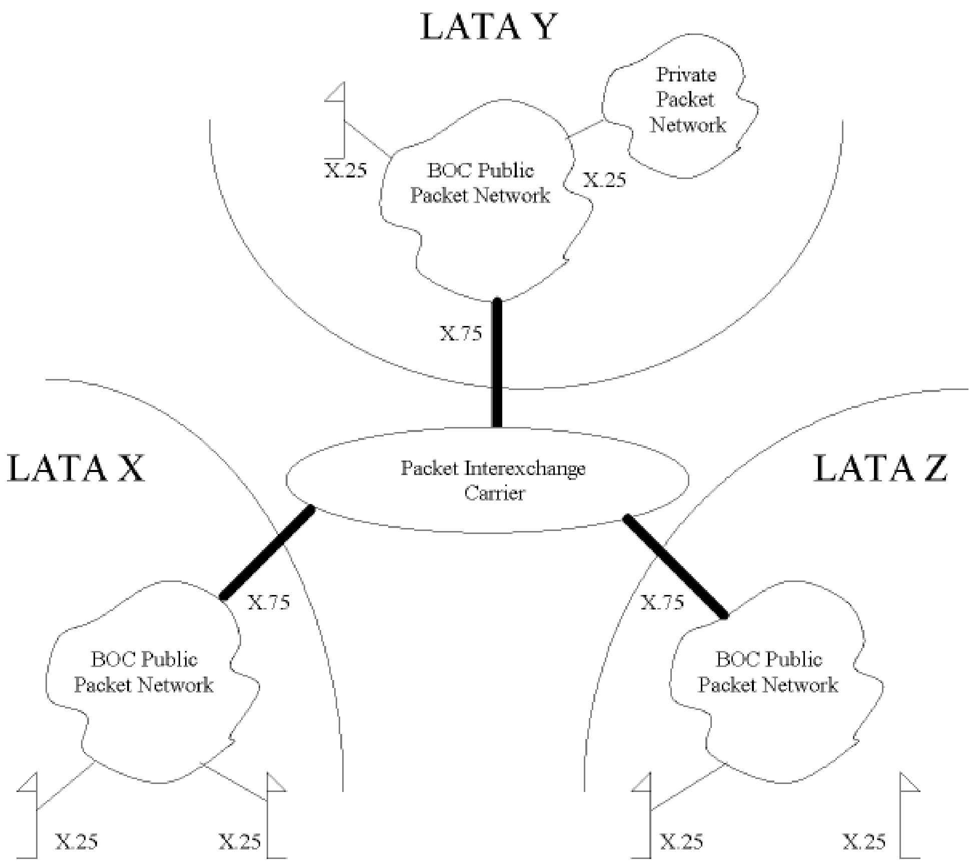

Table 2-1. Summary of PPSN/BOC-ISDN X.75 Interface Attributes & Configuration Options*

Physical Level
- Speeds: 9.6 and 56 Kbps
- Interface: DDS [C]; analog private line (9.6 Kbps only) [O]

Link Level

LAPB	
Single Link Procedure	
Multilink Procedure [O]	
Modulo 8 Frame Sequencing	
Modulo 128 Frame Sequencing [O]	
Parameter K	1-7 (modulo 8) 1-60 or 1-127 (modulo 128) [O]
Timer T1	1-10 seconds in 0.5 sec. Increments
Parameter T2	does not exceed 0.4 seconds
Timer T3	1-30 sec., or functional equiv. of T3 [P]
Parameter N1	2104 or 2120 (SLP) [C]; 2136 (MLP) [O] (ability to set to other values [O])
Parameter N2	2-15, in increments of 1
MPL Parameters MW, MN1, MT1, MT2, MT3 [O] **	

Packet Level

Virtual Call Service	
Parameter Virtual Circuit Service	
Modulo 8 Packet Sequence Numbering	
Modulo 128 Packet Sequence Numbering [O]	
Maximum Number of Logical Channels:	
9.6 kbps	64, 128 [R]
56 kbps	64, 128, 256, 512 [R]
Logical Channel Selection:	lowest unassigned or highest
Unassigned Octet-Aligned User Data Field Passed Transparently	
Enforcement of Octet Alignment (unless waived bilaterally) [R]	
Screening on up to 100 CUG interlock codes per interface [O]	
Time-out T30	180 seconds
Time-out T31	200 seconds
Time-out T32	180 seconds
Time-out T33	180 seconds
Window Sizes (VC/PVC):	1-3 [C]; 4-7 [O] (modulo 8) 1-60 or 1-127 (modulo 128) [O]
Throughput Classes (VC/PVC):	75, 150, 300, 600, 1200, 4800, and 9600 19200 and 48000 on 56 kbps interface [0]
Maximum Packet Sizes (VC/PVC):	128, 256

NOTE: * All items are [C]urrent unless explicitly marked [P]lanned, [O]ptional, or [R]ecommended: See Table 1-1 for meanings.
** MLP is optional; there are no BOC/IDC standardized ranges for associated parameters.

Table 2-2. Utility Support Summary

UTILITY	TR Sect.	CCITT X.75	BOC/IDC INT'L X.75	BOC/IDC DOMEST.X.75
International Mandatory				
Transmit Network Identification	6.1	M	C,E	C,E
Call Identifier	6.2	M	C,E	C,E
Throughput Class Ind.	6.3	M	C,E	C,E
Window Size Indication	6.4	M	C,E	C,E
Packet Size Indication	6.5	M	C,E	C,E
Fast Select Indication*	6.6	M	C	C
Closed User Group Ind.	6.7	M	C,E	C,E
Called Line Address Modified Notif.	6.8	M	C,E	C,E
Transit Delay Indication*	6.9	(M,1985)	O	O
International Optional				
Closed User Group/OA Ind.	6.7	O	C	C
Reverse Charging Indication	6.10	O	C	C
Clearing Network Identif. Code	6.11	O	P	P
Transit Delay Selection	6.12	(O,1985)	O	O
Utility Market	6.13	O	P	P
National				
RPOA Selection	6.14	(N,1985)	B	P
CCITT Further Study				
Tariffs*	6.15	S	S	S
Traffic Class Indication	6.16	S	S	S
Address Extension	6.16	S	S	S
BOC/IDC-Specified				
IC Preselection Indication	7.1	-	B	O
Proposed for CCITT				
Network User Identification	8.1	-	S	S
Numbering & Addressing Plan Ind.	8.2	-	S	S

LEGEND: CCITT And TR Catagories

M = Mandatory (CCITT)

O = Optional (CCITT; or as per Sect. 1-3)

S = For further study

B = Should not use (without special bilateral agreement)

R = Telcordia (formerly Bellcore) Recommended (Sect. 1-3)

E = Support of Interfaceing Network Expected (Sect. 1-3)

C = Currently Available on PPSNs (Sect. 1.3)

* = By Bilateral Agreement for Interim Period

N = National (CCITT)

P = Planned PPSN Availability (Sect. (Sect. 1.3)

1985 = Added in 1985 X.75 Draft Revision

2.3. Physical Level

A packet-capable network may connect to a PPSN/BOC-ISDN with one or more X.75 interfaces, depending on the throughput characteristics and reliability requirements that apply to the traffic to be carried between the two networks. The specific BOC/IDC or PPSN/BOC-ISDN should be contacted directly for guidelines on determining the appropriate number and speed of X.75 interfaces.

All PPSNs support X.75 interfaces with 9.6 and 56 kbps physical level data signaling rates. BOC-ISDNs should provide such support, when deployed. All PPSN/BOC-ISDNs support digital interfaces that are compatible with the Digital Data System (DDS) Interface at both transmission speeds.[6],[7] [Interfaces operating at 64 kbps may be introduced in the future in support of ISDNs.]

Some PPSNs may also support analog private line interfaces at the 9.6 kbps data signaling rate.[8] The interconnecting network and the PPSN should mutually agree on a private line analog channel with the appropriate data conditioning and modem. [For example, type D1 high performance data conditioning on a type 3002 private line with 2096A type compatible modems.]

2.4. Link Level

The link level of the X.75 interface supported by all PPSN/BOC-ISDNs is LAPB, as specified in section 2 of X.75. All PPSN/BOC-ISDNs conform to the integral (i.e., non-optional) portions of these LAPD specifications and these specifications are not repeated in this document. It is expected that non-BOC/IDC network X.75 interfaces also conform to the integral portions of LAPB. This section discusses support of optional aspects of LAPD, parameter values and other aspects of the link level which are not specified in X.75. The material is addressed under three headings, corresponding to the three major components of the link level: frame structure and format, procedures, and parameters & configuration options.

2.4.1. Frame Structure and Format

PPSN/BOC-ISDNs support modulo 8 frame sequencing. Support of modulo 128 frame sequencing is optional. For an interim period, some networks supporting modulo 128 frame sequencing may only support the alternative (1980 version) U format (2-octet control field), as specified in Tables 4/X.75 and 6/X.75 of CCITT Recommendation X.75. Thus, during this period, support of at least this alternative may be necessary for compatibility in modulo 128 frame sequencing. The 1-octet control field U format is the standard format for modulo 128, which CCITT specifies is to be used in the absence of a bilateral agreement to use the alternative format.

2.4.2. Procedures

PPSN/BOC-ISDNs support the single link procedure (SLP) and it is expected that interfacing networks also support SLP, at least as an interface option. Support of multilink procedure (MLP) is optional.

2.4.3. Parameters & Configuration Options

1. The degree of flexibility available in setting parameters and configuration options on an X.75 interface are expected to be such that a PPSN/BOC-ISDN and the interfacing network can achieve a mutually agreeable set of compatible values. For those parameters which must match at both ends of the interface to achieve compatibility, the set of PPSN/BOC-ISDN and other network alternatives for the parameter or option must contain at least one appropriate value in common that can be selected by both ends. Link level parameters which must match for interface compatibility include: window size for each direction of transmission and frame sequencing modulo. Link level addresses assigned to the STE at each end of the interface must be complementary. Other parameters, such as T1 and T2, are related in a more complex manner for compatibility, as stated below.

2. For modulo 8 frame sequencing, PPSN/BOC-ISDNs support a link level window size, k, selectable from among the values 1-7 (in increments of one). The same value of k applies in both directions or transmission and this parameter must match at both ends of the interface.

3. If modulo 128 frame sequencing is used, the link level window size is selectable from among the values 1-60 (in increments of one). Among PPSN/BOC-ISDNs that support modulo 128 frame sequencing, some may allow window size to be selected from the range 61-127, in addition. The same value applies in both directions of transmission.

4. All PPSN/BOC-ISDNs support a timer, T1, (defined in X.75 section 2.4.8.1), which can be set to values in the range from 1-10 seconds in 0.5 second increments. Some PPSN/BOC-ISDNs may support other values for this parameter as well.

5. The response parameter T2 (defined in X.75 section 2.4.8.2) does not exceed 0.4 seconds on any PPSN/ISDN X.75 interface. The period associated with parameter T2 starts when the last bit of the frame is received and ends when the STE has completed the process necessary to generate an acknowledgment of that received frame in the next frame it transmits. For correct operation, T1 and T2 should be settable so that the conditions of sections 2.4.8.1 and 2.4.8.2 of X.75 are satisfied. Correct operation can be assured if the value of T2 is smaller than TTY the value of T1, minus twice the propagation time over the interface, minus the total frame processing time at both ends, and minus the transmission time for the acknowledgment frame (assuming the T1 timer is started at the end of the transmission of a frame).

6. All PPSN/BOC-ISDNs plan to support a timer T3 (defined in X.75 section 2.4.8.3), or an alternate mechanism with similar functionality to detect a link layer abnormality. On

expiration of the T3 timer, an indication of an observed excessively long idle channel state condition is passed on MLP (if supported), or to the packet level, for proper error recovery and disconnection. If the T3 timer is supported, Telcordia (formerly Bellcore) recommends that it be settable to all least the values from 1-30 seconds, in 1 second increments, other parameter values may also be used. If an alternate mechanism of similar functionality is supported, a serious abnormality in the link layer will be reported to a higher layer within a reasonable period of time (recommended to be less than 30 seconds). The values of parameters set for the T3 or alternate mechanism at either end of the interface are not critical for compatibility, but X.75 specifies that the T3 value should be made known to the two interfacing networks.

If a PPSN/BOC-ISDN packet level is informed of expiration of the T3 timer, Telcordia (formerly Bellcore) recommends that the packet layer assume failure of the link layer, apply the failure procedures specified in X.75 Section 3.6, and report the failure for administrative/maintenance purposes.

7. All PPSN/BOC-ISDNs can support at least the N1 value (X.75 section 2.4.8.5) of 2104 (or 2120) for SLP operation. These values can accommodate 256-octet user date field data packets with SLP operation (2120 also accommodates modulo 128 sequencing at the link and packet layers). Other values of N1 may also be supported, depending on sequencing and SLP/MLP options, and the packet size configured for the interface. In some cases, the value on N1 should also be able to accommodate a maximum size Clear Request packet which may exceed the maximum size of a data packet. For compatibility, the value of N1 should be no smaller than the maximum frame size that can be legally generated at either end of the interface given the maximum packet size, frame and packet level sequencing, SLP/MLP support, and utilities/facilities supported on the interface.

8. All PPSN/BOC-ISDNs support the parameter N2 (defined in X.75 section 2.4.8.4) with values that can be set in the range 2-15, in increments of 1. The values of N2 configured at either end of the interface need not match for compatibility.

9. Complementary frame level addresses for the PPSN/BOC-ISDN and interfacing network STEs, for a given X.75 interface, are assigned by mutual agreement.

10. If a PPSN/BOC-ISDN support MLP, it conforms to the procedure specified in the 1985 (CCITT Red Book) version of X.75. If the X.75 interface is configures as part of the MLP, it assumed that the interfacing network also supports the 1984 version of the MLP, as specified in section 2.5 of X.75.

11. If MLP is supported, six additional parameters apply. These are parameters MW, MX, and MN1 and the timers MT1, MT2, and MT3. The value of the multilink window size

MW must be agreed upon by the PPSN/BOC-ISDN and the interfacing network and it must be the same for both STEs for a given direction of transmission. Minimum supported ranges of values have not yet been established for PPSN/BOC-ISDNs for any of the six MLP parameters. If MLP is desired and the PPSN/BOC-ISDN does support this capability, a compatible set of parameter values should be negotiated by the two networks. The following are illustrative of the type of ranges that might be supported for these parameters:

MW	2-4094
MX	1-2047
MN1	0-15
MT1	1-30 sec.
MT2	1-60 sec.
MT3	1-30 sec.

The minimum set of parameter values that can be configured for a specific PPSN/BOC-ISDN that supports MLP can only be determined by contacting the PPSN/BOC-ISDN or responsible BOC/IDC.

2.5. Packet Level

All PPSN/BOC-ISDNs are, and any interfacing network is expected to be, in conformance with the integral (i.e., non-optional) features, capabilities, and procedures of the X.75 packet layer protocol (PLP), as specified in sections 3, 4, and 5 of X.75. The remainder of this section provides amplifications on the additions to the X.75 specifications that apply to connections with PPSN/BOC-ISDNs. This material is presented under five major subheadings: virtual call and PVC service, packet formats, procedures, parameters & configuration options, and transmission of X.25 user facilities. Although part of the PLP, network utilities are presented in three separate sections (6, 7, and 8) because of the volume of material that must be covered.

2.5.1. Virtual Call and PVC Service

1. All PPSN/BOC-ISDNs support virtual call service as specified in section 3.1 of X.75.

2. All PPSN/BOC-ISDNs support inter-network permanent virtual circuit (PVC) service as specified in section 3.2 of X.75 and CCITT Recommendation X.181.[9]

3. The maximum number of simultaneous virtual calls plus permanent virtual circuits that can be in use on the interface is equal to the number of logical channels configures for the interface, excluding logical channel 0. [Logical channel 0 is reserved for control packets that affect the entire interface, such as the restart request packet].

4. Telcordia (formerly Bellcore) recommends that networks be able to support up to 64, 128, 256, or 512 logical channels on a 56-kbps X.75 interface and up to 64 or 128 log-

ical channels on a 9.6 kbps X.75 interface, as configuration options. Some PPSN/BOC-ISDNs may support other values in addition. For compatibility, the PPSN/BOC-ISDN and interfacing network must agree upon the same value for the maximum number of logical channels supported on the interface.

5. All PPSN/BOC-ISDN interfaces can be configured to specify a range of logical channels as reserved for PVCs and a range as reserved for (two-way) virtual calls. Some PPSN/BOC-ISDNs may also be able to specify ranges of logical channels as reserved for incoming-only virtual calls and outgoing-only virtual calls. [Here, “incoming” and “outgoing” are relative to the STE, and thus the incoming range of STE-X is the outgoing range of STE-Y.] Telcordia (formerly Bellcore) recommends that it should be possible to define any of these ranges as null sets. Some PPSN/BOC-ISDNs may require that these ranges of logical channels be contiguous. The PPSN/BOC-ISDN and interfacing network should be able to agree upon a compatible set of such ranges for the available logical channels.

6. All PPSN/BOC-ISDN X.75 interfaces can be configured to select among logical channels on either a “lowest unassigned” or “highest unassigned” basis when allocating calls to logical channels within the appropriate range.

2.5.2. Packet Formats

The coding and arrangement of the fields composing the various packet types are consistent with X.75 section 4. The following also apply.

1. All PPSN/BOC-ISDNs will transparently pass octet-alligned user data. Furthermore, Telcordia (formerly Bellcore) recommends that octet alignment be required in the absence of a specific bilateral agreement to sort user data fields that are not octet aligned. In the absence of such a bilateral agreement, Telcordia (formerly Bellcore) recommends enforcement of octet alignment as follows. If a packet that is not octet aligned is detected, the packet level procedure associated with handling this error condition (see Annex C of X.75) is applied. In particular refer to Note 2 of Tables C-2/X.75, C-4/X.75, and C-5/X.75; Note 3 of Table C-3/X.75; and the specifications for the “ERROR” condition in each of the tables of Annex C.

2. All PPSN/BOC-ISDNs support modulo 8 packet sequencing on X.75 interfaces.

3. Some PPSN/BOC-ISDNs may also support modulo 128 packet sequencing on X.75 interfaces as a configuration option.

4. The following clarification applies to the clear request packet format. The address length field is always present when the network utility length field is present. The net-

work utility length is always present when the user facility length field is present. The user facility length field is always present when the user data field is present.

Sections 4.2.3, 4.4.3, and 4.5 of X.75 address the three types of packet in which a diagnostic code may appear. Diagnostic codes in the range 0-127 are specified in X.75 on an internationally standardized basis. Codes in the range of 128-255 are defined on a network-specific basis.

In addition to those code values already defined, use of currently unused codes in the 0-127 range may be proposed to CCITT to deal with problem conditions for which existing diagnostic codes are inadequate.

Given these considerations:

5. All PPSN/BOC-ISDNs plan to conform to the X.75 specifications for CCITT-standardized (0-127) diagnostic codes, including the numberical value interpretations presented in Annexes C, D, and E. Any exceptions to such conformance should be explicitly noted to the opposite network.

6. All PPSN/BOC-ISDNs plan to be capable of accepting and transparently passing (except for code conversions specifically required by X.75 Tables 14, 15, and 18 when the cause is “network congestions”) all diagnostic codes, including those in the network-specific range (128-225). Any exceptions to such handling of diagnostic codes should be explicitly noted to the opposite network.

7. Proposals may be submitted to CCITT to assign specific new diagnostic meanings to several code values in the 0-127 range that are currently unused. It is desirable for networks to be able to accommodate such code additions within a reasonable time after their adoption. Introduction of the following three diagnostic codes is part of a proposal currently being considered [the precise interpretation of each code would depend on the accompanying cause]:

    - Requested RPDA invalid/unknown or RPDA not specified
    - Requested RPDA cannot service request
    - NUI value invalid, unsupported, or absent

2.5.3. Procedures

PPSN/BOC-ISDN X.75 interfaces conform to the packet level procedures specified in section 3 of X.75. It is expected that interfacing networks also conform to these procedures.

Although the more data flag (i.e., the M bit) procedures are supported, a PPSN/BOC-ISDN may not be able to fragment and/or recombine packets. These are the capabilities to divide the same user data, respectively. These capabilities allow for inter-working between DTEs operating with different maximum packet sizes.

