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SERIES X: DATA NETWORKS AND OPEN SYSTEM COMMUNICATIONS

Public data networks – Network aspects

International routing principles and routing plan for Public Data Networks

ITU-T Recommendation X.110

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ITU-T Recommendation X.110

International routing principles and routing plan for Public Data Networks

Summary

This Recommendation provides high level general principles and guidelines that should be applied by Network Operators for the routing of international data traffic across interconnected public data networks. The aim of this Recommendation is to provide network operators with the necessary information to ensure that data traffic can be effectively and economically routed across interconnected public data networks making best use of the available network resources. Although this Recommendation is focused towards packet switched data networks (such as X.25 and Frame Relay), the principles are applicable to both circuit-switched and packet-switched public data networks.

Source

ITU-T Recommendation X.110 was revised by ITU-T Study Group 17 (2001-2004) and approved under the WTSA Resolution 1 procedure on 13 April 2002.

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications. The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

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

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As of the date of approval of this Recommendation, ITU had not received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementors are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database.

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ITU-T Recommendation X.110

International routing principles and routing plan for Public Data Networks

1 Introduction

This Recommendation specifies the high level routing principles and guidelines that should be applied for the establishment of calls across interconnecting public data networks. Although this Recommendation is focused towards packet switched data networks (such as X.25 and Frame Relay), the principles are applicable to both circuit-switched and packet-switched public data networks.

2 Scope

2.1 The scope of this Recommendation is the provision of general principles and guidelines that should be applied by Network Operators for the routing of international data traffic across interconnected public data networks. The aim of this Recommendation is to provide network operators with the necessary information to ensure that data traffic can be effectively and economically routed across interconnected public data networks utilizing the available network resources. It is recognized that the guidelines will need to be reviewed periodically to ensure that it is in step with actual practice taking place within the international public data networks.

A model of the international public data network is illustrated in Figure 1. This model consists of a set of national public networks and shows the interconnection of national public data networks and International Data Switching Exchanges (IDSEs) and reflects the manner in which public data networks have evolved in different ways in many countries. The model shown illustrates six types of networks that have evolved as follows:

a) Some countries may have more than one PDN and also more than one IDSE. See country A in Figure 1.

b) Some countries may have one IDSE which stands alone from that country's PDN. See country B in Figure 1.

c) Some countries may have one PDN and gain international access through one IDSE. See country C in Figure 1.

d) Some countries may not have a PDN but utilize an IDSE for international connections. See country D in Figure 1.

e) Some countries may have more than one PDN each with its own IDSE. See country E in Figure 1.

f) Some countries may have more than one PDN each sharing one or more IDSE. See country F in Figure 1.

