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Operation, numbering, routing and mobile service – International operation – Numbering plan of the international telephone service

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Numbering plan interworking in the ISDN era

Reedition of CCITT Recommendation E.166 published in the Blue Book, Fascicle II.2 (1988)

NOTES

1 CCITT Recommendation E.166 was published in Fascicle II.2 of the *Blue Book*. This file is an extract from the *Blue Book*. While the presentation and layout of the text might be slightly different from the *Blue Book* version, the contents of the file are identical to the *Blue Book* version and copyright conditions remain unchanged (see below).

2 In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

Recommendation E.166

NUMBERING PLAN INTERWORKING IN THE ISDN ERA

1 Introduction

1.1 Numbering plan interworking is a fundamental requirement for successful completion of calls routed between networks using different numbering plans, e.g., calls routed between an ISDN using the Recommendation E.164 numbering plan and a public data network (PDN) using the X.121 numbering plan.

1.2 This Recommendation is one of a set of CCITT Recommendations that address numbering plan interworking procedures for calls between terminals connected to an ISDN and terminals connected to a dedicated network. The term "dedicated network" in the context of this Recommendation includes: public switched telephone network (PSTN), packet switched public data network (PSPDN), circuit switched public data network (CSPDN) and telex network.

1.3 This Recommendation is related to and is compatible with the following Recommendations:

- Rec. E.160: Definitions relating to national and international numbering plans
- Rec. E.163: Numbering plan for the international telephone service
- Rec. E.164: Numbering plan for the ISDN era
- Rec. E.165: Timetable for coordinated implementation of the full capability of the numbering plan for the ISDN era
- Rec. F.69: Plan for telex destination codes
- Rec. I.330: ISDN numbering and addressing principles
- Rec. I.332: Numbering principles for interworking between ISDNs and dedicated networks with different numbering plans
- Rec. Q.931: ISDN user-network interface layer 3 specification
- Rec. Q.761-Q.764: Signalling System No. 7 – ISDN User Part
- Rec. U.202: Requirements to be met in providing telex service within the ISDN
- Rec. X.121: International numbering plan for public data networks
- Rec. X.122: Numbering plan interworking between a packet switched public data network (PSPDN) and an integrated services digital network (ISDN) or public switched telephone network (PSTN) in the short-term

2 Scope

2.1 The scope and application of this Recommendation includes the following numbering plan interworking and address signalling scenarios indicated in Figure 1/E.166, i.e., interworking for calls from an ISDN terminal to:

a) an ISDN terminal on another ISDN to provide an ISDN service as defined in the I-200 Series of Recommendations;

b) a voice terminal on a PSTN, for voice services;

c) a data terminal on a PSTN, for voice-band data services;

d) a data terminal on a PSPDN, for packet switched data services;

e) a data terminal on a CSPDN, for circuit switched data services;

f) a telex terminal on a telex network, for telex services defined in Recommendation F.60.

2.2 The term "ISDN terminal" is used here in a generic sense, i.e., an integrated terminal that can support one or more services as per the I-200 Series Recommendations using the Q.931 protocol, and may include the services provided by the dedicated networks under cases b) to f) above. This functionality may be provided by using appropriate existing terminals with terminal adaptors (TA) supporting requisite protocols, e.g., an X.25 terminal with a TA supporting protocol defined by Recommendation X.31/I.462 for packet switched data services.