2.5.4. Parameters & Configuration Options

1. The degree of flexibility available in setting parameters and configuration options on an X.75 interface is expected to be such that the PPSN/BOC-ISDN and the interfacing network can achieve a mutually agreeable set of compatible values. For those parameters which must match at both ends of the interface to achieve compatibility, the set of PPSN/BOC-ISDN and other network alternatives for the parameter or option must contain at least one appropriate value in common that can be selected by both ends. Packet level parameters which must match for interface compatibility include: maximum window size, maximum packet size, and throughout class for each direction of transmission; maximum number, assignment direction, and allocation ranges of logical channels; and packet sequencing modulo.

2. All PPSN/BOC-ISDN interfaces support the packet level time-outs defined in X.75 Annex 0. It is expected that interfacing networks support these time-out or equivalent capabilities.

3. All PPSN/BOC-ISDNs support maximum packet (date field length) sizes of 128 and 256 octets as configuration options for the X.75 interface. Some PPSN/BOC-ISDNs may support other sizes in addition. Unless an alternative value is agreed upon by the two networks, a default value of 128 is assumed for the interface. The maximum packet sizes configured for the interface apply to all virtual calls, unless overriden by the Packet Size Indication utility (see section 6.5). It is possible to select different packet sizes for each direction of transmission. The configured maximum packet size should be the same as both ends of the interface for each direction of transmission.

4. Telcordia (formerly Bellcore) recommends support of maximum packet sizes of 128 and 256 octets as configuration options for each VC on an X.75 interface, independent of the virtual call maximum packet size configured for the interface. It is possible to select different packet sizes for each direction of transmission. These values should match at the two ends of the interface for each PVC configured.

5. The maximum value of the packet level window size for each direction of transmission of an X.75 interface that applies to all virtual calls on that interface is a configurable parameter on PPSN/BOC-ISDNs. The maximum window size is settable to values in the range 1-3 on all PPSN/BOC-ISDNs and to values in the range 4-7 in addition to

some PPSN/BOC-ISDNs for modulo 8 packet sequencing. If modulo 128 sequencing is supported, maximum window size is settable in the range 1-60. Some PPSN/BOC-ISDNs that support modulo 128 packet sequencing may support values in the range 61-127 in addition. The maximum window size configured for each direction of the interface should match at both interface ends. The window sizes selected for each direction of transmission for a particular virtual call should be less than or equal to the corresponding interface maximum values.

6. Telcordia (formerly Bellcore) recommends support of packet level window sizes settable in the range 1-7 for a PVC, as a configuration option, on X.75 interfaces using modulo 8 packet sequencing, independent of the packet level window size configured for the interface. If modulo 128 packet level sequencing is used on an X.75 interface, support of packet level window sizes of 1-60 as configuration options for PVCs, independent of the packet level window size configured for the interface, is recommended. PVC window sizes in the range 61-127, in addition, could also be supported on some PPSN.BOC-ISDNs. It is possible to select different window sizes for each direction of transmission. The configured window sizes for each PVC should match on the two ends of the interface.

7. All PPSN/BOC-ISDN X.75 interfaces support, as an interface configuration option, default throughout class values for each direction of transmission to apply to all virtual calls on the interface, unless overridden via the Throughput Class Indication utility on a per-call basis. It is expected that the interfacing network also supports this capability. The default values configured on the two ends of the interface should match.

8. Telcordia (formerly Bellcore) recommends that X.75 interfaces allow the throughput class for each direction of transmission on a PVC to be selected at subscription time from the range of throughput class values supported by the interface. It is possible to select different throughtput class values for each direction of transmission. The thoughput class values supported should be the same as those for the Throughput Class Indication utility (section 6.3).

9. Some PPSN/BOC-ISDNs may support screening of CUGs at the X.75 interface. If supported, the interface can be configured with up to 100 CUG interlock codes. If a PPSN/BOC-ISDN X.75 interface is configured with CUG interlock codes, any call request packet transiting the interface must indicate one of the configured interlock codes or the call will be cleared. This capability allows a PPSN/BOC-ISDN to screen calls to or from a directly connected private network upon request, for example.

2.5.5. Transmission of X.25 User Facilities

All PPSN/BOC-ISDNs plan to support the ability to transparently pass X.25 user facilities (that are not mapped into network utilities) within the facility field of the call request, call connected, or clear request packet, as appropriate. At a minimum, facilities falling into this category include all those specified in Annex G of CCITT Recommendation X.25.[10].

2.6. CCITT Utilities

With one exception, the utilities addressed in this section are addressed in section 5 of the 1984 version of CCITT Recommendation X.75. Those that are fully defined have been categorized as either "International Mandatory" or "International Optional" during CCITT meetings held in April/May 1985 (Geneva) and November 1985 (Munich).[11] The mandatory utilities (designated with a "M" below) are to be supported on all international interfaces. Internationally, the optional utilities (designated with an "0") are supported by bilateral agreement, but are to be implemented as specified if supported.

The RPDA Selection utility was added to the list of CCITT X.75 utilities during the April/May 1985 CCITT meeting. The RPDA Selection utility has been categorized as a "National Utility (N)," and is not supported on an international basis. Thus, a network would normally not pass the RPDA selection utility over interfaces that cross national boundaries, unless a specific bilateral agreement permitting such international use where in effect.

The heading of each subsection addressing a CCITT defined utility parenthetically specifies one of these three utility categories, based on the 1985 CCITT meeting cited above. However, these CCITT categories are not equivalent to the support levels designated for PPSN/BOC-ISDN X.75 interfaces. The level of support provided for each utility on X.75 interfaces for PPSN/BOC-ISDNs is specified within the text of each utility subsection below and in Table 2-2.

In addition to the specifications provided below for individual utilities, the following apply in general.

1. Utility codes supported on PPSN/BOC-ISDNs conform to Table 20/X.75 of 1984 CCITT Recommendation X.75.

2. Each utility indicated as being international mandatory (M) in the subsection headings below is expected to be supported as specified in Recommendation X.75 by any network connecting to a PPSN/BOC-ISDN via an X.75 interface, with the following possible exceptions:

    - Fast Select Indication. This utility is expected to be supported in the long term, but it may not be supported by some networks for an interim period.

- Called Line Address Modified Notification. This utility is expected to be supported in the long term, but it may not be supported by some networks for an interim period.

- Transit Delay Indication. Support of this utility is expected to be provided in the long term. The coding of this utility was recently specified [11} and some networks may not support this utility for an interim period.

3. Utilities categorized as “International Optional” or “National” are supported by PPSN/ BOC-ISDNs as specified in Table 2-2 and the text below for the corresponding utilities. Support of such utilities on X.75 interfaces to other networks is assumed to be by bilateral agreement.

4. Some of the utilities listed in Table 2-2 have been specified by CCITT on a draft basis, but have not yet been formally approved and published. Until such utilities are formally published by CCITT, their status is ambiguous. Telcordia (formerly Bellcore) recommends that prior to draft approval of any such utility by CCITT, the utility be passed after the utility market, if it is supported. Following the draft approval by CCITT, Telcordia (formerly Bellcore) recommends that it should be passed before the utility market, is supported. However, the ability to place and accept such “draft” utilities either before or after the utility marker would reduce the possibility of incompatible implementations among networks during transitional periods. Currently the utilities that fall into this category are: Transit Delay Indication, Transit Delay Selection, and RPDA Selection.

2.6.1. Transit Network Identification (M)

The Transit Network Identification (TNIC) utility is used to identify each transit network controlling a portion of the virtual call. A typical use for the information carried in this utility is to identify participating transit networks so that inter-network agreements (covering areas such as billing) can be implemented.

Most often, a PPSN/BOC-ISDN will be an originating or terminating, rather than transit, network. However, there are certain circumstances under which a PPSN/BOC-ISDN might serve as a transit network. In particular, a PPSN/BOC-ISDN might act as a transit carrier if it receives a call from a directly connected private packet network and passes the call on to an IC or directly connected PSPDN. In such a case a PPSN would insert an instance of the TNIC utility with its own Data Network Identification Code (DNIC) in the parameter field over an X.75 interface. It remains for further study what coding or method would be used if the transit network is an ISDN.

A PSTN or BOC/IDC ISDN within the same LATA is not considered to be a separate network for the purposes of determining whether the PPSN is acting as a transit network. Similarly, a

PPSN within the same LATA is not considered to be a separate network for the purposes of determining whether the BOC-ISDN is acting as a transit network.

Several PPSNs and possibly other packet networks may share a DNIC. Thus, various possibilities for extending or supplementing the standard TNIC utility to permit identification of individual operating companies or LATAs as a transit network are being considered. One possibility is introduction of a new utility to be used to supplement the DNIC when it alone cannot uniquely identify a network. The above mentioned possibilities are all for further study.

1. The transit network identification utility is supported on the X.75 interface, as specified in sections 5.3.1 and 5.4.3.1 of Recommendation X.75.

2. It is expected that any non-BOC/IDC network, connected to a PPSN/BOC-ISDN via an X.75 interface, will insert an instance of the TNIC utility identifying itself (via its DNIC) in the call request packet if it is acting as a transit network for the call being established. Instances of the utility inserted by other networks are passed transparently over subsequent X.75 interfaces by PPSN/BOC-ISDNs and this same treatment is expected of interfacing networks.

3. A PPSN/BOC-ISDN will normally not insert a TNIC utility instance sine it normally does not function as a transit network. However, for some PPSN/BOC-ISDNs there may be circumstances under which the PPSN/BOC-ISDN does insert an instance of the TNIC utility identifying it as a transit network. This may occur if the call originates on or is destined for a private packet network directly connected to the PPSN/BOC-ISDN via an X.75 interface.

4. The current specification of TNIC relies solely on the DNIC value in the parameter field of the utility to identify the corresponding transit network. Because a DNIC may be shared by numerous PPSNs and possibly other PSPDNs within the U.S., the TNIC may not be able to uniquely identify a PPSN or even an individual BOC/IDC as the transit network. Several alternative approaches to permit individual PPSNs (and ISDNs operating in the packet mode) to be distinguished from one another are currently under consideration. Any such approach is intended to apply to all utilities in which a network is to be uniquely identified (e.g., TNIC, clearing network identification code, and closed user group). Adoption of such an approach is for further study. Until such an approach is adopted and supported, a TNIC inserted by a PPSN may not unambiguously identify it if more than one transit network involved in the call shares the same DNIC. The coding or method to be used to identify an ISDN as a transit network is for further study.

2.6.2. Call Identifier (M)

The Call Identifier utility is always present in the call request packet passed over an X.75 interface. Its initial insertion is the responsibility of the originating network and it is passed transparently over subsequent X.75 interfaces during call setup. The utility carries a 24 bit parameter field, which, together with the calling address, is intended to uniquely identify a virtual call to all of the networks involved, over a reasonable period of time (see below). This unique identifier can be used by the networks participating in the call to permit meaningful comparison of billing and error reports and other call statistics.

1. The call identifier utility is supported by PPSN/BOC-ISDNs and is expected to be supported by networks connecting to PPSN/BOC-ISDNs over X.75 interfaces, as described in sections 5.3.1 and 5.4.3.2 of X.75.

2. Responsibility for first inserting the call identifier utility rests with the originating network.

3. Pending further study on the contents of the parameter field by CCITT, some networks may not pass a significant parameter field value in this utility. If the parameter field value is not significant, it cannot fulfill the intended purpose of uniquely distinguishing virtual calls and is set to all zeros by the originating network.

4. If the content of the utility parameter field is significant, Telcordia (formerly Bellcore) recommends that the value be such that it, together with the calling address, can uniquely identify the corresponding virtual call (or call attempt) over a reasonably long period of time (i.e., calls from the same calling address during the same day can be distinguished from one another). However, beyond this general requirement, there is no further constraint upon the encoding format or contents of the 24 bits.

5. For the purposes of determining responsibility for generating this utility, a PPSN is also considered to be the originating network if the call originates in the PSTN on a dial-in basis to the PPSN.

2.6.3. Throughput Class Indication (M)

The throughput class indication utility is used to request and negotiate between networks the throughput class values to apply to a virtual call for each direction of transmission. Networks may maintain or reduce the throughput class explicitly requested across an X.75 interface, but may not increase it. If the utility is not present, the default throughput class bilaterally agreed for the interface is assumed.

1. All PPSN/BOC-ISDNs support the throughput class indication utility and the utility is expected to be supported by any network connected to the PPSN/BOC-ISDN over an

X.75 interface. This support should be in accordance with sections 5.3.3 and 5.4.3 of X.75.

2. An STE through which a call transits may either accept the requested/current throughput class values of lower it. The value should not be raised. If the throughput class indication utility is not present, the network should assume the default value agreed upon by the PPSN/BOC-ISDN and the interfacing network. Reliance upon this default should be avoided if the prevailing default throughput class exceeds a value requested by a previous network or a DTE, since this condition should result in clearing of the call. Throughput classes may be different for each direction of transmission.

3. Within the constraints of the throughput class requested by the user and prevailing resource limitations applying to a given call, all PPSN/BOC-ISDNs will be capable of supporting throughput classes up to and including 9600 bps (i.e., 75, 150, 300, 600, 1200, 2400, 4800, and 9600 bps). The 19.2 and 48 kbps throughput classes might be supported by some PPSN/BOC-ISDNs on 56 kbps interfaces. [The addition of 64000 and/or 16000 bps as valid X.75 throughput class values may be proposed to CCITT in conjunction with the corresponding ISDN access speeds.]

2.6.4. Window Size Indication (M)

The window size indication utility is used to request, and negotiate among networks, the packet level window values to apply to a virtual call for each direction of transmission.

1. All PPSN/BOC-ISDNs support the window size indication utility and the utility is expected to be supported by any network connected to the PPSN/BOC-ISDN over an X.75 interface. This support should be in accordance with sections 5.3.4 and 5.4.3.4 of X.75.

2. If the X.75 interface supports modulo 8 packet level sequencing, all PPSN/BOC-ISDNs support bracket level window sizes of 1 through 3. Window size values in the 4 through 7 range may be supported by some PPSN/BOC-ISDNs. The actual range of window sizes available is subject to any maximum size configured for the PPSN/BOC-ISDN interface that applies to all virtual calls. If the window size indication is not present, a default of 2 should be assumed unless prior arrangement between the PPSN/BOC-ISDN and connecting network has assigned another default value. If extended mode (modulo 128) packet level sequencing is supported on the interface, additional window size values in the range 1-60 will be supported and values in the range 61-127 may also be supported.

2.6.5. Packet Size Indication (M)

The packet size indication utility is used to request, and negotiate among networks, the maximum date field length (i.e., packet size) to apply to a virtual call for each direction of transmission.

All PPSN/BOC-ISDNs support the packed size indication utility and the utility is expected to be supported by any network connected to the PPSN/BOC-ISDN over an X.75 interface. This support should be in accordance with sections 5.3.5 and 5.4.3.5 of X.75. All PPSN/BOC-ISDNs support maximum packet size values of 128 and 256 octets. If the packet size indication utility is not present, the default maximum packet size determined by interface configuration option is used.

2.6.6. Fast Select Indication (M)

The fast select indication utility allows up to 128 octets of user data to be carried in the call request packet. When no restriction on response is indicated in such a call request packet, the remote STE is permitted to issue a call connected packet containing a user data field of up to 128 octets. If a response restriction is indicated in the call request packet, the remote STE is not permitted to issue a call connected packet in response. At any time, a clear request packet containing up to 128 octets of user data may be issued. The fast select mode permits information transfer during the call establishment phase and without necessarily entering the data transfer phase.

PPSN/BOC-ISDNs support the fast select indication utility, as described in sections 5.3.6 of X.75. Both “restriction on response” options are supported.

2.6.7. CUG (M) Indication and CUG/DA (O) Indication

The closed user group (CUG) indication and closed user group with outgoing access (CUG/DA) indication utilities are used to enable the establishment of virtual calls by DTEs which are members of CUGs that span networks. Associated with each CUG is a CUG interlock code which has end-to-end significance across the networks involved. This interlock code is mapped from or to a corresponding CUG index at the DTE/DCE interface which has only local access interface significance. The CUG/DA indication is passed instead of the CUG indication if outgoing access capability is being signaled for the call.

1. All PPSN/BOC-ISDNs support both the CUG indication utility and the CUG/DA indication utility. Any network connecting to a PPSN/BOC-ISDN via an X.75 interface is expected to support at least the CUG indication utility. Support of these utilities should be consistent with sections 5.3.7, 5.3.8 and 5.4.3.7 of X.75 and section 5.3.3.1.2.2 of 1984 CCITT Recommendation X.300.

2. Only one, the CUG indication or the CUG/DA indication, should be present in a call request packet.

2.6.8. Called Line Address Modified Notification (M)

The called line address modified notification (CLAMN) utility indicates that the called address in the call connected or clear request packet is different from the called address in the call request packet for that call. The utility also indicates the reason for the change in called address.

All PPSN/ISDNs plan to support the CLAMN utility. The utility should be supported as described in sections 5.3.10 and 5.4.3.8 of X.75.

2.6.9. Transit Delay Indication (M)

The transit delay indication utility was not fully specified in the 1984 version of X.75. However, it was fully defined and categorized as an international mandatory utility in 1985.

The revised specifications relating to this utility are reproduced below [emphasis omitted and editorial notes added] from the Special Rapporteur report cited earlier.[11] The coding of the utility code field remains as in the 1984 X.75 Recommendation.

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.

The transit delay is defined as [1] 3 in Recommendation X.135, and is expressed in terms of the 95% value. [See item 3 below] 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.” [See item 4 below.].

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. The call will be established without this utility.

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.

The revised specifications for the coding of the utility parameter are as follows:

This parameter is two octets. Transit delay is expressed provisionally in milliseconds, binary coded, with bit 8 of octet 1 being the high order bit and bit 1 of octet 2 being the low order bit.

1. Pending official publication of the revised CCITT specifications, support of the transit delay indication utility is considered to be optional. If this utility is not supported across the X.75 interface, calls are established without it. If it is supported, it is supported in conformance to these specifications and section 5.4.2 of X.75.

2. If supported, PPSN/BOC-ISDNs will insert (if not instance of the utility yet exists) or add (if an instance of the utility already exists) an estimate of the nominal transit delay across the network to the parameter field at each outgoing X.75 interface.

3. Recent decisions within CCITT suggest that “mean value” will replace “95% value” in the above definition of transit delay.

4. During an interim period when not all networks support this utility or the X.25 Transit Delay Selection and Indication facility, a draft revision of Recommendation X.25 specifies that all bits of the parameter field be set to one to indicate that at least one transit or designation network participating in the call does not support the utility/facility. Since a transit delay longer than 65534 milliseconds is highly unlikely, possible confusion between use of “all ones” coding to indicate delay values greater than 65534 milliseconds and use to indicate network non-support is not considered to be a significant problem. The latter interpretation should normally be assumed during the interim period.

2.6.10. Reverse Charging Indication (O)

The reverse charging indication utility is used to signal that the originating user has requested charges be reversed to the destination user. In the absence of this utility, it is assumed that the call is charged to the originating user. [The use of the NUI facility is assumed not to alter the end of call held responsible for the bill.]

All PPSN/BOC-ISDNs support the reverse charging indication utility, as described in sections 5.3.9 and 5.4.3.6 of X.75.

2.6.11. Clearing Network Identification Code (O)

The clearing network identification code (CNIC) utility provides additional information about the network origin of a clear request.

1. All PPSN/BOC-ISDNs plan to support the CNIC utility, as specified in sections 5.3.11 and 5.4.3.9 of X.75.

2. A PPSN will identify itself as the source of a clear request by inserting a CNIC utility instance in the clear request packet, with its DNIC in the parameter field of the utility. The DNIC of the PPSN will be used even if the physical location of the clearing condition is within the PSTN portion of the BOC/IDC network for a dial-in call.

3. Since DNICs are shared within the U.S., the CNIC utility issued by a PPSN may not be able to uniquely identify that PPSN as the clearing network if another network sharing that DNIC is also participating in the call. Various possibilities for extending or supplementing the standard CNIC utility to permit identification of individual operating companies or LATAs as a clearing network are being considered. One possibility is introduction of a new utility to be used to supplement the DNIC when it alone cannot uniquely identify a network. These possibilities are all for further study. The coding or method to be used for identifying ISDNs as the clearing network is also for further study.

2.6.12. Transit Delay Selection (O)

The transit delay selection utility was not fully specified in the 1984 version of X.75. However, it was fully defined and categorized as an international optional utility in 1985.

The revised specifications relating to this utility are reproduced below [emphasis omitted] from the Special Rapporteur report cited earlier.[11] The coding of the utility code field in these new specifications is “01001011” with bit 8 on the left.

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.

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.

The revised specifications for the coding of the utility parameter are as follows:

This parameter is two octets. Transit delay is expressed provisionally in milliseconds, binary coded, with bit 8 of octet 1 being the high order bit and bit 1 of octet 2 being the low order bit.