2.2 Circuits between IDSEs in the same country are not classed as international links.

2.3 A list of the terms and definitions used in this Recommendation are recorded in Annex A.

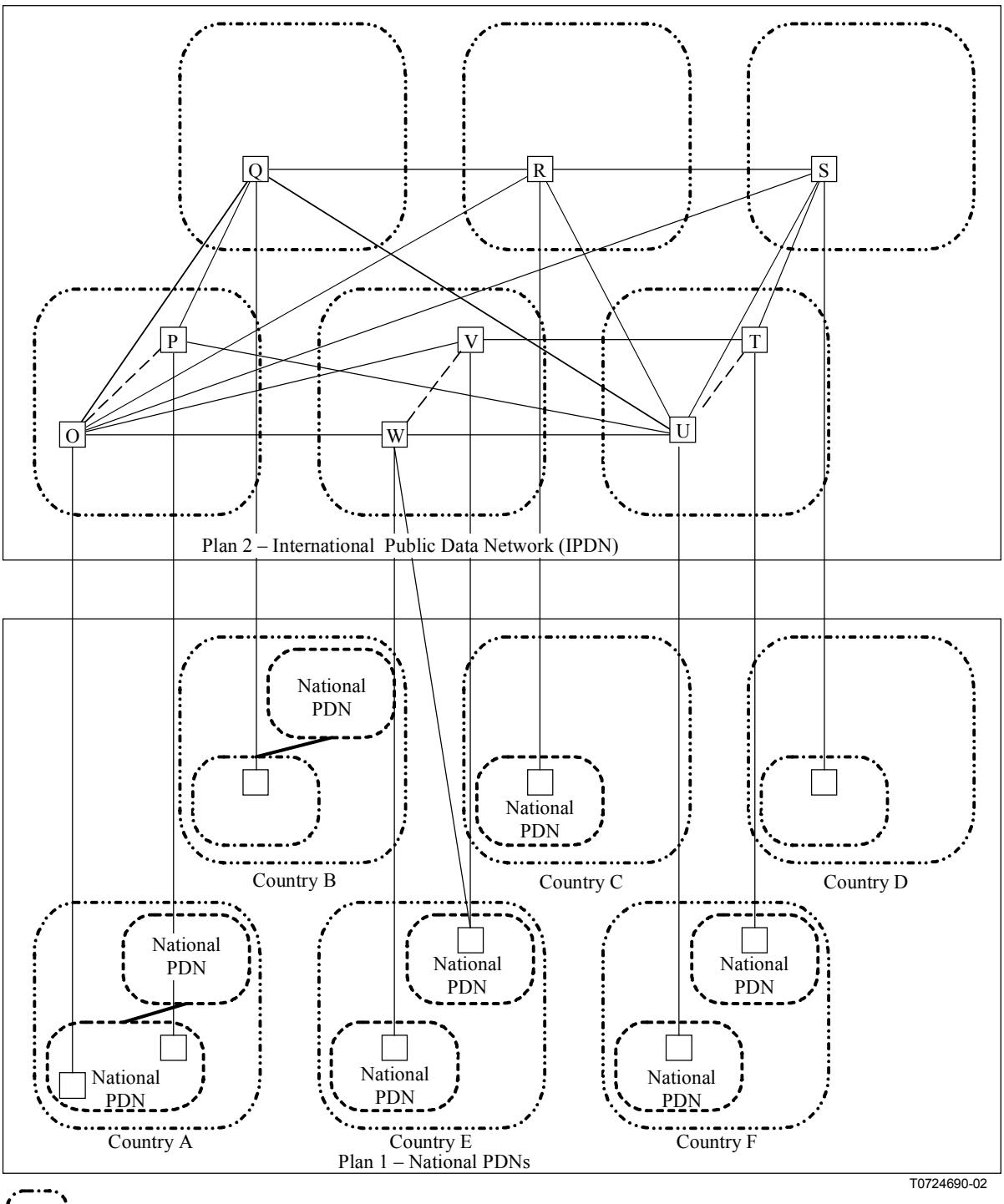


Figure 1/X.110 – International public data network model

3 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision: users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published.

- ITU-T Recommendation X.1 (2000), *International user classes of service in, and categories of access to, public data networks and Integrated Services Digital Networks (ISDNs)*.
- ITU-T Recommendation X.7 (2000), *Technical characteristics of data transmission services*.
- ITU-T Recommendation X.60 (1988), *Common channel signalling for circuit-switched data applications*.
- ITU-T Recommendation X.61 (1988), *Signalling System No. 7 – Data user part*.
- ITU-T Recommendation X.70 (1988), *Terminal and transit control signalling system for start-stop services on international circuits between anisochronous data networks*.
- ITU-T Recommendation X.71 (1988), *Decentralized terminal and transit control signalling system on international circuits between synchronous data networks*.
- ITU-T Recommendation X.75 (1996), *Packet-switched signalling system between public networks providing data transmission services*.
- ITU-T Recommendation X.75 Corrigendum 1 (1998).
- ITU-T Recommendation X.76 (2000), *Network-to-network interface between public networks providing PVC and/or SVC frame relay data transmission service*.
- ITU-T Recommendation X.92 (1988), *Hypothetical reference connections for public synchronous data networks*.
- ITU-T Recommendation X.115 (1995), *Definition of address translation capability in public data networks*.
- ITU-T Recommendation X.116 (1996), *Address translation registration and resolution protocol*.
- ITU-T Recommendation X.121 (2000), *International numbering plan for public data networks*.
- ITU-T Recommendation E.166/X.122 (1998), *Numbering plan interworking for the E.164 and X.121 numbering plans*.
- ITU-T Recommendation X.123 (1996), *Mapping between escape codes and TOA/NPI for E.164/X.121 numbering plan interworking during the transition period*.
- ITU-T Recommendation X.124 (1999), *Arrangements for the interworking of the E.164 and X.121 numbering plans for frame relay and ATM Networks*.
- ITU-T Recommendation X.125 (1998), *Procedures for the notification of the assignment of international network identification codes for public frame relay data networks and ATM networks numbered under the E.164 numbering plan*.
- ITU-T Recommendation X.130 (1988), *Call processing delays in public data networks when providing international synchnronous circuit-switched data services*.

– ITU-T Recommendation X.131 (1988), *Call blocking in public data networks when providing international synchronous circuit-switched data services*.

– ITU-T Recommendation X.135 (1997), *Speed of service (delay and throughput) performance values for public data networks when providing international packet-switched services*.