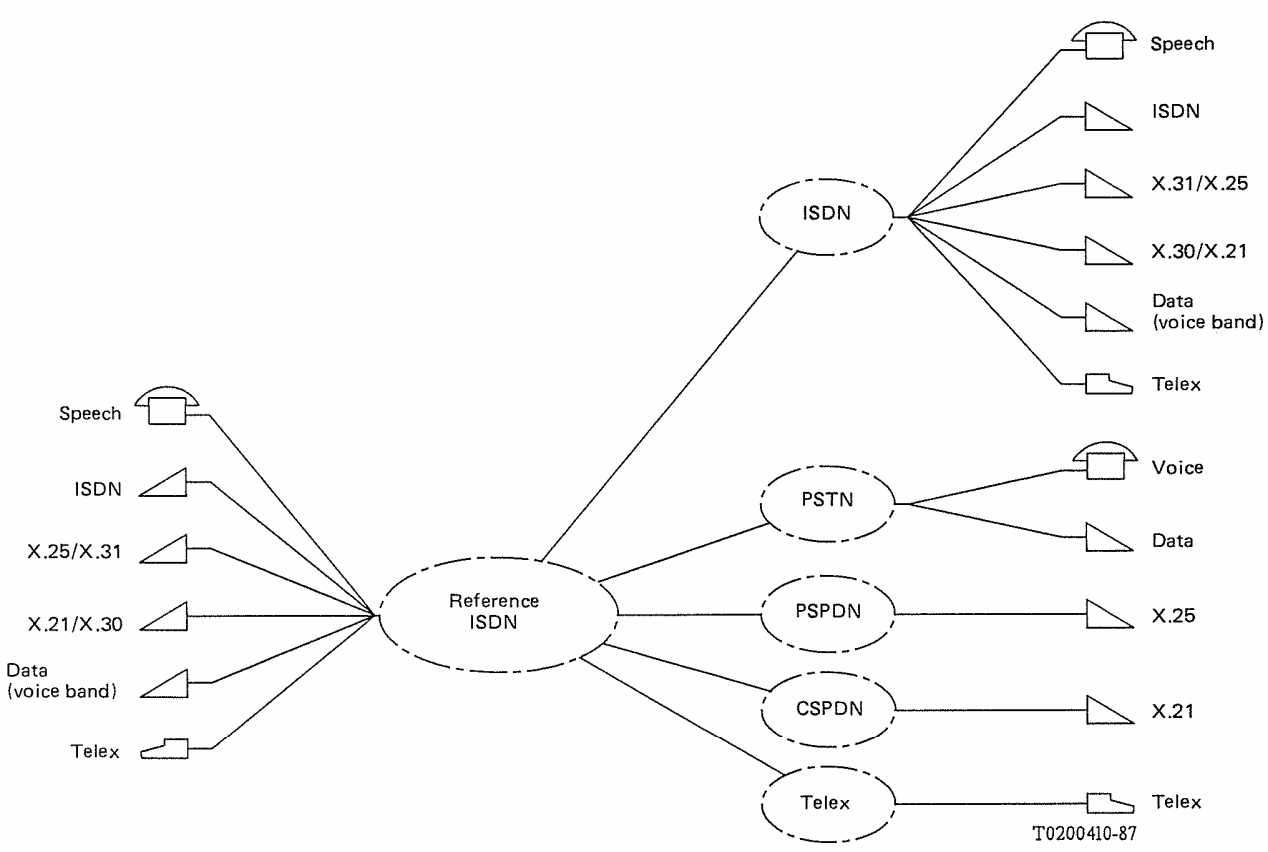
2.3 The following interworking cases need to be considered, based on the terminal/TA combinations on the originating and destination networks:

a) calls from a speech terminal on ISDN to:

- a speech terminal on another ISDN,
- a voice terminal on a PSTN.

b) calls from an X.25 terminal on an ISDN to:

- an X.25 terminal on another ISDN,
- an X.25 terminal on a PSPDN,
- an X.25 terminal on a PSTN,
- an X.25 terminal on a CSPDN,
- a telex terminal on a telex network.



Note 1 – Interworking scenarios that involve transit networks are not shown in this Figure.
Note 2 – Some of the cases in this Figure do not involve numbering plan interworking.
Note 3 – Non-ISDN terminals access ISDN through appropriate terminal adapters.

FIGURE 1/E.166

Scenarios for interworking with ISDNs

c) calls from an X.21 terminal on an ISDN to:

- an X.21 terminal on another ISDN,
- an X.21 terminal on a CSPDN.

d) calls from a voice-band data terminal on an ISDN to:

- a voice-band data terminal on another ISDN,
- a voice-band data terminal on a PSTN.

e) calls from a telex terminal on an ISDN to:

- a telex terminal on a telex network.

2.4 The primary focus of this Recommendation is to specify the numbering plan interworking and/or address signalling methods for:

- calls originated in an ISDN for terminals on another ISDN, or terminals on a dedicated network, and
- calls originated in a PSTN for terminals on an ISDN.

This Recommendation complements other CCITT Recommendations (e.g., Recommendation X.122) which focus on numbering plan interworking for calls originated from terminals on dedicated networks (other than PSTN) and which are intended for compatible terminals on an ISDN.

2.5 For the purposes of this Recommendation, ISDNs can, where appropriate, be assumed to provide both ISDN and PSTN access. In this case, the originating ISDN will generally be unable to differentiate between the two types of access in the terminating network based on the called E.164 number.

It is the responsibility of the terminating network to establish appropriate bilateral arrangements to ensure successful interworking to serve both its ISDN and PSTN customers.

3 Interworking arrangements

3.1 To allow an ISDN subscriber to set up calls intended for completion on other networks, the following two basic methods are available:

3.1.1 *Single stage method*

Interworking by using single stage dialling (or equivalent) is achieved by an arrangement where the calling party accesses a different type of network by selecting a numbering plan indicator, e.g., NPI (numbering plan identifier in Recommendation Q.931) or an escape code consisting of one or more digits (see Recommendation E.160 for definition of escape code), which determines the type of destination network (i.e., its numbering plan). The NPI and/or escape code is then followed by the address of the called terminal on the destination network. The originating network provides the necessary intelligence to route the call to the appropriate interworking function (IWF), to ensure delivery of the call to the destination network.

3.1.2 *Two-stage method*

The two-stage selection method of interworking is an arrangement wherein the first stage of selection establishes a connection from the calling subscriber's terminal to an IWF associated with a point-of-presence of, or gateway to, the desired destination network or an appropriate transit network. To gain access to the IWF, the calling subscriber uses selection procedures assigned to the IWF within the originating network, i.e., the IWF is assigned a number from the numbering plan of the originating network.