1. Support of the transit delay selection utility is optional. If not supported on an X.75 interface, a virtual call is established without the utility. If supported, it will conform to the above specifications.

2. What routing action a PPSN/BOC-ISDN takes in response to the delay value carried in this utility, if any, is for further study.

2.6.13. Utility Market (O)

The utility marker is used to separate any BOC/IDC-specified and other non-CCITT supported on the X.75 interface by bilateral agreement from CCITT utilities.

1. All PPSN/BOC-ISDNs plan to support the utility market, as specified in sections 5.3.17 and 5.4.3.15 of X.75.

2. All CCITT X.75 utilities (international mandatory, international optional, and national) should precede the utility marker, if present. [Draft CCITT utilities that have not yet been formally published may appear before or after the marker during an interim period, depending on interface implementation and bilateral agreement. However, Telcordia (formerly Bellcore) recommends that such utilities appear after the market, prior to draft CCITT approval, and before the marker, following draft approval, if the placement cannot be easily switched in response to the needs of the opposite STE.]

3. All other utilities, including any non-standard versions of CCITT utilities should follow the utility marker.

2.6.14. RPDA Selection (N)

As of April 25, 1985, the RPDA selection utility has been included in CCITT Recommendation X.75. The text of this addition to the X.75 is reproduced below from the meeting report of the Special Rapporteur cited earlier.[11]

DPDA selection is a network utility that may be used to name an RPDA 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 RPDA in the originating country.

This utility can be used to carry an RPDA transit network DNIC specified by the calling DTE. When more than one transit network is specified by the calling DTE, a sequence of RPDA selection utilities may be present in the Call Request packet. In this case, the order of identification of transit networks by the RPDA selection utilities is identical to the order specified by the calling DTE.

Temporary Note – The identity of the RPDA transit network for ISDN-to-PSPDN and ISDN-to-ISDN inter-workings is currently under study.

A network receiving a Call Request packet containing one or more RPDA selection utilities will route to the next requested network, removing the RPDA 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 RPDA selection utility should not be present in the Call Connected and Clear Request packets. No indication of the RPDA selection should be present in the user facility field of the Call Request packet.

The addition to the Recommendation X.75 designates the utility code for RPDA selection to be the following class B value: “01000100” (bit 8 at the left). It also states the following on coding of the utility:

The parameter field contains the data network identification code for a requested RPDA transit network and is in the form of four decimal digits.

Temporary Note – The RPDA transit network identify coding for ISDN-to-PSPDN and ISDN-to-ISDN inter-working is currently under study.

Each digit is coded in a semi-octet in binary coded decimal with bit 5 or 1 being the low order bit of the digit. The high order digit is coded into bits 8 to 5 of the first octet of the parameter.

PPSN/BOC-ISDNs normally use this utility for internal purposes and to permit directly connected packet networks to signal that a particular interexchange carrier (IC) be used to complete a call. If the extended format of the utility is not used, an RPDA utility would not be passed to ICs across the X.75 interface.

1. All PPSN/BOC-ISDNs plan to support the RPDA selection utility, as specified above, with the following qualifications and amplifications.

2. The extended format of the utility may not be permitted in some PPSN/BOC-ISDNs.

3. Normally, the outgoing PPSN/BOC-ISDN X.75 STE deletes the (next) RPDA selection utility (associated with the interfacing network) form the X.75 call setup packet. However, some PPSN/BOC-ISDNs may support two configuration option variables associated with the handling of the RPDA selection utility. These option variables would specify, respectively, whether or not the RPDA selection utilities is to be: (1) deleted

before being passed and (2) accepted if receive, over an X.75 interface. These configuration options are used to support certain special cases (such as calls originating on private networks directly connected to the PPSN/BOC-ISDN, which require that the RPDA utility be retained on the associated inter-network interfaces). If the PPSN/BOC-ISDN X.75 interface is configures not to accept an RPDA selection received over an X.75 inter-network interface, it will clear any incoming call request containing an RPDA selection utility.

2.6.15. Tariffs Utility

In general, the Tariffs utility is intended to be used to pass information among networks to permit or facilitate billing and other financial arrangements negotiated by the interfacing networks. Because of the nature of this information, it can also be useful for other administrative applications within a network.

Neither the operation nor coding of the Tariffs utility is yet defined in X.75. It is a subject for further study. However, some PPSNs may support a PPSN-specified utility that serves a similar function and could be used, subject to bilateral agreement, across the X.75 interface. This PPSN-specified utility is typically class A and is used to pass an 8-bit class code defined by the source network: the originating network if it appears in the call request packet and the destination network if it appears in the call connected or clear request packet. For additional information on possible availability and coding of such a network-specific utility, the individual PPSN should be contacted.

2.6.16. Traffic Class Indication & Address Extension

The 1984 version of X.75 identifies two other utilities: the Traffic Class Indication utility and the Address Extension utility. At this time, both are for further study.

2.7. BOC/IDC-Specified Utilities

Some PPSN/BOC-ISDNs may support the following network-specific utility. It is introduced to address PPSN/BOC-ISDN needs that are not adequately addressed by existing CCITT utilities. As a network-specified utility, it should follow the utility marker, and it is passed between networks only by bilateral agreement.

2.7.1. IC Preselection Indication

The BOC/IDC-specified utility, IC Preselection Indication, is used to pass an indication that the originating DTE has subscribed to the IC Preselection facility. This facility permits a user to specify a default interexchange carrier (IC) to be used in all calls requiring such a carrier if an RPDA is not explicitly selected on a per-call basis. The parameter field of the utility contains the DNIC of the preselected IC. This utility differs from the RPDA Selection utility in that an explicit RPDA selection always results in routing via the designated IC, whereas routing via a preselected IC is conditional upon need (see section 10 for further details on PPSN/BOC-ISDN inter-network call routing rules). This utility would be used if:

- both the PPSN/BOC-ISDN and a packet network directly connected to the PPSN/ BOC-ISDN by an X.75 interface support this utility by bilateral agreement;
- the network directly connected to PPSN/BOC-ISDN supports an IC preselection subscription option for its users; and
- that network relies upon the PPSN/BOC-ISDN for the routing logic necessary to determine if an IC is necessary to complete the call and for the physical connection to the IC.

1. Some PPSN/BOC-ISDNs may support the IC Preselection Indication utility on X.75 interfaces on an interface configuration option basis.

If supported, the following apply.

2. If the IC Preselection Indication utility is present in a call request received over an X.75 interface, the PPSN/BOC-ISDN will use the DNIC contained in the parameter field for routing in accordance with section 10. The IC Preselection Indication utility will not be passed by a PPSN/BOC-ISDN over an outgoing X.75 interface.

3. Format and coding of the IC Preselection Indication utility should follow those specified for CCITT utilities in section 5.4.1 of X.75. The class B utility code is “01100101” (bit 8 on the left). The parameter field contains the DNIC of the preselected IC. Each semi-octet encodes one of the four digits of the DNIC in BBCD, in the same order specified for the RPOA Selection utility.

2.8. Other Utilities Under Study

There are several areas for which no CCITT utility has yet been specified, but which are under consideration to meet identified PPSN/BOC-ISDN interworking needs. Proposed utilities associated with two of these areas are identified below. Both are currently for further study.

2.8.1. Network User Identification

A network user identification (NUI) utility would permit passing between networks either a portion of the X.25 NUI selection facility passed by an end user or user identification information derived from that NUI. This utility could be used to facilitate inter-network billing agreements and/or to pass customer verification information. Support of this utility assumes the existence of an agreement for passing such information between the PPSN/BOC-ISDN and the interfacing network. The need for and coding of this proposed utility is for further study.

2.8.2. Numbering and Addressing Plan Indicator

As a PSPDN, a PPSN has a native addressing system that conforms to CCITT Recommendation X.121. However, calls carried by a PPSN can originate or terminate on network that are not PSPDNs, such as a PSTN or ISDN. These other network types use addresses conforming to CCITT Recommendations E.163 and E.164. For calls which involve networks which do not have the same native numbering plan, it is necessary to be able to distinguish the type of address present. Descriptions of these numbering plans and a short-term approach to distinguish among them using escape digits are contained in Section 9.

However, a different mechanism is needed as a long-term solution. Among the reasons for a long-term solution based on a new Number and Addressing Plan Indicator (NAPI) utility is the need to avoid an address field overflow that can occur with an address party prefix or escape code approach. The need for such a long-term solution is currently being addressed within CCITT Study Group VII. Once this mechanism is defined for X.75 interfaces by CCITT, it should be supported. Until that time, it is considered to be for further study.

2.9. Addressing

2.9.1. General Comments

This section discusses network addresses, the associated numbering plans, and the passing of addresses between networks over X.75 interfaces. The rules that PPSNs and BOC-ISDNs apply in determining whether to route a call via another network and in selecting the appropriate interfacing network are discussed in the next major section.

The numbering plans from which the PPSN and BOC-ISDN addressing schemes are derived are outlined below. The conforming subsets of these reference numbering plans that are used within PPSNs and BOC-ISDNs are then described. Next, major issues related to numbering are discussed. Finally, format assumption and desirable configuration option capabilities for address handling between a PPSN/BOC-ISDN and another network over an X.75 interface are detailed.

Throughout this section ,"N" is used to present a digit in the range 2-9 and “X” is used to represent a digit in the range 0-9.

2.9.2. Reference Numbering Plan

There are separate, internationally standardized (i.e., CCITT) numbering plan Recommendations for PSPDNs and for telephone service and ISDNs. In addition, there is a more highly structured scheme that has been used within North America for telephony. [This scheme is not a CCITT numbering plan, but rather a conforming subset.] Since these reference numbering plans form the basis for the numbering plans used within PPSNs and BOC-ISDNs, they are introduced below and the key format components that are relevant on an inter-network basis are briefly described.

2.9.2.1. PSPDN Numbering Plan (X.121)

The numbering plan used within PSPDNs is specified in CCITT Recommendation X.121.[12] Although abbreviated forms of PSPDN addresses are often used within a network, a full International Data Number (IDN) is always passed over an X.75 interface between networks. An IDN consists of from five to fourteen decimal digits. The first four digits are the Data Network Identification Code (DNIC) which identifies a network or group of networks. The remaining one to ten digits are the Network Terminal Number (NTN) which identifies a specific PSPDN DTE/DCE interface or hunt group within the network or group of networks assigned that DNIC.

2.9.2.2. ISDN Numbering Plan

The numbering plan used within ISDNs is specified in CCITT Recommendation E.164.[13] Related CCITT Recommendations include E.163,[14] E.160,[15] and I.330.[16] ISDN addresses consist of 15 or fewer decimal digits, made up of a Country Code (CC) and a National (Significant) Number or N(S)N. The N(S) can be broken down into two components: a National Destination Code (NDC) and a Subscriber Number (SN). The first one to three digits of the address constitute the Country Code (CC), used to specify the country or geographic area. Country Code 1 has been assigned by CCITT to World Zone 1, which thus applies to the North American Numbering Plan (see below).

The N(S)N is used to specify the individual subscriber. The first component of the N(S)N, the NDC, is of variable length and can be used to specify a network or a geographic area (or both) within the country or geographic area designated by the CC. In fulfilling this function, the NDC can be composed of a Destination Network (DN) code to specify a network, a Trunk Code (TC) to specify a geographic area, or both. The remaining (variable) number of digits of the N(S)N are the Subscriber Number (SN), which identifies the specific end user within the network.

2.9.2.3. North American Numbering Plan

The addressing used for the United States public switched telephone network (PSTN) is the North American Numbering Plan (NANP).[17] According to the NANP, a ten-digit number is used to uniquely address each telephone line. The ten-digit number is composed of three parts:

- The first three digits are referred to as the Numbering Plan Area (NPA) or area code, and designate a geographic area. The NPA is currently of the form N 0/1 X.

There are plans to expand the codes available for NPAs in the future so that the form NXX can be used.

- The following three digits are the Central Office (CO) code which identifies the end office which provides dial tone to the customer. Currently, in all but ten NPSs, the CO code format of NNX is followed. Within the ten NPAs of the exception, interchangeable CO codes[1] have been introduced.

- The last four digits are the station number which uniquely identifies the line. These four digits are in the XXX format.

1. This refers to the situation within a given NPA, in which codes of the format N 0/1 X (i.e., those codes traditionally used only as NPA codes) are used for CO codes in addition to the traditional code of the format NNX. Thus, interchangeable CO codes are of the format N 0/1 X and the full set of working CO codes having the format NXX.

Since 7-digit numbers (the home NPA assumed) are permitted, the network must be able to determine whether the first three digits of a dialed number are an NPA (10-digit number) or a CO code (7-digit number). When overlapping formats are permitted for NPAs and CO codes, it is recommended that the prefix "1" be used to indicate that a 10-digit number is being dialed. Use of the "1" prefix is not recommended for 7-digit numbers.

2.9.3. PPSN and BOC-ISDN Network Addresses

The addressing schemes used in PPSNs and BOC-ISDNs are conforming subsets of the corresponding CCITT numbering plan cited above (X.121 and E.164, respectively). These subsets reflect the NANP format to facilitate administration and so that there can be a graceful transition from the existing telephone numbering plan to ISDN services within the BOC/IDC service areas:

2.9.3.1. PPSN Numbering Plan

The PPSN numbering plan conforms to the 1984 version (Red Book) of CCITT Recommendation X.121,[12] X.110,]18] X.25,[10], X.75,[1] and X.32.[19]

There is a close correlation between the PPSN numbering plan and the NANP formats, but the PPSN numbering plan is not included within the NANP. According to the PPSN numbering plan, the ten-digit NTN is used to uniquely address each PPSN DTE/DCE interface or hunt group. Each PPSN NTN is composed of three parts which are similar in format to the NPA, CO code, and station number of the NANP:

- The first three digits are referred to as the Data Numbering Plan Area (DNPA) code, and may or may not designate a geographic area that corresponds to a telephony NPA. These digits have an NXX format.

- The following three digits are the Data Central Office (DCO) code which identifies a geographic area or an X.25, X.75, or equivalent interconnection point. These digits have an NXX format.
- The last four digits are the End Point Number (EPN) which uniquely identifies the interface or hunt group. These digits have an XXXX format.

The 4-digit DNIC always precedes the NTN as part of the IDN which is passed across X.75 interfaces and it is used to distinguish among PSPDN networks or groups of PSPDN networks.

Within PPSNs, the prefix “1” is used to differentiate between a 10-digit PPSN NTN and any of the other address formats supported within the network. Specifically, a DTE would prefix any of the following address formats with a “1” to alert the network that the 10-digit NTN format (the default format) is not being used:

- DNIC specifically indicated: 1 + DNIC + NTN
- PSTN address: 1 + 9 + TCC + TN
- ISDN address: 1 + 9 + CC + NDC +SN

However, prefixes are never passed over X.75 interfaces. If present within a network, the prefix is stripped off before being passed to another network.

For dial-in calls from the PSTN to a PPSN, some PPSNs always insert the address of the PPSN dial-in port into the calling address field. Other PPSNs insert a virtual network address derived from the contents of the NUI facility, if that facility is present. The specific PPSN should be consulted for the current implementation and long-term plans concerning the calling addressed passed for dial-in calls.

2.9.3.2. BOC-ISDN Numbering Plan

The BOC-ISDN numbering plan conforms to the 1984 version (Red Book) of CCITT Recommendation E.164.[13] Within a BOC-ISDN (including the packet mode component), network addresses are based on the NANP and three E.164 address format are supported.

- international;
- national; and
- local.

The international format for BOC-ISDN network addresses consists of the Country Code (CC) plus ten digits. The national and local formats are shortened versions of the full international number which do not include: (a) the CC or (b) the CC plus NPA, respectively. These shortened formats assume CC=1 (World Zone 1, which includes the U.S.) and the home network NPA (local format only). In the absence of a mechanism to indicate different address formats across X.75 interfaces (see the discussion of major issues in the next section of this document), only the international format may be used between networks.

All BOC-ISDN network addresses are associated with a CC of 1. The next three digits of a BOC-ISDN address is the NPA. The NPA format is currently N 0/1 X, but the expanded NXX format is planned for future applications. This is followed by the three digit CO code in the NXX format. The last four digits are the line number in the XXXX format.

Within a BOC-ISDN, the local format is the default. Prefixes are used to indicate that a national or international format follows. However, only the international format is passed between networks. Thus, prefixes never appear across X.75 interfaces.

2.9.3.3. Escaping From Numbering Plans

Escape digits are prepended to numbers to indicate that the following number does not belong to the native numbering plan (X.121 or E.164) of the network. Escape digits are originally signaled by DTEs and escapes are kept, added, deleted, or modified by networks, over X.75 interfaces encountered during call establishment, as appropriate, given bilateral agreements and the numbering plan format presumed for the interface. Although each numbering plan provides for escaping to the other, the expression “native numbering plan” as it is used here, refers to the numbering plan characteristic of end user addresses on the given network. An ISDN assumes an E.164 address unless an escape is present and a PSPDN assumes an X.121 address unless an escape is present. Since interworking between networks with different native numbering plans is anticipated (e.g., PSPDN/ISDN), escape digits (unlike prefixes) can appear at the beginning of the addresses passed over X.75 interfaces.

Within the X.121 numbering plan, an E.164/E.163 address is indicated by preceding the address with the escape digit “9.” [The escape digit “0” may be used by some non-BOC/IDC networks, but support within BOC/IDC networks of “0” for escape to E.164/E.163 is not planned.]

Within the E.164/E.163 numbering plan, an X.121 address is indicated by preceding the address with the escape digit “0.”

Several issues related to escape digits and interworking between PSPDNs and ISDNs remain open at this time. These and other major issues that impact address handling over X.75 interfaces are discussed in the next section.

2.9.4. Major Addressing Issues

There are several unresolved issues that impact the handling of addresses over X.75 interfaces. They are briefly discussed below. Their ultimate resolution may result in modification or expansion of the guidelines for address handling between PPSN/BOC-ISDNs and other networks over X.75 interfaces that are presented in the next subsection. Also included below are brief issue discussions that provide background for some of the specifications in the address handling subsection.

1. Mechanisms for escaping from one numbering plan to another for interworking between networks are based on an assumption concerning which numbering plan format applies across the interface. An escape is necessary only when the following address belongs to a numbering plan that is “not native” to the format applying across the interface. According to the 1984 (Red Book) version of the X.75 protocol, the X.121 format is assumed across the interface. Based on this assumption, an address (calling or called) would be escaped over an X.75 interface only if it was not a native X.121 (i.e., PSPDN) address, independent of the native numbering plans of the networks on either end of the interface.

However, there are plans to extend the scope of X.75 so that it explicitly addresses connections to networks other than PSPDNs (e.g., ISDNs operating in the packet mode). This extension reflects the internetwork applications planned for X.75 interfaces, as described earlier in this document. Under such an expanded definition for X.75, the escape rule stated above may be modified in the future.

The escape guidelines presented in the next subsection reflect the current CCITT Recommendation concerning numbering plan formats across X.75 interfaces for PSPDN/PSPDN and PSPDN/ISDN interworking. However, for ISDN/ISDN X.75 interfaces, Telcordia (formerly Bellcore) recommends that escaping rules conforming to the E.164/E.163 format be employed. Before these escaping conventions are finalized and until the NAPI mechanism (see below) is available, it may be advisable to implement escaping procedures with configuration option flexibility.

2. Some networks have expressed the desire to receive a service type indication, along with the called address, specifying the appropriate network/user interface type for completing the call at the receiving end. For example, in a call from an X.25 terminal on a PSPDN to an X.25 terminal served by an ISDN, the destination network may with to have an explicit indication of whether the destination end service is to be X.31 (ISDN packet mode connection) or X.32 (circuit-switched). However, this requires that the calling party be aware of the service type at the destination end, in addition to the address. Thus, Telcordia (formerly Bellcore) considers it preferable that the destination

network be able to complete the call based on its own knowledge of the appropriate service type for the called address which it serves.

3. In the long run, it is important to replace escape mechanisms and prefixes with a separate indicator that is not prepended to the address itself. Among the reasons for such a change is the need to remove the restriction placed upon current E.164 addresses by ISDN/PSPDN interworking. The calling and called addresses in X.25 and X.75 packets is restricted to be 15 digits or less. Since E.164 addresses without prefix or escape digits can be up to 15 digits, the use of these additional digits reduces the number of digits available for the E.164 address proper to be less than 15.