– ITU-T Recommendation X.136 (1997), *Accuracy and dependability performance values for public data networks when providing international packet-switched services*.

– ITU-T Recommendation X.144 (2000), *User information transfer performance parameters for data networks providing international frame relay PVC service*.

– ITU-T Recommendation X.145 (1996), *Performance for data networks providing international frame relay SVC service*.

– ITU-T Recommendation X.146 (2000), *Performance objectives and quality of service classes applicable to frame relay*.

– ITU-T Recommendation X.353 (1988), *Routing principles for interconnecting public maritime mobile satellite data transmission systems with public data networks*.

4 Definitions

Within the public switched telephone and public data network environment, the terms used for all networks and services must be compatible and consistent. Therefore this Recommendation, in addition to the terms defined herein, relies on a list of terms and definitions contained in ITU-T Recs. E.164, X.121, X.122, X.25, X.75, X.36 and X.76. A list of terms and definitions is given in Annex A.

5 Abbreviations

This Recommendation uses the following abbreviations.

ATM Asynchronous Transfer Mode

CC Country Code

DCC Data Country Code

DCE Data Circuit-terminating Equipment

DNIC Data Network Identification Code

DTE Data Terminal Equipment

FR Frame Relay

IDSE International Data Switching Exchange

ISDN Integrated Services Digital Network

ITU-T International Telecommunication Union – Telecommunication Standardization Sector

NN National Number

NPI Numbering Plan Identifier

NTN Network Terminal Number

PDN Public Data Network

PFRDN Public Frame Relay Data Network

PNIC Private data Network Identification Code

PSPDN Packet Switched Public Data Network

PSTN Public Switched Telephone Network

ROA Recognized Operating Agency

ToA Type of Address

ToN Type of Number

6 Description of an international route

6.1 The basic function of routing a call (or selecting a route for a call) consists of selecting, at each switching stage, the network equipment (i.e. outgoing link) that will be used for transferring data for that call.

6.2 The route used for an international call always consists of three parts:

– an originating national network part, from the calling DTE to the originating IDSE (i.e. through the originating PDN);

– an international network part, from the originating IDSE to the destination IDSE (i.e. through the international public data network which may consist of a number of transit networks);

– a destination national network part, from the destination IDSE to the called DTE (i.e. through the destination PDN).

NOTE – For maritime satellite data transmission systems a Maritime Satellite Data Switching Exchange (MSDSE) would function as the originating and destination IDSE.

6.3 The planning of the international network part is subject to ITU-T study.

6.4 The planning of the originating and destination national network parts is a national matter. However, the achieved quality of service (e.g. transfer delay) provided on international connections should be considered in the planning of national networks. For example, the number of switching nodes and the transmission bearer capabilities used within a national network in order to route a call to the IDSE.

7 General routing principles

7.1 The planning of international data traffic routes is the responsibility of the Administrations and/or Network Operators concerned and is subject to bilateral agreements between operators.

7.2 The traffic route within the international network part should be so planned as to encompass no more than four international data links in tandem.

7.3 When planning traffic routes, Quality of Service (QoS) requirements should be taken into account. One such QoS requirement is the overall transfer delay of the connection. Recommendations specifying delay objectives for PSPDN and Frame Relay networks are given in the X.130 and X.140 series. In considering the overall transfer delay, the number of satellite links is of major significance. Long terrestrial routes may also incur significant propagation delay. In the case of networks utilizing high speed transmission links and modern switching equipment, propagation delay may be the major contributor to overall transfer delay. For terrestrial transmission links propagation delay is approximately 5 ms per 1000 km of route distance.

7.4 In accordance with ITU-T Rec. X.92, no more than three satellite links should normally be included in an overall PDN route. The international network part should normally not include more than two satellite links. (Refer to Annex B.)

7.5 Traffic routes will normally comprise direct call routes and alternative call routes.

7.6 Traffic routes should be planned so as to avoid the possibility of circular call routings.

7.7 When planning traffic routes, use could be made of time-zone differences to better utilize the capacity of international (long distance) transmission links.

7.8 The routing of a call is a matter under the responsibility of Network Operators.

7.9 All Network Operators concerned with the routing of a given call should be able to obtain the necessary information for that call (e.g. the DNIC of each network concerned).

NOTE – Public Frame Relay Data Networks may be numbered under either the X.121 or the E.164 numbering plan. Networks numbered under E.164 would generally not have a DNIC. A protocol specific mechanism has been defined within the ITU-T Recs. X.36 and X.76 in order to uniquely identify specific Public Frame Relay Network numbered under E.164. These identifiers are known as an International Network Identification Code and are allocated according to procedures defined in ITU-T Rec. X.125.