When the first connection has been established, the IWF sends a response to the calling terminal. Upon receipt of this response, the calling subscriber is required to input, as a second stage of selection, the address information of the called terminal in the destination network. This second called address information is passed transparently through the originating network and the IWF to the receiving equipment on the destination network. Having received the second address, conforming to the numbering plan of the destination network, the destination network will establish a connection from the IWF to the called terminal, thus completing the connection from the originating terminal to the destination terminal.

3.2 The choice of the numbering plan interworking arrangement should ensure that the impact on the user is minimized and there is no requirement for complex selection procedures. Single-stage methods are therefore recommended for numbering plan interworking between ISDN and dedicated networks. Solutions adopted to achieve this interworking arrangement for short-term and long-term applications are covered in subsequent sections. The short-term and long-term are time frames related to Time *T* as specified in Recommendation E.165.

3.3 Special situations in which two-stage interworking arrangements may apply and corresponding partitioning of responsibilities between originating, transit and destination networks are for further study.

3.4 It is recognized that some Administrations may not be able to offer interworking capability for international traffic. Bilateral arrangements may therefore be required to provide interworking capability. Because of administrative difficulties, interworking should not be performed across the international boundary, unless no other interworking possibilities exist.

3.5 Some networks may select other interworking arrangements, such as operator assistance, to complete the call. The need to standardize such interworking arrangements is for further study.

4 Interworking evolution

4.1 The recommended long-term numbering plan interworking solution is based on the NPI/TON field in the ISDN call set-up message as defined in Recommendation Q.931. The NPI element is the numbering plan identifier (e.g., Recommendation E.164/E.163, X.121, F.69), whereas the TON indicates the type of number (e.g., local, national, international). This NPI/TON field will be carried as part of the call set-up message to the originating exchange, which will use this information to route the call. The NPI element will also be available within the network as part of the address message in S.S. No. 7 ISUP.

4.2 The network capabilities in terms of digit storage, digit analysis and signalling protocols to implement the NPI-based interworking solutions on a global basis will not be available in the short term. Thus, a single-stage method for numbering plan interworking in the short term, and a timetable for planned evolution to the NPI/TON-based, long-term solution have been proposed (see Recommendation E.165).

4.3 The short-term, single-stage interworking arrangements will use prefixes and escape codes to indicate the type of number and numbering plan of the destination network, respectively. Definitions of prefixes and escape codes are contained in Recommendation E.160. As indicated in Recommendation E.160, prefixes are not part of the number and are not signalled over internetwork or international boundaries so that they are not subject to international standards. Escape codes, however, may be carried forward through the originating network and across internetwork and international boundaries. Therefore, the values of escape codes need to be standardized.

Table A-1/E.166 summarizes the escape codes recommended by CCITT for numbering plan interworking. Note that escape codes for interworking between ISDNs and PSTNs are not required because the PSTN numbering plan (Recommendation E.163) is a subset of the numbering plan for the ISDN era. (Recommendation E.164).

There may be cases when a standardized escape code is numerically equal to a prefix already in use in the network. In such cases, an optional network-specific digit(s) other than the standardized escape code may be used, and the translation from the optional-network-specific digit(s) to the standardized escape code is performed by the network.

To facilitate short-term interworking (using escape codes) between ISDNs and existing dedicated networks, Recommendation E.165 specifies that the international numbers assigned to ISDN user-network interfaces will be restricted to a maximum of twelve digits till Time *T*. Time *T* is specified in Recommendation E.165. After time *T*, ISDNs can implement the full capability of the ISDN numbering plan (Recommendation E.164). Recommendation E.165, and the date specified for time *T*, provide guidelines for evolution towards full ISDN numbering and numbering plan interworking capabilities.

4.4 The numbering plan interworking solutions in this Recommendation are categorized as short-term (pre-Time *T*, using escape codes) and long-term (post- Time *T*, using NPI/TON). It is however envisaged that, based on their individual network evolution plans, some Administrations will implement the NPI/TON-based interworking solutions prior to Time *T*. Introduction of NPI/TON-based interworking in a given network prior to Time *T* should not impose any specific requirements on networks not supporting NPI/TON for interworking, unless bilaterally agreed.

4.5 The man-machine interface procedures used with ISDN terminals to indicate the appropriate NPI and TON are for further study.

5 Representative interworking scenarios

5.1 This section provides single-stage interworking solutions for a number of representative interworking scenarios. The scenarios presented are not exhaustive.

5.2 It is assumed that all ISDNs and ISDN terminals will support the NPI/TON feature from their inception and that a NPI/TON equivalent feature will be available in PDNs by Time *T*, if not earlier.

5.3 The interworking scenarios presented in this section assume that the called and calling numbers represent international number formats in the appropriate numbering plans. Partitioning of the international number for local and national calls and the associated prefixes are a national matter and are not indicated in the interworking solutions.

5.4 The interworking cases addressed in Figures 2/E.166 to 11/E.166 are indicated by the boxes with numbers in the matrix of Table 1/E.166, where the numbers in the boxes refer to the appropriate Figures (2/E.166 to 11/E.166). Other numbering plan interworking scenarios are for further study.