To address this problem, a Numbering and Addressing Plan Indicator (NAPI) has been proposed and is currently under consideration by CCITT Study Group VII. In the interim, escapes and prefixes will be used and BOC-ISDNs will restrict their network addresses to 12 digits or less. The date December 1996 (time “T”) has been selected by CCITT Study Group II as the point at which a NAPI mechanism has been approved and assumed to be implemented by networks, and a full 15-digit E.164 address can be used.

4. For ISDNs within North America, there remain questions on the integration of networks outside of the BOC/IDCs into the NANP. In particular, questions have been raised concerning the assignment of available codes from the first three digits of the 10-digit NANP number or assignment of dedicated CO codes within existing NPAs to World Zone 1 networks other than the BOC/IDCs and USTA members. Related to these questions is the possibility of supporting Destination Network (DN) codes (identifying networks) as well as NPAs (identifying geographic areas) in the first three digits of a national format E.164 number for World Zone 1. Such DN codes could be followed by a standard NANP format (NXX-XXXX).

Given the unresolved questions in this area, it is recommended that implementation of address handling for X.75 interfaces be designed so that they can accommodate or be configured to accommodate these various possibilities.

2.9.5. X.75 Interface Address Handling

Based on the above material, this subsection summarizes the working assumptions for addresses passed over X.75 interfaces connecting PPSNs and BOC-ISDNs to other networks. It also presents suggestions for address handling by other networks to provide the flexibility necessary to accommodate the anticipated standards developments and to achieve compatibility in an environment of network and equipment implementation diversity.

1. The contents of calling address and called address fields of packets passed over X.75 interfaces connecting PPSN/BOC-ISDNs and other networks should consist of an ad-

dress, possibly preceded by an escape digit. The escape digit is present if and only if the address belongs to a numbering plan that is not the "native" numbering plan, as defined below. Prefixes should not be present.

2. Currently, the X.121 numbering plan format is presumed over X.75 interfaces. However, the escape mechanism included in X.121 allows network addresses corresponding to both the PSPDNs (X.121) and PSTN/ISDNs (E.163/E.164) to be passed over X.75 interfaces. When a PPSN to other PSPDN is either (or both) of the two ends of an X.75 interface, the escaping is done in accordance with Recommendation X.121. [This is consisted with the 1984 version of X.75.] When both ends of an X.75 link are ISDNs, Telcordia (formerly Bellcore) recommends that escaping should be done in accordance with Recommendation E.164. [This reflects an anticipated change in X.75 to accommodate ISDNs.]

3. The default assumption is that any X.121 address (without escape if the native plan is X.121 and preceded by an escape digit if the native plan is E.164) consists of a full IDN (DNIC + NTN), of between 5 and 14 digits, as specified in Recommendation X.121. Those IDNs which correspond to a PPSN network address will conform to the PPSN address format described earlier.

4. The default assumption is that any E.163/E.164 address (without escape if the native plan is E.164 and preceded by an escape digit is the native plan is X.121) consists of a full international format number, as specified in Recommendation E.163 and E.164 (TCC + TN or CC + N(S)N). The address must consist of at least 7 digits. Prior to time "T" (December 1996), the total number of address digits cannot exceed 12. After time "T" the address may be up to 15 digits and the NAPI mechanism will replace the escape code mechanism. Currently, addresses on a BOC-ISDN or PSTN network are of the format 1 + NXX-NXX-XXXX (with the NPA and CO components possibly restricted to more limited formats than NXX, as described earlier). Other addresses that have a Country Code (CC) of 1 are assumed to have the same format as BOC/IDC networks or (possibly) a format in which a Destination Network (DN) code follows the CC.

5. It is expected that a Numbering and Addressing Plan Indictor (NAPI) mechanism will be adopted by CCITT in the near future. The proposed facility/utility version of this mechanism will permit numbering plans and address formats to be explicitly distinguished without the need of escape digits or prefixes within the address field itself. After a NAPI mechanism is approved by CCITT, it is suggested that it be implemented expeditiously over X.75 interfaces. After the availability of the NAPI mechanism (and by bilateral agreement during any interim period during which this mechanism is not yet universally available), escape digits would not be required and address formats other than the full IDN (X.121) or international number (E.164) would be permissible across X.75 interfaces.

6. The digit “0” is the escape digit used to indicate that an X.121 address follows, if the native numbering plan is E.163/E.164.

7. The digit “9” is the escape digit used to indicate that an E.163/E.164 address follows, if the native numbering plan is X.121. However, the digit “0” may also be used, when bilaterally agreed by the interfacing networks, to escape from the X.121 native numbering plan for service indicator purposes. While BOC/IDC networks may support the receipt from other networks of either the “9” or “0” to escape from X.121, there are no plans for these networks to distinguish destination interface service type on the basis of which of these two digits is received.

8. Normally, a PPSN will pass the escape digit signaled by the DTE, if any, across the X.75 interface. However, some PPSNs may be capable of converting the “0” escape digit to a “9” or converting the “9” escape digit to a “0” before passing an address over the X.75 interface, by bilateral agreement with the interfacing network.

9. If an invalid address format is received over the X.75 interface by a BOC/IDC network, the call will be cleared.

10. The following summarizes the address formats supported across X.75 interfaces:

All Except ISDN STE to ISDN STE Case:

X.121 IDN

or

9 + E.164/E.163 Int’l Address

or

0 + E.164/E.163 Int’l Address

ISDN STE to ISDN STE Case:

0 + X.121 IDN

or

E.164/E.163 Int’l Address

11. Addresses within PPSNs and BOC-ISDNs have the following formats:

PPSN X.121 IDN: DNIC + NXX-NXX-XXXX

BOC/IDC E.164/E.163 Int'l Address: 1 + NXX-NXX-XXXX

2.10. Routing Between PPSN/BOC-ISDNs and Other Networks

The previous section described the nature and format of addresses passed over the X.75 interface from or to a BOC/IDC network. It also discussed the currently available mechanisms used to distinguish between the two numbering plan (escape digits) and address formats (prefixes, used within the BOC/IDC network). This section discusses routing and related rules used or assumed by BOC/IDC packet mode networks that are relevant for internetwork calls. The address described in the previous section are an important input to the selections and decisions resulting from these rules.

This section consists of five subsections. The first outlines the ability of PPSNs and BOC-ISDNs to screen (and possibly block) incoming and outgoing calls at an X.75 interface (STE) on the basis of the first digits of the called address. The second subsection discusses the number of digits that may need to be examined to make network routing decisions, given the existing BOC/IDC numbering plans. The third describes the actual path selection criteria and rules. The fourth discusses alternate routes and path diversity. The final subsection discusses the ability to reconnect a path that has experienced some failure, without clearing the call.

2.10.1. Screening

Some PPSN X.75 interfaces may be configured with lists of DNIC values which are permitted to be received in the called address of incoming call requests. If the DNIC of the called address of any incoming call request is not on such a list, the call is cleared. If the interface is not configured with such a list, this screening does not take place. Such lists normally include the PPSN's DNIC, the DNICs of networks for which the PPSN is allowed to act as a transit network (e.g., directly connected private networks), and one or more codes of the form 91XX, where XX are the first two digits of the NPA(s) assigned to the LATA containing the PPSN and reachable by PPSN/BOC-ISDN interworking or via a dial-out port on that PPSN.

Some PPSN X.75 interfaces may be configured with lists of DNIC values which are not permitted to be sent in the called address of outgoing call requests. If the DNIC of the called address of any outgoing call request is on such a list, the call is cleared. If the interface is not configured with such a list, this screening does not take place. These lists could be used to block calls to networks with which the BOC/IDC does not have a billing agreement, for example.

2.10.2. Digit Requirements for Routing

Based on the nature of the numbering plans used by PPSNs and BOC/IDC ISDNs and PSTNs, other networks must inspect a minimum number of digits of the called address before an individual BOC/IDC network can be uniquely identified for routing purposes. For X.1121 addresses, it is necessary to examine either the DNIC plus the next three digits or the DNIC plus the next six digits of the X.121 address to determine the specific PPSN to which the address belongs. For World Zone 1 E.163/E.164 addresses, either the first three digits or the first six digits of the national format must be examined to establish the specific BOC-ISDN or PSTN to which the address belongs.

2.10.3. BOC/IDC Path Selection Criteria and Rules

This subsection discusses those aspects of Telcordia (formerly Bellcore) recommended routing procedures for PPSNs and BOC-ISDNs that are of relevance to interfacing networks. Implementation of these procedures is planned for all PPSNs.

First, recommended general routing capabilities and network information storage needs are described. Next, the criteria and rules recommended for use by BOC/IDC networks in routing calls to other networks and within the network (when received from other networks) are described in detail. Rules for routing to destinations within the BOC/IDC network are included so that interfacing networks can correctly populate the called address field (and possibly, the RPDA selection and/or IC Preselection utilities) to reach the desired BOC/IDC network destination.

2.10.3.1. General Routing Capabilities

Telcordia (formerly Bellcore) recommends that:

1. A PPSN be capable of routing to networks directly connected to itself or to a BOC-ISDN within the same LATA that is reachable from this PPSN on the basis of:

    - a DNIC or pseduo-DNIC as the RPDA selection or IC preselection; or

    - a DNIC, 9+CC, or 9+TCC plus the following zero, three, or six digits of the called address.

A pseduo-DNIC, as used here, is the four digits of the RPDA selection or IC preselection which does not correspond to a regular PSPDN DNIC. [Later, the term “pseudo-DNIC” will also be used to refer to four digits consisting of escape digit 9, the country code 1, and the following first two digits of an E.163/E.164 address (“91XX”).]

2. A BOC-ISDN be capable of routing to networks directly connected to itself or to a PPSN within the same LATA that is reachable from this ISDN, on the basis of:

    - a DNIC or pseudo-DNIC as the RPDA selection or IC preselection;

    - DNIC plus the following zero, three or six digits of an X.121 number; or

- the first three or six digits of an E.163/E.164 NANP number.

3. A PPSN be capable of distinguishing a destination within the PPSN from destinations on other networks which share the same DNIC on the basis of the first three to six digits of the NTN.

4. A PPSN be capable of routing, on the basis of the first three to six digits of World Zone 1 E.163/E.164 national addresses, to the BOC/IDC PSTN or ISDN in the same LATA, and to other ISDNs connected directly to the PPSN or to a BOC-ISDN within the LATA.

5. A BOC-ISDN be capable of distinguishing a destination within that network from destinations on other World Zone 1 ISDNs and PSTNs on the basis of the first three to six digits of the E.163/E.164 national address. The same digits can be used to distinguish which of the ISDNs that are directly attached to the BOC-ISDN or the PPSN in the same LATA is the appropriate destination.

6. A BOC-ISDN be capable of routing, on the basis of the first three to six digits of the NTN of an X.121 address with the same DNIC as the PPSN within the same LATA, to that PPSN or to any packet network that is directly connected to the BOC-ISDN or the PPSN in the same LATA.

2.10.3.2. Routing Rules Used by BOC/IDC Networks

Calls are routed primarily on the basis of three pieces of information contained in the call request packet: the RPDA selection (if present); the called address; and the preselected IC (if configured/present). Until the NAPI mechanism is available, address fields are examined for the presence of escape digits to determine the corresponding numbering plan and the appropriate escape digit to use, if any, on outgoing X.75 interfaces. Routing logic recommended for use by a BOC/IDC network can be separated into two major cases: (a) RPDA selection specified and (b) RPDA selection not specified.

1. If an RPDA Selection Has Been Specified:

   A. For incoming inter-LATA calls, some BOC/IDC X.75 interfaces may be configured not to accept an RPDA selection in the incoming call request. This configuration option can be used to prevent the network from serving a purely transit network function. If this is the case, the incoming call attempt will be cleared if an RPDA selection utility is present.

   B. If an RPDA selection is received from a DTE on the network or in an incoming call request from another network (if permitted), and the specified four-digit value matches a DNIC or pseudo-DNIC (e.g., “9XXX”) contained in the network routing tables as belonging to the BOC/IDC network(s) in the LATA or a network directly connected to these, then the call should be routed to the specified network (however, see the exception for special DNIC values described in item “3”).

C. In all cases of a call reaching an outgoing X.75 interface, if that interface is configured with a list of DNICs and pseudo-DNICs (e.g., “91XX”) that are not allowed in the called address field, then the first four digits of the called address is compared against this list. [These four digits include the “9” escape digit, if present before an E.163/E/164 address, but not the “0” escape digit before an X.121 address.] If there is a match, the call is cleared. This capability can be used in cases for which the BOC/IDC does not have a billing agreement with the corresponding destination network, for example.

D. If the four-digit value specified in the RPDA selection does not match a DNIC or pseudo-DNIC in the network routing tables, then the call should be cleared.

E. Some PPSN/BOC-ISDNs may support a special class of DNIC value, which will be handled in a different way when it appears in a RPDA selection. Normally, a valid RPDA selection supersedes all other criteria (i.e., called address and IC preselection) for routing. However, if a four-digit value is specified as being of this special type by the network, its presence in an RPDA selection received from a network user will be ignored if the call can be completed on an intra-LATA basis. This special class could be used for transit networks that either do not which to or are not permitted to handle intra-LATA traffic, for example.

2. If an RPDA Selection Has Not Been Specified:

A. For incoming calls from another network, if the X.75 interface is configured with a list of called address DNICs and pseudo-DNICs that are permitted for incoming calls, the first four digits of the called address are compared to this list. [The first four digits include the escape digit “9” before an E.163/E.164 address, but not a “0” escape digit before an X.121 address.] If there is such a list configured and there is no match, the incoming call is cleared.

B. If the first digits of the called address are contained in the routing tables for other BOC/IDC networks in the LATA or networks directly connected to a BOC/IDC network in the LATA, the call is routed accordingly.

C. For X.121 PSPDN addresses, if the first four digits of the called address are the home DNIC of the BOC/IDC network, and the next three to six digits are contained in the BOC/IDC routing tables for the home DNIC, the call is routed accordingly. For E.164/E.163 World Zone 1 addresses, if the first three to six digits of the national number are contained in the BOC/IDC routing tables, the call is routed accordingly.

D. If none of the above hold then IC preselection in investigated. If a call originates on an access interface within the network that is configured with a preselected IC or, for an incoming call, if the X.75 interface is configured to accept the IC Preselection utility and this utility is present in the incoming call request, then the preselection value is used to route in the same manner as the RPDA selection was used when present (see case 1 above).

E. In all cases of a call reaching an outgoing X.75 interface, if that interface is configured with a list of DNICs and pseudo-DNICs that are not allowed in the called address field, then the first four digits of the called address is compared against this list. If there is a match, the call is cleared.

F. If the call amount be routed according to any of the above, the call is cleared.

Figure 10-1 is a flowchart which summarizes the routing logic described in more detail above. This flowchart only includes major decision branches for routing capabilities and options that are planned to be implemented on a majority of the BOC/IDC networks.

2.10.4. Gateway/Route Diversity

Some PPSN/BOC-ISDNs will be able to connect to another network with multiple X.75 interfaces. When available, this capability is used to provide additional traffic capacity, enhanced connection reliability, and/or reduced path lengths. Even when alternate routing capabilities are present, a PPSN/BOC-ISDN will not route a call to a network other than the specified by the RPDA selection, destination address, or IC preselection (in that order of precedence).

2.10.5. Reconnect Capability

Some PPSNs/BOC-ISDNs may support the ability to reconnect existing virtual calls, for which a virtual circuit component within the network fails, along an alternate route, without resetting.

2.11. Interface Provisioning and Maintenance

Procedures and responsibilities associated with requesting, provisioning, configuring, "turning up," and maintaining an X.75 interface between a PPSN/BOC-ISDN and another network are established by mutual agreement of the two networks. The representative of a network which wishes to establish one or more X.75 interfaces to a PPSN/BOC-ISDN should directly contact that PPSN/BOC-ISDN or the responsible BOC/IDC for details.

One maintenance capability that is supported on many PPSN/BOC-ISDNs is X.75 interface takedown. This permits an X.75 interface to be taken out of service upon PPSN/BOC-ISDN operator request for maintenance action, to conduct diagnostic tests, and for similar purposes. It is assumed that most interfacing networks have a similar capability to temporarily remove an X.75 interface from service from its end for maintenance purposes.

As stated above, the administrative procedures and responsibilities associated with removing an active X.75 interface from service are established through mutual agreement between the PPSN/BOC-ISDN and the interfacing network. However, the technical capabilities associated with two forms of interface takedown that are planned for PPSN/BOC-ISDNs are outlined below. The two forms are labeled unconditional and conditional.

1. Unconditional takedown allows a craftsperson to take an individual X.75 interface out of service so that existing virtual calls associated with the interface are cleared and PVCs are reset immediately.

2. Conditional takedown allows a craftsperson to take an individual interface out of service more gracefully (i.e., the interface will be taken out of service only after all existing virtual calls associated with the interface have been cleared by DTE request or other cause).

3. When an unconditional X.75 interface takedown request is issued by a craftsperson, the STE executes the following actions:

    A. A restart procedure is initiated for the specific X.75 interface, which results in the clearing of all active virtual calls and the resetting of all PVCs that pass over the interface. All Restart Request, Clear Request, and Reset Request packets generated as a result of this restart procedure should contain the cause "network congestion" and the diagnostic code "maintenance action" (#122).

    B. After the restart procedure is completed, the STE should initiate a link level disconnect procedure for the X.75 interface. The STE should consider the interface unavailable for normal traffic and in the disconnected mode at the link level until the interface is restored to service by craftsperson command.

C. Following a craftsperson request to restore the interface to normal service, the interface should be re-initialized at the link level; PVCs should be reset and restored to operational status; and new call requests should once again be permitted to pass over the interface in the normal manner. At the packet level, a Restart Request with cause “network operational” may be used as part of this service restorial.

4. When a conditional X.75 interface takedown request is issued by a craftsperson, the STE first does all of the following before executing the actions associated with an unconditional takedown (item 3 above):

A. Prevent any new virtual calls from being established over the interface by routing call requests over alternate facilities or immediately issuing a Clear Request in response to a Call Request that can only be routed over the facility to be taken out of service. The Clear Request should contain a cause code of “network congestion” and a diagnostic code of “maintenance action” (#122). Existing virtual calls and PVCs should not be affected at this point.

B. When the STE detects that all virtual calls thought the X.75 interface have been cleared, the STE than applies the same procedure associated with the unconditional interface takedown, as described above. However, no virtual calls that must be actively cleared by the STE should at this time still be active for the conditional takedown case.

5. Some BOC/IDC networks may also support the ability of the craftsperson to abort a conditional takedown and restore the interface to normal service or “upgrade” the conditional takedown to an unconditional takedown if conditions or elapsed time justifies the action.

2.12. Acronyms

BOC - Bell Operating Company

BOC-ISDN - BOC/IDC ISDN

kbs - bits per second

CC - Country Code

CCITT - International Telegraph and Telephone Consultative Committee

CLAMN - Called Line Address Modified Notification (utility)

CNIC - Clearing Network Identification Code (utility)

CO - Central Office

CUG - Closed User Group

DCE - Data Circuit Terminating Equipment

DCO - Data Central Office

DDS - Digital Data System

DN - Destination Network (code)

DNIC - Data Network Identification code

DNPA - Data Numbering Plan Area

DTE - Data Terminating Equipment

EPN - End Point Number

IC - Interexchange Carrier

IDN - International Data Number

IDC - Information Distributing Company

ISDN - Integrated Services Digital Network

kbps - kilobits per second

LAPB - Link Access Procedure - Balanced

LATA - Local Area and Transport Area

LC - Logical Channel

M - Mandatory (utility)

MLP - Multilink Procedure

N - National (utility)

N - digit with value 2 through 9

NANP - North American Numbering Plan

NAPI - Numbering and Addressing Plan Indicator

NDC - National Destination Code

NNX - see “N” and “X”

NPA - Numbering Plan Area

N(S)N - National (Significant) Number

NTN - Network Terminal Number

NUI - Network User Identification

NXX - see “N” and “X”

O - Optional (utility)

OA - Outgoing Access

PAD - Packet Assembler/Disassembler

PLP - Packet Layer Protocol

PPSN - Public Packet Switched Network

PS - Packet Switch

PSPDN - Packet Switched Public Data Network

PSTN - Public Switched Telephone Network

PVC - Permanent Virtual Circuit

RPDA - Recognized Private Operating Agency

SLP - Single Link Procedure

SN - Station Number

STE - Signaling Terminal

TC - Trunk Code

TCC - Telephone Country Code

TN - Telephone Number

TNIC - Transit Network Identification (utility)

TR - (Bell Communications Research) Technical Reference

USTA - United States Telephone Association

VAN - Value Added Network

VC - Virtual Call

X - Digit with value 0 through 9

2.13. *Appendix A: Summary of CCITT Modifications & Enhancements*

CCITTsect	Trsect	Description	CCITT Spec.	TR Spec.
1	3	Transmission speeds	64, 48 kbps, other	9.6, 56 kbps
1	3	Interface type	V-Series Recommendation	DDS avail.; analog private line opt.
2.1.5	4.1	Frame sequencing modulo	8 or 128	8 avail.; 128 opt.
2.3.2.1.3	4.1	U format 128 modulo 2-octet control field	bilat., interim	recom., interim
2.3.5.3 Annex C	5.2	Octet alignment	opt.	recom., except by bilat.
2.4.8.1	4.3	Configuration T1 values	N.S.	1-10 sec. In 0.5 incr. Avail.
2.4.8.2	4.3	Value of 12	T2 < T1	T2 <= 0.4 sec.
2.4.8.3	4.3	T3 timer	reg.	T3 or equiv., plan.
2.4.8.3	4.3	Configurable T3 values	N.S.	T3, if used; 1-30 sec. recom.
2.4.8.4	4.3	Configurable N2 values	N.S.	2-15 avail.
2.4.8.5	4.3	Min. set of configurable N1 values	N.S.	SLP: 2104 or 2120 avail.
2.4.8.6	4.3	Modulo 128 link level window size (k)	1-127	If modulo 128 supported: 1-60 avail.; 61-127 opt.
2.5	4.2	Support of MLP	impl.	opt.
3,4.1	5.1	Max. no. of logical Channels	N.S. (<4096)	64, 128 recom. (and for 56 kbps link: 26, 512 also recom.)
3.3.3	5.4	Max. packet sizes	128 reg.; 16, 32, 64, 256, 512 & 1024 opt.	128, 256 avail.

LEGEND

N.S. = not specified
N.A. = not applicable/covered
bilat. = by bilateral agreement
impl = implied by CCITT X.75
req. = required
util. = utility
avail = available
equiv. = equivalent
incr. = increment
opt. = optional
recom. = Bellcore recommended
plan. = planned availability
interim = for interim period

CCITTsect	Trsect	Description	CCITT Spec.	TR Spec.
3.4.1.1	5.4	Supported VC packet window sizes	1-7 or 1-127	Mod 8: 1-3 avail., 4-7 opt.; mod 128: 1-60 avail., 61-127 opt.
3.4.1.1	5.4	Supported PVC packet window sizes	1-7 or 1-127	Mod 8: 1-7 avail.; mod 128: 1-60 recom., 61-127 opt.
3.4.1.2	5.2	Packet sequencing modulo	8 or 128	8 avail.; 128 opt.
5.3.7	5.4	CUG screening on X.75 interface	N.S.	Up to 100 interlock codes,. Opt.
5.3.8	6.7	CUG/OA indication util.	bilat.	avail.
5.3.9	6.10	Reverse charging indication util.	bilat.	avail.
5.3.10	6.8	Called Line Address Modif. Notif. Util.	reg.	plan.
5.3.11	6.11	Clearing network identification code util.	bilat.	plan.
5.3.13	6.9	Transit delay indication util.	reg. (1985)	defined, opt., before/after marker
5.3.14	6.12	Transit delay selection util.	opt. (1985)	defined, opt., before/after marker
5.3.17	6.13	Utility marker	bilat.	plan.
Annex E	5.2	Transparent passing of diag. Codes 128-255	impl.	plan.
—	6.14	RPOA selection util.	1985 national	plan., before/after marker; extended format opt.
—	7.1	IC preselection util.	N.A.	opt.

LEGEND

N.S. = not specified
N.A. = not applicable/covered
bilat. = by bilateral agreement
impl = implied by CCITT X.75
req. = required
util. = utility
avail = available
equiv. = equivalent
incr. = increment
opt. = optional
recom. = Bellcore recommended
plan. = planned availability
interim = for interim period

2.14. Appendix B: Sample X.75 Interface Configuration Worksheets

This appendix illustrates the type of information that would be supplied and the values that would be mutually agreed upon in establishing X.75 interfaces between a BOC/IDC network and another network. It is intended to be a convenient summary of the salient configuration option material contained in the body of this document, from the perspective of a person responsible for ordering/negotiating actual X.75 interfaces to PPSNs and BOC/IDC ISDNs. Although ranges of values and defaults provided are consistent with those specified elsewhere in this document, the specific BOC/IDC should be contacted directly for values pertaining to the PPSN or ISDN in question when actual interfaces are to be arranged. Similarly, the actual forms and procedures used by a particular BOC/IDC must be obtained from that specific company. Details of a business nature (e.g., billing arrangements, segment size) are not addressed in this document.

This appendix consists of an overview on using this appendix and the five tables:

- B-1 - Guide to the Use of Configuration Worksheet Tables
- B-2 - SLP Physical and Link Level Worksheet
- B-3 - MLP Link Level Worksheet
- B-4 - Interface/MLP Packet Level Worksheet
- B-5 - Permanent Virtual Circuit Worksheet

Table B-1 summarizes the use of the other (i.e., worksheet) tables for the various types of interface additions or modifications that might be requested/negotiated. An X.75 interface must be fully specified before any PVC can be specified for that interface. If one or more SLPs (interface link level) are to be coordinated through an MLP, then an MLP worksheet must be specified and the appropriate cross references between the MLP and each SLP it coordinates should be provided. Modifications to existing arrangements are specified through revisions to the table(s) used to request the original interface, MLP, or PVC. Simple deletions are specified by reference to the relevant identification code assigned to the interface, MLP, or PVC.

Table B-1: Guide to the Use of Configuration Worksheet Tables

	Worksheet Table			
	B-2	B-3	B-4	B-5
Establish/Modify a X.75 Interface (SLP Link Level)	X		X	
Establish/Modify an SLP Component of an MLP	X	CR		
Establish/Modify an MLP	CR	X	X	
Establish/Modify a PVC with SLP link layer	CR		CR	X
Establish/Modify a PVC with MLP link layer	CR	CR	CR	X
Add/Remove SLP(s) in MLP	CR	X		

X = Specify or Modify
CR = Cross-reference this other table

Table B-2: SLP Physical and Link Level Worksheet

Unique Interface ID Code: I- ________________

Part of MLP?: _____ Yes _____ No   If yes, MLP ID Code: M-____________________

______ New ________ Modification

Non-BOC/IDC Requester is: ______ PSPDN ____ Private Packet Network ____ ISDN
Non-BOC/IDC STE Identification: __________________________
Non-BOC/IDC Link ID: ___________________ ____ Terrestrial ____ Satellite

BOC/IDC STE: ____ PPSN ____ ISDN (D)NPA/(D)CO Code:______-______

Physical Level Item	Possible Values	Notes/Constraints	Requested
Transmission Speed	9.6, 56 kbps		
Interface Type	DDS, analog*	analog only 9.6 kbps	
Private line type	[ask BOC/IDC]	analog only	
Line conditioning	[ask BOC/IDC]	analog only	
Modem type	[ask BOC/IDC]	analog only	

SLP Link Level Item	Possible Values	Notes/Constraints	Requested
Link address of non-BOC/IDC STE	SLP: A,B; MLP: C,D	Pick a letter	
Frame sequencing modulo	8, 128*		
U format control field length (mod. 128)	1,2 octet	1 is standard	
Window size k, both STEs	Modulo 8: 1-7; modulo 128: 1-60, 61-127*		
Timer T1 of non-BOC/IDC STE	1-10 sec. In 0.5 steps (+)		
Parameter T2 of non-BOC/IDC STE	<<T1	BOC/IDC value < 0.4 sec.	
Non-BOC/IDC timer T3 or equiv.*	< 60 sec. Or N.A.	BOC/IDC T3: 1-30 sec.	
N1 of non-BOC/IDC STE	> max. legal frame size	BOC/IDC N1: 2104 Or 2120 for SLP, 2136 for MLP (256 packet size)	
N2 of Non-BOC/IDC STE	2-15 suggested	two ends need not Match	

* = Not available on all BOC/IDC networks
(+) = Additional values are often supported
N.A. = not applicable

Table B-3: MLP Link Level Worksheet*

Unique MLP ID Code: M-_________________

______ New _______ Modification

How Many SLPs?: _____________ For each, specify Interface ID:

I-______________________	I-____________________
I-______________________	I-____________________
I-______________________	I-____________________
I-______________________	I-____________________
I-______________________	I-____________________
I-______________________	I-____________________

All of above must apply to the same STE-X/STE-Y pair:

Non-BOC/IDC Requester is: ____ PSPDN ____ Private Packet Network ____ ISDN
Non-BOC/IDC STE Identification: ______________________

BOC/IDC STE: ____ PPSN ____ ISDN (D)NPA/(D)CO Code: ______-______

SLP Link Level Item	Possible Values	Notes/Constraints	Requested
Link address of non-BOC/IDC STE	SLP: A,B; MLP: C,D	Pick a letter	
Frame sequencing modulo	8, 128*		
U format control field length (mod. 128)	1,2 octet	1 is standard	
Window size k, both STEs	Modulo 8: 1-7; modulo 128: 1-60, 61-127*		
Timer T1 of non-BOC/IDC STE	1-10 sec. In 0.5 steps (+)		
Parameter T2 of non-BOC/IDC STE	<<T1	BOC/IDC value < 0.4 sec.	
Non-BOC/IDC timer T3 or equiv.*	< 60 sec. Or N.A.	BOC/IDC T3: 1-30 sec.	
N1 of non-BOC/IDC STE	> max. legal frame size	BOC/IDC N1: 2104 Or 2120 for SLP, 2136 for MLP (256 packet size)	
N2 of Non-BOC/IDC STE	2-15 suggested	two ends need not Match	

* = Note that MLP may not be supported at all by a specific BOC/IDC network.
** = Numerical values cited as possibilities are only illustrative for MLP.

Table B-4: Interface/MLP Packet Level Worksheet

Applies to: _____ SLP _____ MLP; SLP/MLP ID Code: [I/M] -____________________

____ New ____ Modification

Non-BOC/IDC Requester is: ______ PSPDN ____ Private Packet Network ____ ISDN
Non-BOC/IDC STE Identification: __________________

BOC/IOC STE: ____ PPSN ____ ISDN (D)NPA/ (D)CO Code: ______-______

Packet Level Item	Possible Values	Notes/Constraints	Requested
Max. Logical Channel No.	64, 128, 256, 512 (+)	256, 512 at 56 kbps only	
Range of LCs for 2-way calls	X-Y, Null	Specify X > 0, Y <=Max	
Range of LCs for PVCs	X-Y, Null	no overlap/gaaps with VCs	
Range of LCs for incoming (to non-BOC/IDC STE) VCs	X-Y*, Null	no overlap/gaps	
Range of LCs for outgoing (from non-BOC/IDC STE) VCs	X-Y*, Null	no overlap/gaps	
Non-BOC STE LC assignment rule	lowest or highest avail.		
Octet alignment enforced by Non-BOC/IDC?	Yes, No*		
Packet sequencing modulo	8, 128*		
Maximum packet size for VCs, To BOC/IDC	128, 256 (+)	128 default	
Maximum packet size for VCs, from BOC/IDC	128, 256 (+)	128 default	
Max. packet window for VCs, to BOC/IDC	1-3, 4-7*; if mod. 128 1-60, 61-127*	2 default for mod. 8	
Max. packet window for VCs from BOC/IDC	1-3, 4-7*; if mod. 128 1-60, 61-127*	2 default for mod. 8	
Default throughout class for VCs, to BOC/IDC	75, 150, 300, 600, 1200, 2400, 4800, 9600 + at 56 kbps: 19.2k*, 48k*		
Default throughput class for VCs, from BOC/IDC	75, 150, 300, 600, 1200, 2400, 4800, 9600 + at 56 kbps: 19.2k*, 48k*		

(Continued)

* = Not available on all BOC/IDC networks
(+) = Additional values are often supported

Table B-4 (Continued): Interface/MLP Packet Level Worksheet

Packet Level Item	Possible Values	Notes/Constraints	Requested
Screening of CUG interlock codes by BOC/IDC?*	Yes, No	If yes, specify no. of codes needed, up to 100	
T30 restart timer		CCITT: 180 sec.	
T31 call req. timer		CCITT: 200 sec.	
T32 reset req. timer		CCITT: 180 sec.	
T33 clear req. timer		CCITT: 180 sec.	
CCITT diagnostic codes (9-127) in full conformance to X.75?	Yes, No	If no, specify any exceptions	
Does network generate and pass network specific diagnostic codes (128-255)?	Yes, No	If yes, specify Values and meanings	
Does network transparently pass X.25 facilities?*	Yes, No	If no, provide details or exceptoins	

* = Not available on all BOC/IDC networks
(+) = Additional values are often supported

Table B-4 (Continued): Interface/MLP Packet Level Worksheet

Utility	Notes	NON-BOC/IDC SUPPORT (see Codes)	
		To BOC/IDC	From BOC/IDC
Transit Network Identification	Mandatory		
Call Identifier	Mandatory (Specify) if contents to BOC/IDC significant)		
Throughput Class Indication	Mandatory		
Window Size Indication	Mandatory		
Packet Size Indication	Mandatory		
Fast Select Indication	Mandatory (indicate if either of two response options not supported)		
CUG Indication	Mandatory		
CUG/DA Indication	Optional		
Called Line Address Modified Notif.*	Mandatory		
Transit Delay Indication*	1985 Mandatory; If support, indicate before or after marker		
Reverse Charging Indication	Optional		
Clearing Network Identification Code*	Optional		

(Continued)

* = Not currently supported by all BOC/IDC networks

SUPPORT CODES

Gen/Pass: Can generate utility or pass from prior network (to BOC/IDC)
Pass: Can pass utility from prior network but will not generate (to BOC/IDC)
Use: Will accept and make use of utility received (from BOC/IDC)
Accept: Will accept but not make use of utility received (from BOC/IDC)
No: Not supported (either direction)

Table B-4 (Continued): Interface/MLP Packet Level Worksheet

Utility (Cont.)	Notes	NON-BOC/IDC SUPPORT (see Codes)	
		To BOC/IDC	From BOC/IDC
Transit Delay Selection*	1985 Optional; if support, indicate before or after marker		
Utility Marker*	Optional		
RPDA Selection*	1985 National; if support, indicate before or after marker and if extended format		
Tariffs Utility*	Not yet defined; If support network-specific version provide details		
IC Preselection*	BOC/IDC-specified; toward BOC/IDC only		
Non-BOC/IDC network specific	If any such will be passed, provide details		

* = Not currently supported by all BOC/IDC networks

SUPPORT CODES

Gen/Pass: Can generate utility or pass from prior network (to BOC/IDC)
Pass: Can pass utility from prior network but will not generate (to BOC/IDC)
Use: Will accept and make use of utility received (from BOC/IDC)
Accept: Will accept but not make use of utility received (from BOC/IDC)
No: Not supported (either direction)

Table B-4 (Continued): Interface/MLP Packet Level Worksheet

Addressing/Routing Item	Notes/Alternatives	VALUE
DNIC of Non-BOC/IDC as Transit Network		
DNIC of Non-BOC/IDC Network Addresses	Non-ISDNs only	
Range of first 3-6 digits after DNIC (or “All”) that characterizes all addresses on non-BOC/IDC network	Non-ISDNs only	
CC & range of first –6 following digits that characterizes all addresses on non-BOC/IDC network	ISDNs only	
Escape digit sent to BOC/IDC before X.121 address	none or 0	
Escape digit expected from BOC/IDC before X.121 address	none or 0	
Escape digit sent to BOC/IDC before E.163/E.164 address	none, 0, 9, or either	
Escape digit expected from BOC/IDC before E.163/E.164 address	none, 0, 9, or either	
Can the Non-BOC/IDC act as an inter-LATA carrier?	Yes or No	
Can the Non-BOC/IDC act as an intra-LATA carrier?	Yes or No	

Table B-5: Permanent Virtual Circuit* (PVC) Worksheet

Unique PVC ID Code: P-________________

______ New _______ Modification

Link Level: _____ SLP ______ MLP

ID Code of Interface/MLP to which PVC Assigned: [I/M]-________________________

All of above must apply to the same STE-X/STE-Y pair:

Non-BOC/IDC Requester is: ____ PSPDN ____ Private Packet Network ____ ISDN
Non-BOC/IDC STE Identification: ______________________

BOC/IDC STE: ____ PPSN ____ ISDN (D)NPA/(D)CO Code: ______-______

PVC Configuration Item	Possible Values	Notes	Requested
Max. packet size, to BOC/IDC	128, 256 (+)	128 default	
Max. packet size, from BOC/IDC	128, 256 (+)	128 default	
Packet level window size to BOC/IDC	Modulo 8: 1-7; Modulo 128: 1-60, 61-127*		
Packet level window size from BOC/IDC	Modulo 8: 1-7; Modulo 128: 1-60, 61-127*		
Throughput class to BOC/IDC	75, 150, 300, 600, 1200, 4800, 9600; 56 kbps interfaces: 19200*, 48000*		
Throughput class from BOC/IDC	75, 150, 300, 600, 1200, 4800, 9600; 56 kbps interfaces: 19200*, 48000*		

* = Not currently available on all BOC/IDC networks
(+) = Additional values are often supported

2.15. References

1. “Terminal and Transit Call Control Procedures and Data Transfer System on International Circuits Between Packet-Switched Data Networks,” The International Telegraph and Telephone Consultative Committee (CCITT) Recommendation X.75, Red Book, Volume VIII, Fascicle VIII. 4, 1984.

2. Public Packet Switched Network (PPSN) Generic Requirements, Issue 1, Bell Communications Research Technical Reference TR-TSY-000301, September 1986.

3. ISDN Basic Access Call Control Switching and Signaling Requirements, Issue 1, Bell Communications Research Technical Reference TR-TSY-000268, June 1986.

4. “Public Packet Switched Network (PPSN) X.25 Interface Description,” Telcordia (formerly Bellcore) Technical Reference TR-TSY-000462, June 1987.

5. “Public Packet Switched Network (PPSN) Asynchronous Interface Description,” Telcordia (formerly Bellcore) Technical Reference TS-TSY-000486, forthcoming.

6. “Digital Data System Channel Interface Specification,” PUB 62310, September 1983.

7. “Digital Data Special Access Service Transmission Parameter Limits and Interface Combinations,” PUB 62507, December 1983. Release of a revised version of this document (TR-NPL-000341) is pending. Contact the Information Operations Center of Bell Communications Research for current status of the revised document.

8. “Data Communications Using Voiceband Private Line Channels,“ PUB 41004, October 1973.

9. “Administrative Arrangements for the Provision of International Permanent Virtual Circuits (PVCs),” CCITT Recommendation X.181, Red Book, Volume VIII, Fascicle VIII.4, 1984.

10. “Interface Between Data Terminal Equipment (DTE) and Data Circuit Terminating Equipment (DCE) for Terminals Operating in the Packet Mode and Connected to Public Data Networks by Dedicated Circuit,” CCITT Recommendation X.25, Red Book, Volume VIII, Fascicle VIII.3, 1984.

11. Meeting Report of Special Rapporteur Group on Q.22/VII (Nov. 4-8, 1985), Munich, CCITT COM VII-No. M 72-E.

12. “International Numbering Plan for Public Data Networks,” CCITT Recommendation X.121, Red Book, Volume VIII, Fascicle VIII.4, 1984.

13. “The Numbering Plan for the ISDN Era.” CCITT Recommendation E.164, Red Book, Volume II, Fascicle II.2, 1984.

14. “Numbering Plan for the International Telephone Service,” CCITT Recommendation E.163, Red Book, Volume II, Fascicle II.2, 1984.

15. “Definitions Relating to National and International Numbering Plan,” CCITT Recommendation E.160, Red Book, Volume II, Fascicle II.2, 1984.

16. “ISDN Numbering and Addressing Principles,” CCITT Recommendation I.330, Red Book, Volume III, Fascicle III.5, 1984.

17. "Notes on the BOC Intra-LATA Networks – 1986," Bell Communications Research Technical Reference TR-NPL-000275, Issue 1, April 1986.

18. "International Routing Principals and Routing Plan for Public Data Networks," CCITT Recommendation X.110, Red Book, Volume VIII; Fascicle VIII.4, 1984.

19. "Interface Between Data Terminal Equipment (DTE) and Data Circuit-Terminating Equipment (DCE) for Terminals Operating in the Packet Mode and Accessing a Packet Switched Public Data Network Through a Public Switched Telephone Network or a Circuit Switched Public Data Network," CCITT Recommendation X.32, Red Book, Volume VIII, Fascicle VIII.3, 1984.