TABLE 1/E.166

Matrix of interworking cases and the figures in which they are shown

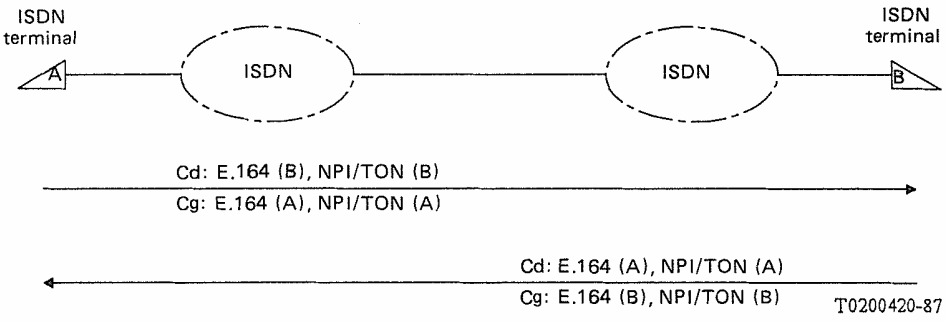
Networks	Terminals	ISDN				
		ISDN	V Séries	Rec. X.25	Rec. X.21	Telex
ISDN	ISDN	2				
	V Series					
	Rec. X.25			6, 10		
	Rec. X.21					
	Telex					
PSTN	Voice	3				
	V Series		4			
	Rec. X.25			5		
PSPDN	Rec. X.25			7, 11		
CSPDN	Rec. X.21				8	
Telex	Telex					9

5.5 The following abbreviations are used in Figures 2/E.166 to 11/E.166 which contain short-term and long-term interworking solutions for representative configurations:

Cd	Called number
Cg	Calling number
IWF	Interworking function
PH	Packet handler
M	Modem
NPI/TON	Numbering plan identifier/Type of number feature as defined in Recommendation Q.931
CRP	Call request packet in Recommendation X.25
TA	Terminal adapter

Note – As stated in Recommendation X.25, presence of the calling number, i.e., address (Cg) in the call request packet (CRP) is not mandatory. However, even when it is given by the calling terminal, this does not preclude the network from checking and possibly modifying this information, e.g., for security reasons.

5.6 Interworking solutions in the reverse direction, i.e., dedicated networks to ISDN, are also indicated in Figures 2/E.166 to 11/E.166. However, except for PSTN to ISDN calls, these may also be the subject of complementary CCITT Recommendations (e.g., Recommendation X.122).

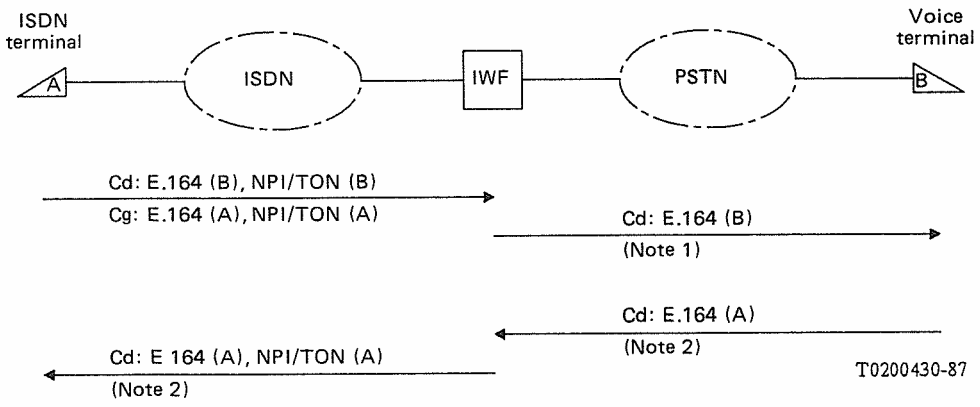


Note 1 – This scenario represents the case of generic ISDN terminals which support NPI/TON features defined in Recommendation Q.931 and are capable of supporting all ISDN services per I-Series Recommendations.

Note 2 – In the short term, the NPI/TON capabilities are not available in the X.25 protocol used to handle packet mode calls. Work is in progress to provide NPI/TON in X.25.

FIGURE 2/E.166

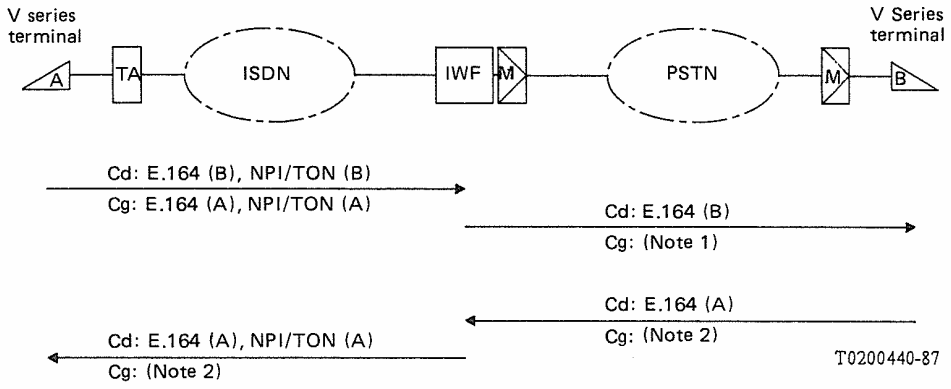
Address signalling between ISDNs (except short-term packet mode)



Note 1 – The PSTN terminal (B) may not receive the calling party (A) number.
Note 2 – For calls originated on the PSTN, calling number (B) may not be passed to the ISDN.
Note 3 – Since E.163 numbers are a subset of E.164 numbers, only E.164 numbers are indicated.
Note 4 – In the short-term, the length of the E.164 numbers will be restricted to 12 digits as per Recommendation E.165.

FIGURE 3/E.166

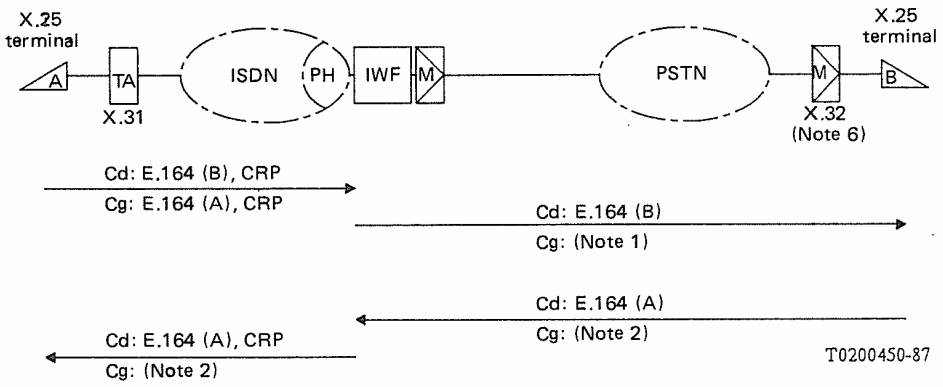
Address signalling between ISDN and PSTN for voice services (short-term and long-term)



Note 1 – The PSTN terminal (B) may receive the calling party (A) number if appropriate signalling and terminal functionality is available.
Note 2 – For calls originated on the PSTN, the calling number (B) may not be provided to the called terminal (A).
Note 3 – Since E.163 numbers are a subset of E.164 numbers, only E.164 numbers are indicated.
Note 4 – Modem selection procedures are not part of this Recommendation.

FIGURE 4/E.166

Address signalling between ISDN and PSTN for voice band data services (short-term and long-term)



Note 1 – The PSTN terminal (B) may receive the calling party (A) number if appropriate signalling and terminal functionality is available.

Note 2 – For calls originated in the PSTN, the calling number (B) may not be provided to the called terminal (A).

Note 3 – Since E.163 numbers are a subset of E.164 numbers, only E.164 numbers are indicated.

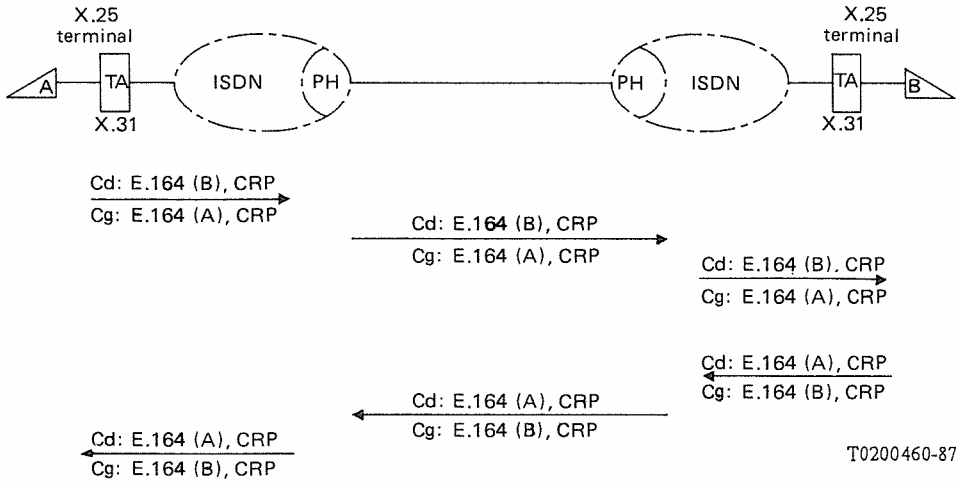
Note 4 – Under X.31 procedures, the TA will establish the connection to the PH prior to receiving the CRP which is passed transparently to the PH, and which will carry the E.164 (B) number.

Note 5 – Modem selection procedures are not part of this Recommendation.

Note 6 – Use of X.32 type procedures for PSTN access to ISDN for X.25 terminals is for urgent further study (see also Annex B).