NOTE

Readers are advised to check current status and availability of all documents; all documents are subject to change.

Document may be ordered from Ameritech by contacting the Document Order Center at (847) 248-4324.

3. Section 3, Siemens

3.1. Introduction

This Technical Reference describes the X.75 interface between the Siemens packet switched network and other foreign (i.e., non-Siemens) packet switched networks (both public and private). CCITT Recommendation X.75 [1] specifies the interface between two Signaling Terminals (STEs); each STE being within a packet-mode data network and directly connected by an internetwork link. The X.75 Packet Transport Network interface described in this Technical Reference conforms to the STE procedures set forth in the 1980 version of CCITT Recommendation X.75. Selected 1984 Recommendations are also supported. Unless otherwise indicated, any further reference to X.75 pertains to the 1980 version of CCITT Recommendation X.75. The capabilities described in the Technical Reference support to the Open Systems Interconnection (OSI) Network Services as defined in CCITT Recommendation X.213 [2].

The X.75 interface supports Virtual Circuit Calls and Permanent Virtual Circuit Calls. This interface also supports features such as Closed User Groups, Reverse Charging, Hunt Groups, and Access Line Takedown. This document provides information on the specific X.75 features currently being supported, including:

- The values of X.75 parameters

- The actions taken in those areas where X.75 offers alternative actions or has not completely specified the actions to be taken
- Other interface features which are not presently included in X.75.

This document is meant to be used within the context of the 1980 and 1984 versions of CCITT Recommendation X.75.

This section provides a description of the Packet Transport Network based on the Siemens supported packet switched public data network equipment. It also includes a discussion of those areas in need of bilateral agreement between the network service provider and other packet switched public data networks before the interconnection can be made. Section 2 describes the X.75 network interface in more detail. Section 3 described the X.75 network utilities supported in the X.75 Packet Transport Network interface. Section 4 describes the network defined capabilities supported by the X.75 Packet Transport Network interface. Section 5 describes expected performance parameters.

3.1.1. Reasons for Reissue

This document describes the X.75 interface between the Siemens PSN and other public and private packet networks. Updates to this document may be issued as new capabilities become available. When the document is reissued, the reasons for reissue will be given in this section.

3.1.2. Terms

This section defines some relevant terms used in this technical reference. Please refer to Appendix A for additional terms and abbreviations.

- Network refers to Siemens packet switched network.
- STE link denotes a single physical link on an X.75 Packet Transport Network interface.
- Gateway denotes a group of one or more STE Links connecting the network to another packet switched network.
- STE-X refers to another packet switched network.
- STE-Y refers to the Siemens packet switched network.
- Public Packet Switched Networks (PPSNs) - A Bell Operating Company maintained and operated Public packet switched data network.

3.1.3. Packet Transport Network Description

The network shown in Figure 1-1, has X.25 DCE interfaces to users and X.75 STE interfaces to other packet switched networks. The X.75 interfaces support digital private line facilities at speeds of 9.6 and 56kbps and analog private line facilities at speeds up to 9.6 kbps.

The X.75 STE interfaces support Virtual Circuit call service and Permanent Virtual Circuit service. The network also supports the 1980 version of CCITT Recommendations S.1, X.2, X.25, X.87, X.96, X.110, X.121, and X.180. See the CCITT Yellow Book for details on these recommendations.

3.1.4. Agreed on Technical Capabilities

CCITT Recommendation X.75 has defined several technical areas which providers of packet switched public data networks need to agree on before interconnecting their networks. These areas, subject to bilateral agreements, encompass levels 1, 2 and 3 (of the OSI mode 1) capabilities.

3.1.5. Summary of X.75 Packet Transport Network Interface

The X.75 Packet Transport Network interface is characterized as a high throughput and a highly flexible interface. It supports Virtual Circuit Call service and the X.75 utilities necessary to provide the essential (E) facilities as well as many additional (A) features as defined in Recommendations X.2 [3]. The X.75 Packet Transport Network interface supports the physical, link and packet level procedures of CCITT Recommendation X.75 as set forth below.

The physical level is compatible with the Digital Data System (DDS) Channel Interface [4].

3.1.6. TITLE

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

The link level conforms to the bit oriented Single Link Procedure (SLP) described in X.75 and is based on the Link Access Procedure Balanced (LAPB) described in CCITT Recommendation X.25 [6]. The link level also supports the capabilities necessary to allow internetwork connections via satellite. These capabilities include modulo 128 link level frame sequence numbering and link level window sizes up to 127. However, specific customer applications, configurations and desired throughput will be the determining factors in choosing the appropriate window size.

The X.75 Packet Transport Network interface supports all X.75 utilities in the 1980 version of CCITT Recommendation X.75 except those utilities which were left for further study by CCITT.

Several additional capabilities (e.g., link group) not included in the 1980 version of CCITT Recommendation X.75 are supported and described in the document.

3.2. X.75 Packet Transport Network Interface

This section describes the physical, link, and packet level procedures supported at the X.75 Packet Transport Network interface. Appendix C contains a summary of the X.75 physical, link and packet level network interface default values.

3.2.1. Physical Level

The physical level provides the mechanical, electrical, functional and procedural characteristics to activate, maintain and deactivate the physical path between the STEs. The network supports digital STE links and analog links on X.75 Packet Transport Network interfaces. The physical link operation if full duplex. When multiple STE links are employed for one gateway, they are arranged as an STE link group (see Section 4.2).

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

3.2.1.1. Digital STE Link

The X.75 interface supports digital STE links using the physical level data signaling rates of 9.6kbps and 56 kbps. The DDS (Digital Data System) X.75 digital line interface can support access rates of 0.6 kbps, and 56 kbps. Information covering individual and multiplexed access arrangements are covered in PUB 62507, “Digital Data Special Access Service” December, 1983.

3.2.1.2. Analog STE Link

Analog STE links are supported on the X.75 Packet Transport Network interface using the physical level data signaling rate of 9.6 kbps. The analog STE links are compatible with the line side of synchronous modems as specified in Appendix D.

3.2.2. Link Level

The link level interface provides point-to-point communications 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.

The following paragraphs describe link parameters and all relevant exception conditions. Exception conditions are those situations which may occur as the result of transmission errors, STE malfunction or operational situations.

3.2.2.1. Link Level Parameters

The values of the link level parameters on each STE link are described below.

3.2.2.1.1. Parameter K

The Signaling Terminal Equipment (STE) will support a window size, parameter K, of 7 at the Link Level. This is compatible with modulo 8 (non-extended) sequence numbering. For modulo 128 (extended) sequence numbering, parameter K is selectable from 7 to 127 at the Link Level with a network default value of 7. However, specific customer applications configurations and desired throughput will be the determining factors in selecting the appropriate window size.

3.2.2.1.2. Timer T1 and Parameter T2

The STEs will support an acknowledge timer T1. The acknowledgment time is the system parameter at the end of which retransmission of a frame be initiated. The timer T1 is started at the end of the transmitted 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 network default value of T1 is 3 seconds. The range of values of timer T1 is from 5 ms to 35 seconds with increments of 5 ms.

The STEs will support a system parameter T2 which indicates the amount of time available before the acknowledging frame must be initiated in order to ensure receipt prior to the expiration of timer T1. The period of parameter T2 includes the round trip propagation delay of the link/trunk plus any processing time in the STE. The PSN network value of system parameter T2 is set at 0.4 seconds (considering worst case round trip propagation delay plus processing time in the STE).

3.2.2.1.3. Parameter N2

The default value of the maximum number, N2, of transmission and retransmissions of a frame following the running out of Timer T1 is selectable from 1 to 20. The network default value is 10. After N2 attempts, the network will clear all virtual circuit calls and reset all permanent virtual circuits on that link (DISC). The timer recovery procedure is described in Paragraph 2.2.2.

3.2.2.1.4. Parameter N1

The maximum number of bits in an information frame (excluding flags and 0 bits inserted for transparency), parameter N1, may not exceed 2096.

3.2.2.2. Time-out Recovery

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

The STE supports this time-out recovery as indicated in the following paragraph.

When time T1 expires, the STE enters the time-out recovery condition, transmits an appropriate supervisory frame (RR or RNR) with the P bit set to 1 (poll), and timer T1 reset. If the STE receives a supervisory frame from the other end with the F bit set to 1 (final), then the timeout recovery is cleared. This response frame includes N(R) that identifies where in the numbering cycle I frame retransmission should resume. The STE N2 attempts (that includes initial Information (I) frame transmission plus subsequent Supervisory (S) frame transmission with P bit set to (1) to obtain and acknowledgment from the remote STE. After N2 unsuccessful attempts, the STE will reset the link. If a response is received but without 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 V(S) such that the next retransmission may be a different frame with P bit set to 1.

3.2.2.3. Link Level Reset Procedures

The network will clear all virtual circuit calls on a link whenever it receives a Disconnect (DISC) command from STE-X and responds with an Unnumbered Acknowledgment (UA) response, or whenever it transmits a DISC command to the network. The network will not clear virtual circuit calls when it receives or transmits a Set Asynchronous Balanced Mode (SABM) command or Set Asynchronous Balanced Mode Extended (SABME) command. When initialing a link level reset (e.g., in response to a FRMR response received from STE-X), the network will not transmit a DISC command before transmitting the SABM or SABME command.

3.2.2.4. Link Testing

The network may use the link integrity test procedure to insure proper operation of link level transmission facilities. The encoding of the command field for this frame is binary 1100F111 (modulo 8) or 1100F111F0000000 (modulo 128). This test frame can contain up to 255 bits in the information field.

3.2.2.5. 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 correct N(S) is received. The REJ frame is sent by the receiver of the out of sequence I frame. The STE receiving the REJ initiates sequential (re)transmission of I frames starting with the I frame indicated by the N(R) obtained in the REJ frame.

3.2.2.6. Link Level Frame Structure

The frame structure as defined in Section 2.2 of the CCITT Recommendation X.75 is supported by the network. A control field length of 1 octet is used. For the Frame Check Sequence (FCS), the typical implementation described in Section 2.2.7 of the CCITT Recommendation X.75 is used. The network uses the frame addressing convention as specified in Section 2.4.1 of CCITT Recommendation X.75. A frame cannot contain more than one packet. Information frame with zero length will be ignored.

3.2.2.7. Procedures for the Use of the Poll/Final Bit

The uses of the Poll/Final (P/F) bit are as specified in Section 2.4.2 of CCITT Recommendation X.75. In addition, the STE will also send SABM/SABME (Set Asynchronous Balanced Mode/Set Asynchronous Balanced Mode Extended) or DISC (Disconnect) command with P bit set to 1.

If the STE is expecting a response with the F-bit set to 1, no information frames will be sent until a response with the F-bit set to 1 is received. The P bit is also used during time-out recovery as described in Paragraph 2.2.2.

3.2.2.8. Link Level Procedures

3.2.2.8.1. Link Set-Up

Procedures for the set-up of the link level are specified in Section 2.4.3.1 of CCITT Recommendation X.75. Either STE may send SABM (Set Asynchronous Balanced Mode) to initialize the link. The sending STE, in “SABM Send”, state, starts timer T1. If the timer T1 runs out for not receiving a valid response to the SABM command, the STE will resend SABM and restart timer T1. After N2 attempts, the STE will initiate higher level recovery action and will enter the disconnected phase.

If a valid response UA (unnumbered acknowledgment) is received, then the link is considered initialized and it enters information transfer state. If a DM (disconnected mode) or DISC (disconnected) is received, then the link enters disconnected phase.

3.2.2.8.2. Information Transfer Phase

The procedure used during the information transfer phase are as specified in Section 2.4.3.2 of CCITT Recommendation X.75. 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 send an RNR. After receiving an RNR the STE will not transmit any other I frames before receiving an RR or REJ. When busy condition is cleared, the STE sends 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. The RR frame will be a command frame with the P bit set to 1 if acknowledgment of the transfer from the busy to not-busy state is required. Otherwise the RR frame may be a response frame.

3.2.2.8.3. Link Disconnection

Procedures for link disconnection of the link level are as specified in Section 2.4.3.3 of CCITT Recommendation X.75.

3.2.2.8.4. Disconnected Phase

The disconnected phase is implemented as specified in Section 2.4.3.4 of the CCITT Recommendation X.75. When the STE transmits the DISC, it starts the timer T1 and enters the disconnected state immediately. After recovery from an internal temporary malfunction the STE may send a DISC (disconnect) command with P bit set to 1. In the disconnected state the STE may initiate link set-up with a SABM/SABME.

3.2.3. 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. Both data and control information are transferred in transmission units called packets. Each packet transferred across the interface is contained within a single level information frame. The packet types, formats, and procedures are those given in X.75. Also refer to CCITT Recommendation X.75 for the semantics of the control/data packets.

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 parameters and/or management data immediately following connection establishment. Control packets are used to established/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 (Information) frame. That is, the level 3 packet (control or data) is carried as information within the level 2 I-frame. The limitations on the length of this field are described in the following paragraphs.

3.2.3.1. Logical Channels

The logical channels are used to enable simultaneous virtual circuit calls (VCs) and/or permanent virtual circuits (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 a given X.75 interface. The range of logical channels and logical channel groups available for assignment to VCs or PVCs is agreed to bilaterally for a period of time. The assignment procedure of logical channels as new PVCs are established is also agreed bilaterally.

The STE-X has the capability to support a theoretical maximum of 2048 logical channels of VCs and PVCs on a 56 kbps line and 512 logical channels for VCs and PVCs on a 9.6 kbps line. Any number of logical channels up to the theoretical maximum values may be selected for a particular interface. However, specific customer applications, configurations are desired throughput will be the determining factors in choosing the appropriate number of logical channels per interface. 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-of-end) connection.

The states defined below represent states of the STE-X end for the locally selected logical channel and not for the network connections 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.

- 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 entire interface).
- STE-Y Restart Indication (r3): This state is entered wen the STE-Y sends a Restart Request packet (possibly to reinitialize the entire interface).
- Ready State (p1): if no call or 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).
- 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 Call Request) from the 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 the 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 substates defined under Data Transfer state (p4):

  – Flow Control Ready (d1): A substate during which Data packets, Interrupt packets or flow control packets are permitted. In any other p or r states these packets are not permitted. Four other substates are defined within the substate d1. These are:

1. Not Interrupted (i1): When STE-Y is in state d1 and no Interrupt packet has been received.

2. 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.

3. STE-Y Interrupt Request (i3): When STE-Y has sent an Interrupt packet. It may receive an Interrupt Confirmation (as a response) or an Interrupt packet. Data packets are permitted in this state.

4. STE-X and STE-Y Interrupt Request (i4): When both STEs have sent an Interrupt packet. Only valid Interrupt 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-X).

  – 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-Y).

- STE-X Clear Request (p6): A state entered after receiving a clear Request packet by STE-Y from STE-X.

- STE-Y Clear Request (p7): A state entered after sending a Clear Request packet by STE-Y to STE-X.

3.2.3.2. Virtual Circuit Call Service

This section describes the Virtual Circuit Call services provided by the X.75 packet level interface between the STE-X and STE-Y.

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

- Interface initialization and reinitialization.
- Multiplexing VCs/PVCs on the same link.
- Virtual Circuit call set-up, resetting and clearing.
- Flow control.
- Sequenced data transfer.

The following paragraphs 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.

3.2.3.2.1. 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). These 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 or 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 set 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 expires then the calling STE will clear the call (see section 2.3.2.2) with the cause as “Network congestion”. The value of timer T31 is 200 seconds.

The called STE may accept the call by responding the Call Connected packet with the same logical channel as in the Call Request packet. The logical channel 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 include invalid packet format, call collision, invalid utility field or network congestion.

To minimize call collision, in which the STE-X and the STE-Y send Call Request at the same time selecting the same logical channel, the logical channel selected by the STE-X normally begins with the highest logical channel number while those selected by the STE-Y should begin with the lowest logical channel number. However, this can be negotiated subject to a bilateral agreement between the network administrations.

3.2.3.2.2 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 STE-X/STE-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 once again. 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 (p7). The value of T3 will be 180 seconds.

If a valid response (Clear Confirmation or Clear Request) is received, the logical channel will be placed in the Ready (p1) 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.

3.2.3.2.3. Interrupt Procedure

The interrupt procedure allows a DTE to transmit urgent, expedited data to the remote DTE without following the flow control procedures applying to data packets between two STEs. The length of the user data field is not checked as an error condition, however, the maximum supported data field length is 128 octets. 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 will discard this interrupt packet. There is no timer defined to timeout the interrupt confirmation. The network waits indefinitely for the interrupt confirmation.

3.2.3.2.4. Data Interrupt and Flow Control Packet Transfer

The Data Transfer state is reached after successfully establishing the virtual circuit call across the X.75 interface. The Data, Interrupt or Flow Control packets may be transferred in the state. Only in this sate would the flow control mechanism described in Paragraph 2.2.10 apply.

Each data packet transmitted at the STE-X/STE-Y interface in each direction of a VC is sequentially numbered modulo 8 or modulo 128 (agreed to bilaterally). This modulo is common to all logical channels at the STE-X/STE-Y interface. Procedures for sequencing the data flow are described in the CCITT Recommendation X.75.

3.2.3.2.5. Data Field Length

The standard maximum data field length is 128 octets, support of which is expected from all foreign network administrations. In addition, an optional maximum data field length of 256 octets may be provided on a per call basis through the network utility (defined is Section 3 on Network Utilities). 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.

3.2.3.3. Permanent Virtual Circuit Service

This section describes the Permanent Virtual Circuit Call services provided by the X.75 packet level interface between STE-X and STE-Y.

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

- There are no call set up or clearing procedures required.
- When restart procedures are invoked, all the PVCs are reset (while all the VCs are cleared) with the cause “Network congestion” and PVC’s will then continue to handle data traffic.
- Certain facility/utility negotiations performed at call set-up for VCs such as reverse charging indication and billing information 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”.

3.2.3.4. Octet Alignment of User Data Field Lengths

The X.75 Packet Transport Network interface requires user data fields to be an integral number of octets.

3.2.3.5. Transparency of User Data

The network passes transparently all user data present in user data fields of X.75 packets.

Diagnostic code fields supplied by a DTE, STE-X or another PSN in Clear, Reset and Restart Request packets are passed transparently by the network. Currently the network supplied diagnostic codes conform to CCITT Recommendation X.25 Annex E. DTE originated cause code values with the eighth bit set to 1 (i.e., "1XXXXXXX" format where X is either 0 or 1) will be passed transparently by the network.

3.2.3.6. More Data Mark

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 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 an STE receives a packet which is not full but has the M bit set to 1, it will reset the virtual circuit. The resetting cause shall be Network congestion.

3.2.3.7. Qualifier Bit

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

3.2.3.8. Delivery Confirmation

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 by the packet sequence number P(R).

If a remote source 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 STE-X/STE-Y interface and vice versa.

3.2.3.9. Significance of STE-Y Clear, Reset, and Restart Confirmation Packets

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

3.2.3.9.1. Reset Procedures

The Reset procedure is used to reinitialize a VC or 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 STE-X/STE-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 STE-X/STE-Y interface for each direction of data transmission will start from 0.

When a reset occurs, any previous busy condition, e.g., STE RNR, will be cleared. Reinitialization involves two distinct actions:

- Placing the logical channel in the “Flow Control Ready” state (d1).
- Removing and discarding all Data and Interrupt packets in the 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 or d3) the STE will discard Data, Interrupt, RR and RNR packets.

When an STE receives a Reset Request packet, it will conform the reset by transmitting a Reset Confirmation packet before timer T32 expires, where the value of T32 is a system parameter with a definable value of up to 30 minutes (and a network default value of 180 seconds). This completes the reset procedure and places the logical channel in Flow Control Ready state (d1). The reset procedures has only local significance. The data discarded in this procedure are recovered at higher level functions of the end systems.

If T32 expires, then another attempt is made by sending a Reset Request. On the second timeout, the STE initiates clearing procedures.

The resetting cause field and diagnostic field are as defined in the 1980 version of CCITT Recommendation X.75. If a resetting cause other than that defined in the CCITT Recommendation X.75 is received, the STE will pass it unchanged.

If reset collision occurs, the STEs will consider the reset procedure as complete.

3.2.3.9.2. Restart Procedure

The Restart procedure is used to reinitialize all logical channels at the STE-X/STE-Y interface. This procedure clears all VCs putting the corresponding logical channel into the ready (p1) state. The effect of the Restart procedure on the PVC is discussed in Paragraph 2.3.3. 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 the restart.