FIGURE 5/E.166

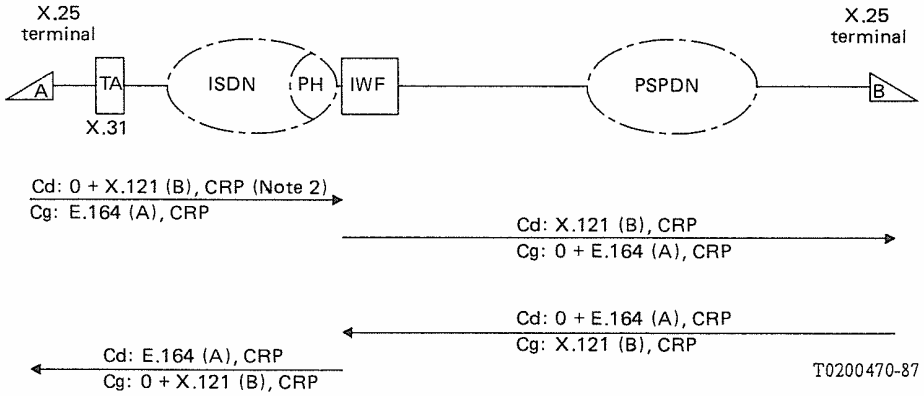
Address signalling between ISDN and PSTN for packet data services (short-term)



Note – Under X.31 procedures, the X.25 call request packet (CRP) will carry the called and calling numbers.

FIGURE 6/E.166

Address signalling between ISDNs for packet data service (short-term)



Note 1 – The PH is required to remove and insert escape code digit(s) as appropriate.

Note 2 – Optional network-specific digit(s) which represent the same functionality as the internationally agreed escape code (digit 0) may be used. Translation from prefix to escape code '0' must be performed by the originating network (PH) prior to advancing the call. The choice of these optional network-specific digit(s) is a national matter.

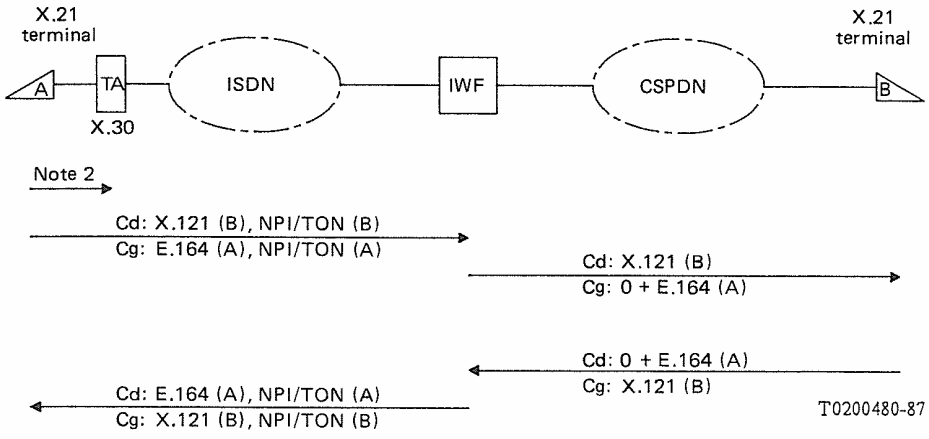
Note 3 – The X.25 CRP will carry the E.164 (A) address.

Note 4 – Under some implementations (refer to Recommendation X.121) escape code digit 9 may also be used.

Note 5 – The ISDN customer may be able to utilise a variety of services offered by the PSPDN by dialling an X.121 number. In some situations the X.121 number may mean 9/0 + E.164 number (see Annex B).

FIGURE 7/E.166

Numbering plan interworking between ISDN and PSPDN for packet data services (short-term)



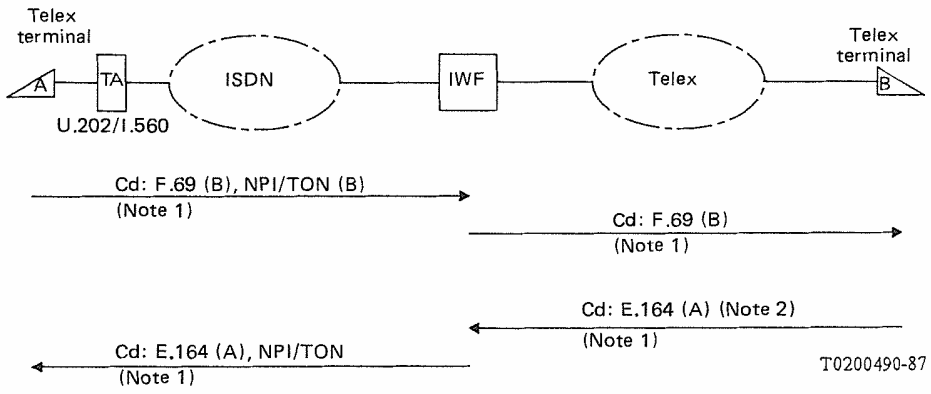
Note 1 – It is understood that the signalling protocol mapping function implemented in the X.30 TA will support the NPI/TON feature as defined in Recommendation Q.931.

Note 2 – The X.30 TA provides mapping from the X.21/X.21 *bis* protocol to the D-channel protocol.

Note 3 – The numbering plan interworking procedures from the CSPDN to the ISDN in this configuration require further study and confirmation.

FIGURE 8/E.166

Numbering plan interworking between ISDN and CSPDN for circuit switched data services (short-term and long-term)



Note 1 – After the connection has been established, the calling party information may be transferred through the exchange of answerback codes as per Recommendation F.60.

Note 2 – The use of a prefix or escape code from F.69 to E.164 requires further study. Two-stage selection may apply in the interim period.

Note 3 – Numbering plan interworking procedures for this configuration require further study and confirmation.

FIGURE 9/E.166

Numbering plan interworking between ISDN and telex networks for telex service (short-term)

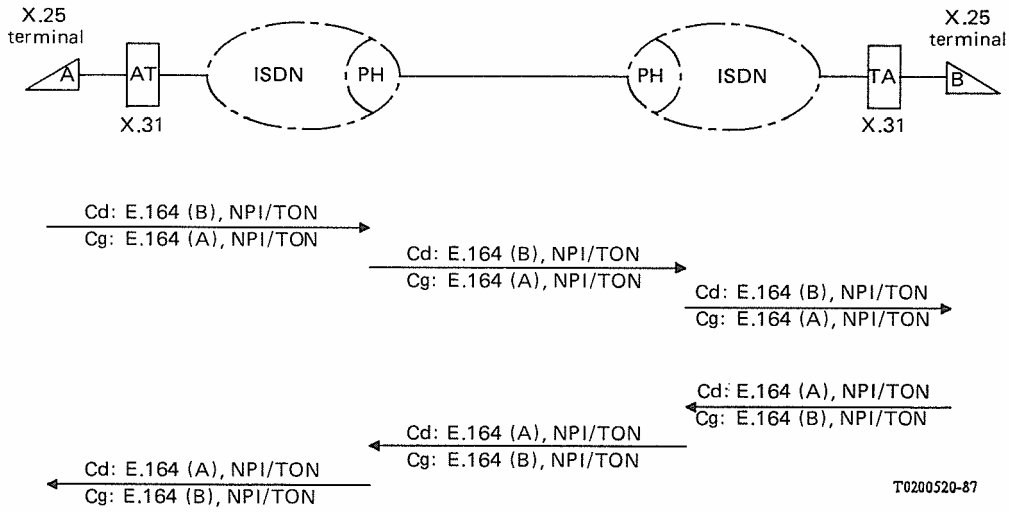


FIGURE 10/E.166

Address signalling between ISDNs for packet data service (long-term)

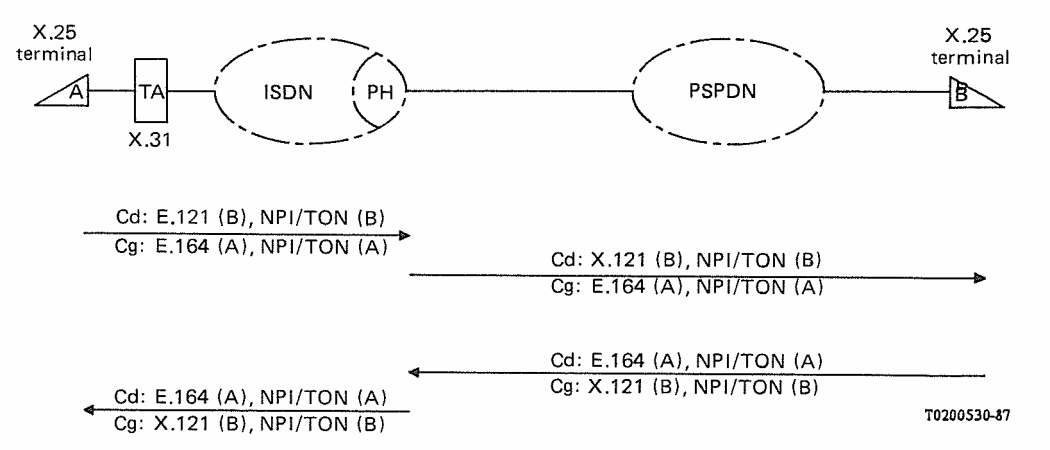


FIGURE 11/E.166

Numbering plan interworking between ISDN and PSPDN for packet data services (long-term)

5.7 The location of the IWF and PH symbols in the diagrams does not imply a fixed position in the network or place any limitations on their functionalities.

ANNEX A

(to Recommendation E.166)

Escape codes for numbering plan interworking

Table A-1/E.166 summarizes the escape codes that are recommended for interworking between different CCITT-defined numbering plans referred to in this Recommendation.

TABLE A-1/E.166

Recommended escape codes for numbering plan interworking

From	To	Escape code	Remarks
ISDN (Rec. E.164)	PSPDN (Rec. X.121)	'0'	Note 1
ISDN (Rec. E.164)	CSPDN (Rec. X.121)	–	Need for an escape code is for further study
PDN (Rec. X.121)	ISDN (Rec. E.164)	'0'	Note 2
Telex (Rec. F.69)	ISDN (Rec. E.164)	–	Need for an escape code is for further study

Note 1 – Use of escape code digit '0' for ISDN to PSPDN numbering plan interworking is restricted to packet data calls originated from an X.25 DTE on an ISDN using an X.31 TA and are a short-term (up to time *T* defined in Recommendation E.165) measure.