If a collision occurs, both STEs will consider the restart as completed. A timer T30 is a defined system parameter with a definable value of up to 30 minutes (and a network default value of 180 seconds). If it expires the first time, one more attempt is made by sending the Restart packet. If T30 expires again, the remote STE-X is declared out of service and STE-Y remains in this state until a Restart Request or Restart Confirmation packet is received from STE-X.

3.2.3.10. Flow control Principles

The interface follows standard flow control principles specified in the CCITT Recommendation X.75. A standard method of packet sequence numbering modulo W (8 or 128) along with a window size from 1 through W-1 must be supported by both STEs. Each direction may be negotiated with a different window size on each logical channel.

RNR is not transmitted by the PSN STE. However, RNR packets which are received are treated as specified in Section 3.4.1.4 of CCITT Recommendation X.75. The PSN network only uses receive sequence number 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 receive sequence number N(R) conveyed in the data packet is updated to the value send in the last RR packet.

3.2.3.11. Packet Level Timers

Several packet level timer values left for further study in the 180 version of CCITT Recommendation X.75 are specified in the 1984 version. The network conforms to both versions by supporting the following values of these timers:

- T30 (restart request timer): 180 seconds
- T31 (call set-up timer): 200 seconds
- T32 (reset request timer): 180 seconds

- T33 (clear request timer): 180 seconds

3.2.3.12. User Facilities

Any X.25 user facilities which require STE action, will be mapped to their corresponding X.75 utilities, and no indication of these facilities should be present in the user facility field of X.75 packets. Therefore, no X.75 network user facilities are required or supported. The X.75 user facility length field is always set to 0.

3.2.3.13. Addresses

The network numbering plan for Virtual Circuit service complies with CCITT Recommendation X.121 [7]. See Section 5 on the numbering plan for further discussion.

3.2.3.14. 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 Permanent Virtual Circuits and clear all the Virtual Circuits at the STE-X/STE-Y interface.

3.3. X.75 Network Utilities

X.75 utilities are network administrative signaling mechanisms contained in Call Request and Call Connected packets. The Clear Request, Call Request, and Call Connected packets do not include the user facility field as no operational user facilities are supported through the network.

3.3.1. Transit Network Identification Code

The Transmit Network Identification Code (TNIC) is a network utility used to name a transmit network controlling a portion of the (perhaps partially established) virtual circuit. A transmit network is identified by the four digit Data Network Identification Code (DNIC) of the transit network.

A Transit Network Identification is always present in a Call Request packet for each transit network controlling the virtual circuit up to this point of call setup. When more than one transit network is 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 by the called DTE.

The Siemens PSN will not act as a transit network. However, it can generate the TNIC utility and will accept this utility on Incoming Call packets from a transit network.

3.3.2. Call Identifier

The Call Identifier utility permits a unique name to be given to each call established. The use of one call identifier over the entire Virtual Circuit (VC) allows common identification. Consequently, this permits a meaningful comparison of call statistics and error reports from many networks. The Call Identifier utility is in the Call Request packet, the Call Connected packet, and the Clear Request packet.

3.3.3. Throughput Class Indication

The Throughput Class Indication is a network utility that can be used by any STE for specifying the throughput classes (for both directions) that apply to a VC.

This utility, when transmitted by the PSN in a Call Request packet, contains throughput class values that the lower than or equal to the ones selected at the calling DTE/DCE interface (either explicitly or by default). The Throughput Class utility, received in a Call Connected packet, should be less than or equal to that specified in the Call Request packet. Otherwise, the call is cleared with the cause of “Network congestion”. The Throughput Class utility, when transmitted by the PSN in a Call Connected packet, corresponds to the minimum of:

- the throughput class of the PSN access line, or
- the throughput class specified in the Call Request packet received from the foreign network.

If particular throughput classes are not explicitly confirmed, the value in the Call Request packet is assumed as the confirmed value. The interconnecting networks must bilaterally agree to a relationship between the requested throughput class and associated window sizes.

3.3.4. Window Size Indication

The Window Size Indication utility is used by either STE for negotiating the window size for both directions on a specified logical channel at the STE-X/STE-Y interface for a given VC.

The PSN supports window sizes of 1 through 7 in modulo 8 and 1 through 127 in modulo 128.

If particular window sizes are not explicitly requested, a default value of 2 is assumed.

The Call Connected packet must indicate a window size which is in the range of values between the default window size and the window size chosen in the Call Request packet; otherwise, the PSN will clear the call with the cause of “Network congestion” in accordance with CCITT Recommendation X.75.

3.3.5. Packet Size Indication

The Packet Size Indication utility is implemented in the PSN network and indicates a packet size of 128 or 256 octets.

A request for a packet size greater than 256 will be negotiated to a packet size of 256. Requests for packet sizes less than 128 will be negotiated to a packet value of 128.

3.3.6. Fast Select Indication

The Fast Select Indication utility is a network utility that allows up to 128 octets of user data in the Call Request packet. When no restriction on response is indicated in such a Call Request packet, the remote STE is permitted to issue a Call Connected packet with a called user data field of up to 128 octets. At any time a Clear Request packet with a clear user data field of up to 128 octets may be sent.

If a restriction on response is indicated in the Call Request packet, the remote STE is permitted to issue a Clear Request packet with a clear user data field of up to 128 octets. The remote STE is not authorized to send a Call Connected packet. Thus the Fast Select mode permits information transfer without actually setting up a Virtual Circuit (VC).

If a VC is established then either STE may initiate disconnection by using a Clear Request packet with up to 128 octets of clear user data.

3.3.7. Closed User Group Indication

The Closed User Group (CUG) Indication is a network utility used for enabling the establishment of Virtual Circuits (VCs) by DTEs which are in different LATAs or which are in different networks and which are members of Closed User Groups. The CUG index assigned to a DTE has local significance. This CUG index (a 2 digit code) is mapped into an Inter-LATA or internetwork CUG interlock code, which has end-to-end significance. This mapping results in an interlock code. The PSN supports the 65,535 interlock codes established in the 1984 version of CCITT Recommendation X.75. At the destination DTE/DCE interface, this interlock code is mapped into a locally define code index defined for the corresponding CUG.

When using the Closed User Group Indication Utility in the Call Request packet, the STE indicates that the Intra-LATA or internetwork virtual circuit call is requested on the basis of valid inter-LATA or internetwork closed user group membership. The network of the calling DTE supplies the relevant interlock code.

An STE will not change the CUG indication field in a received Call Request packet. Only one of the closed user group indication and the CUG with outgoing access indication utilities may be present in the Call Request packet. This utility should not be present in the Call Connected packet.

3.3.8. Closed User Group with Outgoing Access Indication

This utility enables the DTE to belong to one more CUGs and to originate VCs to DTEs in the open part of the network (i.e., DTE not belonging to any CUG) and to DTEs belonging to other CUGs with the incoming access capability. See the description above for Closed user Group Indication Utility for other details of this utility.

3.3.9. Reverse Charging Indication

The Reverse Charging Indication is a network utility used for establishment of VCs on which the Reverse Charging facility applies. The use of this network utility at the STE-X/STE-Y interface is subject to bilateral agreement between the administrations.

When using this utility in the Call Request packet, the STE-X indicates a request for reverse charging to apply to the call.

In the absence of this utility, STE-X is assumed not to request reverse charging for that call.

The Reverse Charging Indication utility is not present in Call Connected packets.

3.3.10. Utility Marker

The Utility Marker, consisting of a single octet pair, is used to separate the X.75 network utilities from non-X.75 (or non-CCITT) network utilities that may be agreed to bilaterally be the involved network administrations.

3.3.11. Tariff Utility

The Tariff Utility is an optional utility used for passing tariff information across the gateway where coding of the utility code and utility parameter fields is network dependent. Since this is a nationally defined utility it must always appear at a position past the utility marker as described in X.75.

The network stores as part of the billing records, any tariff utility received over the gateway.

The coding of the Tariff Utility has been left for further study by CCITT. The network defines 4B in hexadecimal format as the utility code for the Tariff Utility.

The Tariff Utility parameter field consists of two octets. The first octet indicates the source tariff and the second octet indicates the destination tariff. The last three bits of these octets indicate the protocol type (0 for Async, 1 for X.25, 2 for 3270 BSC, 3 for SNA, and 4 for 2780 BSC), the

4th bit indicates access type (0 for dial-in and 1 for dedicated), and the remaining bits are set to 0.

3.3.12. Called Line Address Modified Notification

The Called Line Address Modified Notification is a network utility used to indicate the reasons for the called address in the (Call Connected) packet being different from that specified in the Call Request packet.

The following reasons can be indicated with the use of Called Line Address Modified Indication Utility:

- Call distribution within a hunt group
- Call redirection due to originally called DTE out of order.
- Call redirection due to originally called DTE busy.
- Call redirection due to prior request from the originally called DTE for systematic call redirection.
- DTE originated.

This utility is present in the Call Connected packet where the called address is different from the one originally specified in the Call Request packet. It will also be present in the Clear Request packet, if the call is being cleared by a DTE different from the one originally called as a direct response to the call Request packet.

3.4. Network Defined Capabilities

The handling of network addresses, the STE link group capability, the procedures for taking an STE link in and out of service, a PSN self-testing capability, and the network defined STE-Y actions are described in this section.

3.4.1. Handling of Network Addresses

The network includes the full International Data Number (IDN) when transmitting addresses in X.75 packets as described in CCITT Recommendation X.121. The IDN consists of either the DNIC (Data Network Identification Code) + Network Terminal Number (NTN) or for countries having an integrated numbering scheme, the DOC (Data Country Code) + National Number (NN). A prefix is not used by the network on X.75 interfaces; they are prohibited for use by STE-X on X.75 interfaces. Network handling of addresses in Call Request, Call Connected, and Clear Request packets is as follows:

1. Call Request Packet

Call Request packets from the network contain both the called IDN and the calling IDN.

Call Request packets from the STE-X must contain the called IDN and calling IDN. If an IDN is missing in the Call Request packet, the network will clear the call with a cause code of “Network congestion” and the appropriate diagnostic code of 67/68 - “Invalid called/calling address”.

2. Call Connected Packet

Call Connected packets from the network contain both the called IDN and the calling IDN. Typically, the IDNs transmitted in the X.75 Call Connected packet are the same as the IDNs received in the X.75 Call Request packet from STE-X. However, whenever the network receives a calling and/or called address in an X.25 Call Accepted packet from a DTE (for calls terminating on the network) or in an X.75 Call Connected packet from another PSN (for calls in which the network is a transit network), the network uses these ISDNs in the X.75 Call Connected packet.

Call Connected packets from STE-Y contain and address length field, an address field, a network utility length field, a network utility field, a user facility length which is set to 0, and a called user data field. Call Connected packets from STE-X may contain one, both or neither IDN; if these address fields are empty the network will automatically insert the preface 0. The incoming user facility fields are ignored (and the user facility length field is set to 0).

3. Clear Request Packet

As specified in the 1980 version of CCITT Recommendation X.75, calling and called IDNs are not present in X.75 Clear Request packets transmitted by the network. The address length field is coded with all zeros and the address field is omitted. The network follows the procedure described in Section 4.5.4.4 of this document if it receives a Clear Request packet from STE-X that contains calling and/or called IDNs.

3.4.1.1. Call Pattern Validation

Address transmitted or received in Call Request packet by the network are screened and validated as described below so that invalid internetwork calling patterns are blocked. Internetwork calling patterns are only valid when they have been negotiated by the PSN administrations involved.

The network maintains, for each gateway (STE link or STE link group), a list of all destination DNICs that may be received across the gateway (an Accept List) and a second list of all destination DNICs that may be transmitted across the gateway (a Send List). To accomplish screening of invalid internetwork calling patterns, the network uses these lists as follows:

1. The network will transmit a Call Request packet across the gateway only if the DNIC in the called IDN is a member of the “Send List” and the DNIC in the calling address is a member of the “Accept List”.

2. The network will accept a Call Request packet across the gateway only if both the calling and called IDNs are present and if the DNIC in the called IDN is a member of the “Accept List” and the DNIC in the calling IDN is a member of the “Send List”.

Any calls that do not pass the screening procedure will be cleared with a cause code of “Access barred” and a diagnostic code indicating routing problems.

3.4.1.2. Multiple PPSNs Sharing a Common DNIC

CCITT Recommendation X.110 specifies that the calling and called DNICs are used to determine the destination of a call and routing (X.110 Section 3.1). This procedure applies for calls between networks with unique DNICs. However, an additional procedure, as defined in Annex B of the 1984 version of CCITT Recommendation X.121, is needed when several PPSNs share a common DNIC. Here, the network examines, in addition to the DNIC, the next six digits of the Called NTN when determining the destination gateway.

3.4.2. STE Link Group

An STE link group is a group of STE links that form a single internetwork gateway. Originating virtual circuit call requests are distributed across the available links of the link group so that the number of virtual circuit calls set up to each link is approximately equal. Link group sizes of up to 8 STE links are supported.

The network selects an STE link for each originating virtual circuit call request. Once a virtual circuit call is assigned to a particular STE link, it is treated as a regular call. All packets associated with an individual circuit call are routed over the same STE link.

All STE links in a link group are treated as a single administrative unit when network service provisionable utilities and link level parameters are selected. All STE links in a link group must use the same speed. However, a link group can have a mixture of analog and digital STE links.

3.4.3. STE Line Takedown

The X.75 Packet Transport Network interface supports two capabilities for taking an STE link out of service. These capabilities apply to individual STE links, including STE links which are part of a link group.

3.4.3.1. Unconditional STE Link Takedown

A network administrative authority may request an unconditional takedown of a link to the interfacing network administrative authority. Both the networks, in turn, will clear and reset all the corresponding Virtual Circuits (VCs) and Private Virtual Circuits (PVCs) associated with the link being taken down by initiating the link level disconnect procedure. The clear cause in the Clear Indication packet should be “Out of Order” and the diagnostic code should be “Maintenance procedure”. The Reset Indication packet will be transmitted with the cause code of “Out of Order” and the diagnostic code of “Maintenance procedure”.

When the link is up again, a Restart request is sent from STE-X to STE-Y and STE-X waits for the Restart Confirmation. After receiving the confirmation the corresponding logical channels are placed in the Ready state (p1).

3.4.3.2. Conditional STE Takedown

This feature allows a network to take a link gracefully out of service. The network administration may request conditional takedown of a link. Based on the request, action is taken to prevent any new Virtual Circuit (VC) from being set up on the specified link. Existing VCs and PVCs (Private Virtual Circuit) remain unaffected. When the network detects that all the VCs on the specified link have been terminated, the network will take the line out of service by initiating the restart procedure at the X.75 interface and then initiating the link level disconnect procedure. All the PVCs should be reset at this point with the Reset Indication packet to remote DTEs containing the cause code “Out of order” and diagnostic code “Maintenance procedure”. The link will remain out of service until the network administration requests its return to service.

3.4.4. PSP Self-Testing Capability

The PSN may place virtual circuit calls to itself via the gateway. The network performs virtual circuit call request logical channel selection (see Section 2.3.1) and STE link selection when an STE link group is employed (see Section 4.2) in the usual way. Using this capability, the PSN may test its STE packet level procedures. Note that to allow PPSN to use the self-testing capability, this calling pattern must be validated as described in Section 4.1.1.

3.4.5. Network Defined STE-Y Actions

CCITT Recommendation X.75 has left several items for further study. For each of these cases, the network will take a particular course of action as described below.

3.4.5.1. Out of Order Conditions

Section 3.6 of the 1980 and 1984 versions of CCITT Recommendation X.75 states that in some cases of trouble at the link level it may be appropriate to initiate the restart procedure and to accept no more new calls. In these cases, including the transmission of a DISC command from STE-X and failure to recover at the physical or link levels, the network will clear all virtual circuit calls and reset all PVC's on the link with a cause code of "Network out of order" and an appropriate diagnostic code. The network will also reset all permanent virtual circuits on the link with a cause code of "Network out of order" and an appropriate diagnostic code. During the failure, the network will not set up new virtual circuit calls over the link. When the failure is recovered at the physical and/or link level the restart procedure will be initiated with the cause "Network operational" and reset with the cause "Network operational" will be transmitted to the remote end of each permanent virtual circuit.

3.4.5.2. Flow Control Actions

If an STE receives a Data packet with the 0-bit set to 1, both the 1980 and 184 versions of CCITT Recommendation X.75 (Sections 3.4.1.2) state that the STE may defer updating of the window for previous data packets (within the window) with the D-bit set to 0. The network will not defer updating of the window for previous data packets within the window.

When the network receives a Data packet form STE-X that is out of sequence but within the window, STE-Y will reset the virtual circuit call or the permanent virtual circuit (beginning in 1987) using a cause code of "Network congestion" and a diagnostic code 1 - "Invalid P(S)". This condition is not defined in the 1980/1984 CCITT Recommendation X.75 Section 3.4.1.2.

3.4.5.3. Utilities Procedures

When the PSN receives a call set-up packet with utilities which are not supported by the network, the virtual circuit call will be cleared with a cause code of "Network congestion" and a diagnostic code of 65 - "Utility code not allowed".

The following sections describe how the network will handle each specific utility which was left for further study by the 1980 and/or 1984 versions of CCITT Recommendation X.75.

3.4.5.3.1. Transit Network Identification Code

As previously discussed. the Siemens PSN will currently not act as a transit network. However, the network will insert the Transit network Identification utility and will accept a Clear Request packet either using or omitting this utility.

3.4.5.3.2. Call Identifier

The 1984 version of CCITT Recommendation X.75 (5.3.2) states the Call Identifier should not be present in the Clear Request packet. The network does not use the Call Identifier in the Call Connected and Clear Request packets but accepts a Call Connected or Clear Request packet either using or omitting this utility.

3.4.5.3.3. Traffic Call Indication

The network currently does not support the Traffic Class Indication utility and will clear any Call Request packets containing this utility.

3.4.5.3.4. Estimated Transit Delay

The network currently does not support the Estimated Transit Delay utility.

3.4.5.3.5. Tariff Utility

The network supports this utility as described in Section 3.11 of this document.

3.4.5.3.6. Address Extension

The network currently does not support the Address Extension utility.

3.4.5.4. Network Actions on Improperly Formatted Packets

This section describes the network actions taken on the receipt of improperly formatted packets in states where receipt of these packet types is normal.

3.4.5.4.1. Call Request Packet Which is Too Short

If STE-X issues a Call Request packet which does not contain a utility length field or a facility length field, the network will transmit a Clear Request packet with a cause code of “Network congestion” and a diagnostic code of 38 - “Packet too short”. This condition is omitted from note 3 of 1980/1984 CCITT Recommendation X.75 Table C-3/X.75.

3.4.5.4.2. Omitted Cause Fields or Diagnostic Fields

STE-X should include the cause field and diagnostic field in a Clear Request packet (1980/1984 CCITT Recommendation X.75 Sections 4.2.3.1 and 4.2.3.2). The network action taken as a result of STE-X not including either of these fields depends on the interface state:

- If the network perceives that the interface is in a state p1-p4 when it receives this Clear Request packet from STE-x, the network will clear the virtual circuit call. The network will transmit a Clear Request packet with a cause code of "Network congestion" and a diagnostic code of 38 - "Packet too short". On issuance of this clear Request packet, the network will consider the clearing procedure to be completed at this interface. The interface will be placed in state p1. The network will also transmit to the remote DTE (or STE) a Clear Indication (or Clear Request) packet with a cause code of "Network congestion", and a diagnostic code of 38 - "Packet too short".

- If the network perceives that the interface is in state p6 when it receives this Clear Request packet from STE-X, the network will discard the packet, and the interface will remain in state p6.

- If the network perceives that the interface is in state p7 when it receives this Clear Request packet from STE-X, the network will transmit a Clear Request packet with a cause code of "Network congestion" and a diagnostic code of 38 - "Packet too short". The interface then remains in state p7 and the network starts timer T33.

STE-X should include the cause field and diagnostic field in a Reset packet (1980/1984 CCITT Recommendation X.75 Sections 4.4.3.1 and 4.4.3.2). The network action taken as a result of STE-X not including either of these fields depends on the interface state:

- If the network perceives that the interface is in state d1 when it receives this Reset Request packet from STE-X, the network will reset the virtual circuit. The network will transmit a Reset Request packet with a cause code of "Network congestion" and a diagnostic code 38 - "Packet too short". On issuance of this Reset Request packet, the network will consider the resetting procedure to be completed at this interface. The interface is still in state d1. The network will also transmit to the remote DTE (or STE) a Reset Indication (or Request) packet with a cause code of "Network congestion" and a diagnostic code of 38 - "Packet too short".