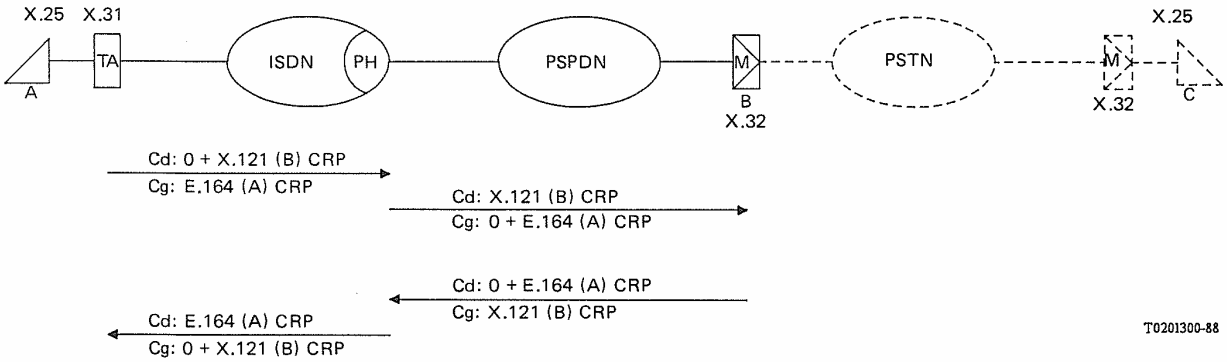
Note 2 – Under certain implementation, escape code digit '9' may also be used (see Recommendation X.121).

ANNEX B

(to Recommendation E.166)

Additional short-term numbering plan interworking scenarios packet-data services

The following scenarios may be used in special circumstances in the short term:



Note 1 – Meaning of abbreviations are given in § 5.5.

Note 2 – Refer to Recommendations X.122 and X.32 for further details.

Note 3 – The PH is required to remove and insert escape code digit(s) as appropriate.

Note 4 – Optional network-specific digit(s) which represent the same functionality as the internationally agreed escape code (digit 0) may be used. Translation to escape digit '0' must be performed by the originating network (PH) prior to advancing the call. The choice of the optional network-specific digit(s) is a national matter.

Note 5 – X.25 CRP will carry the E.164 (A) address.

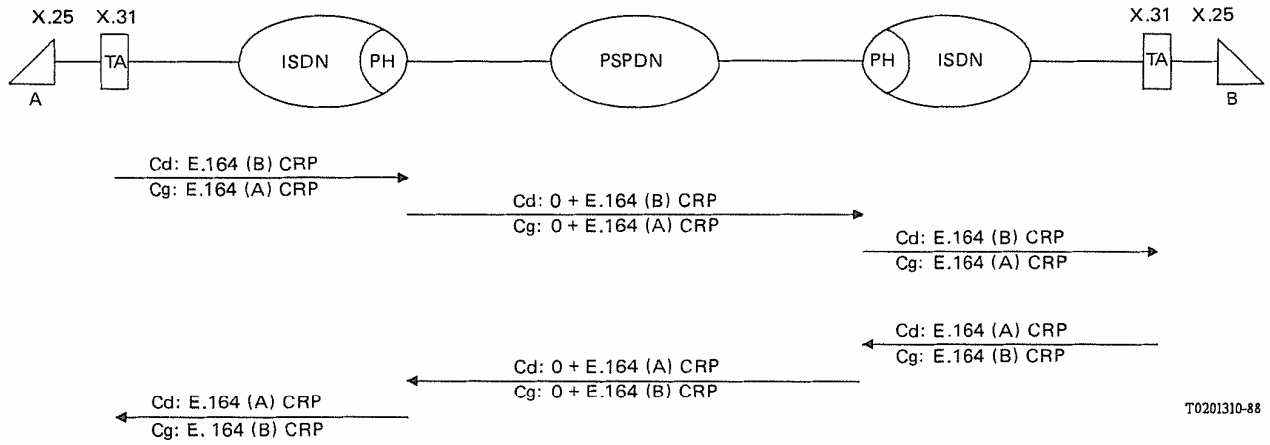
Note 6 – Under some implementations, for PSPDN to ISDN calls, escape code 9 may also be used (refer to Rec. X.121).

Note 7 – Currently, there are no CCITT procedures (similar to X.32) for direct ISDN-PSTN interworking for packet-mode services. Such procedures are for urgent further study.

Note 8 – In the case of this Figure, the ISDN customer may be able to utilize services offered by the PSPDN. In some implementations the X.121 number may mean 9/0 + E.164 (C) number.

FIGURE B-1/E.166

Numbering plan interworking between ISDN and PSPDN for packet data services when the PSPDN destination is a modem serving a PSTN subscriber (short-term)



Note 1 – Meaning of abbreviations are given in § 5.5.

Note 2 – The ISDN PHs are required to insert and remove escape code digits as appropriate.

FIGURE B-2/E.166

Numbering plan interworking between two ISDNs with a PSPDN as a transit network for packet data services (short-term)

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