- If the network perceives that the interface is in state d2 when it receives this Reset Request packet from STE-X, the network will discard the packet. The interface is still in state d2.

- If the network perceives that the interface is in state d3 when it receives this Reset Request packet from STE-X, the network will transmit a Reset Request packet with a cause code of “Network congestion” and a diagnostic code of 38 - “Packet too short”. The interface then remains in state d3 and the network starts timer T32.

STE-X should include the cause field and diagnostic field in a Restart Request packet (1980/1984 CCITT Recommendation X.75 Sections 4.5.1.1 and 4.5.1.2). The network uses the ERROR procedure of Table C-2/X.75 with a diagnostic code of 38 - “Packet too short”, if it receives a Restart Request packet omitting either of these fields. The network uses this procedure if it perceives the interface is in state r1 or r3.

3.4.5.4.3. Interrupt Packet With an Interrupt User Data Field Too Short/Long

If STE-X issues an Interrupt packet with an Interrupt user data field too short or too long, the network will reset the virtual circuit with a cause code of “Network congestion” and a diagnostic code of 38/39 - “Packet too short/long”. The network will also transmit to the remote DTE (or STE) a Reset Indication (or Reset Request) packet with a cause code of “Network congestion” and a diagnostic code of 38/39 - “Packet too short/long”. CCITT Recommendation X.75 does not address this issue.

3.4.5.4.4. Non-zero Address and Facility Length Fields in Clear Request Packets

The 1980 version of CCITT Recommendation X.75 states that the address length fields and the user facility length field should be all zero in the Clear Request packet (1980 CCITT Recommendation X.75 Section 4.2.3.3).

The 1984 version of CCITT Recommendation X.75 (Section 4.2.3.3) states that the address length field and the user facility length field need not be zero in the clear Request packet.

If a Clear Request packet is received while the interface is in state p1-p4 or p7 with non-zero values in the address length fields or in the user facility length field, the network will state a clear sequence. It will transmit a Clear Request packet with a cause field of “Network congestion” and a network defined diagnostic code of 74 - “Non-zero address length field”. On issuance of this clear Request packet, the network will consider the clearing procedure to be completed at this interface. The network will also transmit to the remote DTE (or STE) a Clear Indication (or Clear Request) packet with a cause code of “Network congestion” and a network defined diagnostic code of 74 - “Non-zero length field”. A Clear packet received while the interface is in state p6 is discarded.

3.4.5.5. Network Actions on Receipt on Unauthorized Interrupt Packet

If the network receives an Interrupt packet before it confirms a previous Interrupt packet, the network will reset the virtual circuit (1980/1984) CCITT Recommendation X.75 Table C-5/X.75, note1). The network will transmit a Reset Request packet to the local STE-X with a cause code of “Network congestion” and a diagnostic code of 44 - “Unauthorized interrupt”. The network will also transmit a Reset Indication (or Request) packet to the remote DTE (or STE) with a cause code of “Network congestion” and a diagnostic code of 44 - “Unauthorized interrupt”.

3.4.5.6. Network Actions on Expiration of Timers

This section describes the actions taken by the network on the expiration of packet level timers (see 1980/184 CCITT Recommendation X.75 Table D-1/X.75).

3.4.5.6.1. Restart Request Timer T30

Timer T30 is started when the network issues a Restart Request packet. If Timer T30 expires, the network will send a Restart Request packet with a cause code of “Network congestion” and a diagnostic code of 52 - “Timer expired for restart indication/request”, reset Timer 30 and the interface is in state r3. If Timer T30 expires a second time, the network will consider the restart procedure to be completed, i.e., all logical channels for virtual circuit calls will be placed in state p1.

3.4.5.6.2. Call Request Timer T31

The network starts Timer T31 when it issues a Call Request packet. If Timer T31 expires, the network will clear the virtual circuit call with a cause code of “Network congestion” and a diagnostic code of 48 - “Timer expired for incoming call/call request”. The network then starts Timer T33. The network will also transmit to the remote DTE (or STE) a Clear Indication (or Clear Request) packet with a cause code of “Network congestion” and a diagnostic code of 48 - “Timer expired for incoming call/call request”.

3.4.5.6.3. Reset Request Timer T32

The network starts Timer T32 when it issues a Reset Request packet. If Timer T32 expires, the network will clear the virtual circuit call with a cause code of “Network congestion” and a diagnostic code of 51 - “Timer expired for reset indication/request”. The network will also transmit to the remote DTE (or STE) a Clear Indication (or Clear Request) packet with a cause code of a “Network congestion” and a diagnostic code of 51 - “Timer expired for reset indication request”.

3.4.5.6.4. Clear Request Timer T33

The network starts Timer T33 when it issues a Clear Request packet. If T33 expires, the network will issue a Clear Request packet with a cause code of “Network congestion” and a diagnostic code of 50 - “Timer expired for clear indication/request”, reset Timer T33 and the interface will be placed in state p7. If Timer T33 expires a second time, the network will consider the clearing procedure completed, ie., the interface will be placed in state p1.

3.4.5.7. Maintenance Procedures

If network operations initiates an action that results in a virtual circuit call being cleared or an STE link being restarted, a network defined diagnostic code of 122 - Maintenance action” will be given.

3.4.5.8. Diagnostic Code Fields

The diagnostic code field in a Clear, Reset and Restart Indication packet will always be given in the outgoing packets. The 1980 version of CCITT Recommendation X.75 refers to Annex E of Recommendation X.25 for the standard diagnostic codes to be issued. In addition to the diagnostic codes listed by 1980 CCITT Recommendation X.25 Annex E, the network uses the following code which have later been adopted by CCITT in the 1984 version of CCITT Recommendation X.75:

- Invalid facility length (diagnostic code 69).
- No logical channel available (diagnostic code 71)
- Call collision (diagnostic code 72).
- Non-zero address length (diagnostic code 74).
- Facility/utility not provided when expected (diagnostic code 76).

The diagnostic code field of all incoming packets are passed unchanged through the network.

3.5. Numbering Plan

The PSN numbering plan is independent of the numbering plans used by other packet carriers. The objectives of the PSN numbering plan are to facilitate the following:

- To allow PPSN users in other LATAs to access PSN users in Siemens LATAs.
- To provide an addressing scheme that attempts to comply with CCITT recommendation for public data network addressing as well as forthcoming FCC and T1 committee recommendations.

The numbering plan is compatible with the CCITT Recommendation X.121. Each PSN data termination is uniquely identified by a 10-digit Network Terminal Number (NTN). This consists of a 3-digit Data Numbering Plan Area Code (DNPA), a 3-digit central office code (DCO) and a 4-digit End-Point Number (EPN). In addition, each NTN is preceded by a 4-digit Data Network Identification Code (DNIC) as specified by CCITT Recommendation X.121.

The allocation of DNPA and DCO codes will parallel that of the voice network NPA and CO codes notwithstanding future standards changes.

3.6. Routing

3.6.1. PSN DTE to Foreign DTE

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

3.6.2. Foreign DTE to PSN DTE

Internetwork calls that originates form terminals connected to a foreign network are routed on the basis of the PSN DNIC and the address of the called DTE connected to the PSN network. The number of digits on this inter-network call is a total of 14, of which the first four digits are the PSN DNIC. The foreign network would use the next three or six digits of the called DTE address to route the call to the PSN gateway (STE). The PPSN DNIC will be provided by the terminal user at call set up time.

The destination DCE (in the PPSN network) may add the prefix “1” to the calling address before it delivers the Incoming Call packet to the DTE.

3.6.3. PSN DTE to PSN DTE (Inter-LATA)

Calls that originate on a PPSN network in one LATA and terminate on a DTE to the PPSN network in another LATA must use a transmit network for inter-LATA communications. The call will then be routed by the PSN network to the selected transit network (STE). The PSN DNIC will be included in the address fields of X.75 Call Request packet. The transit network then determines the appropriate routing based on either the next three or six digits of the called address, and routes the call toward the corresponding gateway. The destination PPSN then routes the call to the appropriate DTE.

3.7. References

1. "Terminal and Transit Call Control Procedures and Data Transfer System on International Circuits Between Packet-Switched Data Networks", CCITT Recommendation X.75, 1980.

2. "Network Service Definition for Open System Interconnection (OSI) for CCITT applications", CCITT Recommendation X.213, 1984.

3. "International User Services and Facilities in Public Data Network", CCITT Recommendation X.2, 1980.

4. "Digital Data System - Channel Interface Specifications", Bell System Technical Reference PUB 62310, September 1983.

5. "Interface between DTE and DCE for Terminals Operating in the Packet Mode on Public Data Networks", CCITT Recommendation X.25, 1980.

6. "International Routing Principles and Routing Plan for Public Data Networks", CCITT Recommendations X.121, 1980 (Amended 1984).

3.8. Appendix A: Terms

This section lists relevant abbreviations used in this specification.

ANSI - American National Standards Industry

ASCII - American Standard Code for Information Interchange

BOC - Bell Operating Company

CCITT - International Telegraph & Telephone Consultative Committee

CO - Central Office

CPE - Customer Provided Equipment

CUG - Closed User Group

CUG/IA - CUG / Incoming Access

CUG/OA - CUG / Outgoing Access

DCE - Data Circuit-Terminating Equipment

DCO - Digital Central Office

DDD - Direct Distance Dialing

DDS - Direct Digital Service

DISC - Disconnect

DM - Disconnect Mode

DNIC - Data Network Identification Code

DNPA - Data Numbering Plan Area

DTE - Data Terminal Equipment

EIA - Electronic Industries Association

EPN - End Point Number

FCS - Frame Check Sequence

FRMR - Frame Reject

I - Information

IC - Interexchange Carrier

IDN - International Data Number

Kbps - Kilo bits per second

LAPB - Link Access Procedure Balanced

LATA - Local Access & Transport Area

LC - Logical Channel

MLHG - Multi-Line Hunt Group

MTCE - Maintenance

NPA - Numbering Plan Area

NTN - Network Terminal Number (Also DTN or Data TN)

NUI - Network User Identification

OTC - Operating Telephone Company

PAD - Packet Assembler/Disassembler

PPSN - Public Packet Switched Network

PS - Packet Switch

PSN - Packet Switched Network

PVC - Permanent Virtual Circuit

RES - Reset

RNR - Receiver Not Ready

RPDA - Registered Private Operating Agency

RR - Receiver Ready (packets frames)

SABM - Set Asynchronous Balanced Mode

STE - Signaling Terminal Equipment

TNIC - Transit Network Identification Code

UA - Unnumbered Acknowledgment

VC - Virtual Call/Circuit

XOFF - Transmit Off

XON - Transmit On

3.9. Appendix B: Bibliography

This section lists references identified in this specifications.

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

CCITT Recommendation V.3 - International Alphabet No. 5

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 Assembler/Disassembler (PAD) facility in a Public Data Network.

CCITT Recommendation X.4 - General Structure of Signals of International Alphabet No. 5 Code for data transmission over Public Data Networks.

CCITT Recommendation X.25 - Interface between DTE and DCE for terminals operating in the packet mode on Public Data Networks.

CCITT Recommendation X.28 - DTE/DCE 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.75 - Terminal and transit call control procedures and data transfer system on international circuits between packets switched data networks.

CCITT Recommendation X.87 (X.300 in 1984) - 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 in signals in Public Data Networks.

CCITT Recommendation X.110 - Routing principles for international public data services through Switched Public Data Networks.

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

TR-TSY-000462 * - X.25 Interface Specification, August, 1981

TR-TSY-000301 * - Public Packet Switched Network Generic Requirements

* Document may be ordered from Ameritech by contacting the Document Order Center at (847) 248-4324.

3.10. Appendix C: Summary of X.75 PSN Standard (Default) Interface Attributes

PHYSICAL LEVEL

Transmission Rates	9.6 and 56 kbps
Interface	CCITT Recommendation V.24 and V.35: DDS-Like Facilities

LINK LEVEL

Procedure	LAPB/SLP
Parameter k	7
Parameter N1	2096
Parameter N2	10
Timer T1	3 seconds
Parameter T2	0.4 seconds

PACKET LEVEL

Packet Types	All Basic Packets
Maximum Number of Logical Channels per Link	2048 @ 56 kbps 512 @ 9.6 kbps
Packet Size	128 Octets
Packet Sequence Numbering	Modulo 8
Address Format	4 digit DNIC + 10 digit NTN
Access Line Takedown	Conditional and Unconditional
Timer T30	180 Seconds
Timer T31	200 Seconds
Timer T32	180 Seconds
Timer T33	180 Seconds

3.11. Appendix D: Exchange Termination (Modems, Data Sets) Compatibility Specifications For Siemens Packet Switched Network (PSN) Services

PSN Port Termination			PSN Access		PSN Exchange Termination	
Access Types	Speed (BPS)	Protocol	Line Requirements	PSN Exchange Tariff Reference	Applicable Standards	Required Settings*
Public/ Private Dial In	300	Asynch	2 wire, Public Switched Telephone Network Service (business/ residence), 1 party, no call waiting** (Note: may require additional circuit conditioning)	Sections 3.3.1.D and 3.3.1.E	Bell System (WECO) 103/113 compatible	Full duplex operation
Public/ Private Dial In	1200	Asynch	2 wire, Public Switched Telephone Network Service (business/ residence), 1 party, no call waiting** (Note: may require additional circuit conditioning)	Sections 3.3.1.D and 3.3.1.E	Bell System (WECO) 212A compatible	Full duplex operation

* All other parameters should be set at the factory standard settings.

** The Call Waiting feature, when activated during a data call, may cause data calls to be cleared. Users should consider turning this feature off when making data calls.

PSN Port Termination			PSN Access		PSN Exchange Termination	
Access Types	Speed (BPS)	Protocol	Line Requirements	PSN Exchange Tariff Reference	Applicable Standards	Required Settings*
Direct	1200	Asynch	2 wire, dedicated analog, (Note: may require additional circuit conditioning)	Sections 3.3.1.F	Bell System (WECO) 212A compatible	Full duplex operation; mode selection = originate only; character length = 10 bits; transmit line signal level = 0 dBm; must conform to modulation spectrums of 212A data sets and be operational on private lines.
Direct	2400	Asynch	4 wire, dedicated analog, point-to-point or multi-drop	Sections 3.3.1.F	Bell System (WECO) 201C-1D and OCITT V.26 type A or B encoding compatible	Full duplex operation, must be equipped with internal or external synchronous to asynchronous converter
Direct	4800	Asynch	4 wire, dedicated analog, point-to-point or multi-drop	Sections 3.3.1.F	CCITT V.29 compatible	Fall back speed from 9600 bps; must also be equipped with internal or external synch. to asynch. converter. If fast polling is desired, must use Universal Data Systems (UDS) Model 9600 FP compatible modem.

PSN Port Termination			PSN Access		PSN Exchange Termination	
Access Types	Speed (BPS)	Protocol	Line Requirements	PSN Exchange Tariff Reference	Applicable Standards	Required Settings*
Direct	9600	Asynch	4 wire, dedicated analog, point-to-point or multi-drop	Sections 3.3.1.F	CCITT V.29 compatible	Must be equpped with internal or external synch. to asych. converter. If fast polling is desired, must use US Model 9600 FP compatible modem.
Direct	1200	X.25	2 wire, dedicated analog, (Note: may require additional circuit conditioning)	Sections 3.3.1.F	Bell System (WECO) 212A compatible	Full duplex operation, mode selection = originate only, character length = 10 bits, transmit line signal level = 0 dBm, must conform to modulation spectrums of 212A data sets and be operational on private lines.
Direct	2400	X.25	4 wire, dedicated analog, point-to-point or multi-drop	Sections 3.3.1.F	Bell System (WECO) 201C-1D and CCITT V.26 type A or B encoding compatible	Full duplex operation

PSN Port Termination | PSN Access | PSN Exchange Termination

Access Types	Speed (BPS)	Protocol	Line Requirements	PSN Exchange Tariff Reference	Applicable Standards	Required Settings*
Direct	4800	X.25	4 wire, dedicated analog, point-to-point or multi-drop	Sections 3.3.1.F	CCITT V.29 compatible	Fall back speed from 9600 bps: if fast polling is desired, must use UDS 9600 FP compatible modem.
Direct	9600	X.25	4 wire, dedicated analog, point-to-point or multi-drop	Sections 3.3.1.F	CCITT V.29 compatible	If fast polling is desired, must use UDS Model 9600 FP compatible modem.
Digital	2400	X.25 Asynch	4 wire, dedicated digital	Sections 3.3.1.F	500A DSU compatible	System Status = off Cicuit Assurance = off *** (Note: see below)

*** If asynchonous, must be equipped with internal or external synch, to asynch. converter.

PSN Port Termination | PSN Access | PSN Exchange Termination

Access Types	Speed (BPS)	Protocol	Line Requirements	PSN Exchange Tariff Reference	Applicable Standards	Required Settings*
Digital	4800	X.25 Asynch	4 wire, dedicated digital	Sections 3.3.1.F	500A DSU compatible	System Status = off Cicuit Assurance = off ***
Digital	9600	X.25 Asynch X.75	4 wire, dedicated digital	Sections 3.3.1.F	500A DSU compatible	System Status = off Cicuit Assurance = off ***
Digital	56000	X.25 X.75	4 wire, dedicated digital	Sections 3.3.1.F	500A DSU compatible	System Status = off Cicuit Assurance = off

*** If asynchonous, must be equipped with internal or external synch, to asynch. converter.

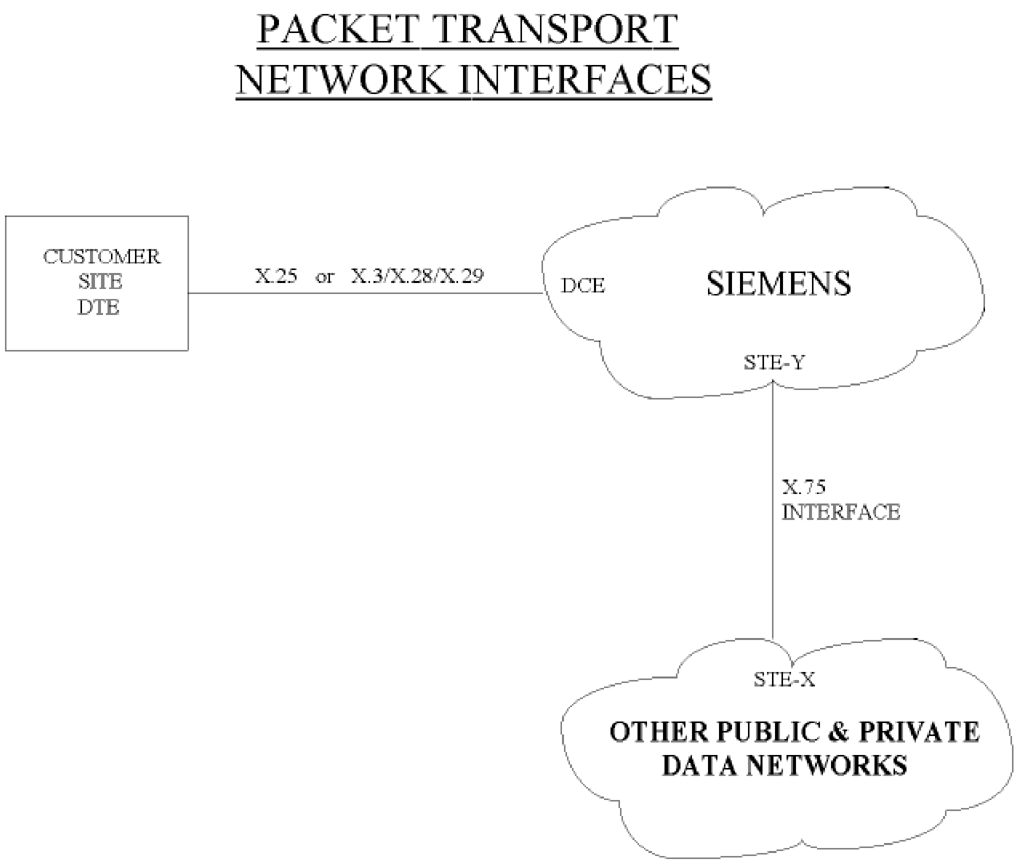
PACKET TRANSPORT
NETWORK INTERFACES
CUSTOMER
SITE
DTE
X.25 or X.3/X.28/X.29
DCE
SIEMENS
STE-Y
X.75
INTERFACE
STE-X
OTHER PUBLIC & PRIVATE
DATA NETWORKS

FIGURE 1-1