7.10 The international network part for a call should be selected on a link-by-link basis by the IDSEs concerned. Under normal conditions, when a call route for a specific call has been established, that call route should be used for the entire duration of that call.

7.11 Calls should be routed using the minimum number of international data links taking into account the economics and practicalities of the situation.

7.12 If a trunk cannot satisfy the throughput requirements made by the originating subscriber, it will be necessary to select one of the possible alternative call routes.

7.13 Where possible, routes should be planned to include diversity to overcome transmission or switching equipment failures.

8 Specific routing possibilities through the International PDN

8.1 Routing possibilities required for maintaining the quality of service

Specific routing possibilities may be considered for maintaining a good quality of service, for example:

– the selection of a reliable route for a call, in order to avoid clearing of the call by the network (or reset of the call in the case of a virtual call), due to internal network problems;

– the availability of more than one call route between originating and destination networks, in order to avoid a call request being barred if one call route is temporarily not available.

8.2 Service characteristics associated with a route

During a call establishment, a public data network may have to consider some aspects of the network service characteristics to make routing decisions.

Whenever several alternative traffic routes can be used to establish the connection between two end users, in addition to the availability of those traffic routes at a given time, it is important that the service characteristics (e.g. throughput capacity, transit delay, acceptance of some facilities, etc.) associated with any one of those traffic routes be considered. However, in most cases the application will be transparent to the network protocols and the routing decision can only be influenced by information provided by the user during the call establishment. For example an application such as voice over frame relay would require the selection of a low transit delay connection if available. Some protocols (e.g. Frame Relay) have a capability to allow the selection of a specific transit network.

8.3 Specific conditions associated with a route

During call establishment, a public data network may have to consider specific conditions such as reverse charge request, access protection (closed user group, incoming calls barred), etc. Under such circumstances, as far as possible, the Network Operators should endeavour to provide call routings subject to:

a) the availability of the facilities required;

b) bilateral agreement.

9 Routing procedures applicable to international interworking between PDNs of the same type, between PSPDNs and ISDNs/PSTN and also between PFRDNs and ATM networks

9.1 Use of DNICs

For networks numbered under the X.121 numbering plan International Data Switching Exchanges (IDSEs) will recognize the calling and the called Data Network Identification Codes (DNICs) or Data Country Codes (DCCs) to determine the destination of a call and the call route. (See Notes 1, 2 and 3.)

NOTE 1 – For PSPDN to PSPDN interworking, possible digit analysis of the first one or more digit(s) beyond the 4 digits DNIC field is to be determined on a bilateral basis if necessary.

NOTE 2 – For routing of calls to ISDN, PSTN and Mobile Satellite Systems from PSPDN, a digit of at least 1 digit beyond the 4-digit DNIC field is required.

NOTE 3 – ROA selection shall have no influence on the determination of the call route between the IDSEs.

9.2 Number plan interworking

A call from an ISDN (or PSTN) to a PSPDN, a PSPDN to an ISDN (or PSTN), a PFRDN (ITU-T Rec. X.121) to a PFRDN (ITU-T Rec. E.164) and calls routed through networks using a different numbering plan to that of the originating or destination network are examples of inter-networking which require the need for numbering plan interworking. Numbering Plan Interworking is a fundamental requirement for the successful completion/routing of calls between networks utilizing different numbering plans.

Specific details and procedures on numbering plan interworking between PSPDNs and ISDNs for the E.164 and X.121 numbering plans are outlined in ITU-T Rec. E.166/X.122 (see also ITU-T Recs. E.165, E.165.1, X.123, X.301 and I.330). Transit cases are considered in these Recommendations. See also 6.3 for number plan interworking for Frame Relay and ATM networks.

9.2.1 Use of escape codes to facilitate number plan interworking

To facilitate number plan interworking, with the E.164 Numbering Plans, the X.121 numbering plan provides for the use of an escape code. An X.121 escape code is an indicator consisting of one digit. It indicates that the following digits represent a number from a different numbering plan.

An escape code when required has to be carried forward through the originating network and can be carried across internetwork and international boundaries.

Digits used for escape codes are the digits 8, 9 and 0. The allocation and their purpose are shown in Table 2/X.121. The escape codes are not part of the international data number but are part of the "international X.121 format".

The escape codes are provided to enable DTEs and networks, (numbered under the X.121 numbering plan), which do not have the capability to support a signalling mechanism such as the ToA/NPI address format as defined in the X.25 signalling protocol, to interwork with terminals numbered under the E.164 numbering plans.

The maximum length of an E.164 number is 15 digits. Support of the ToA/NPI address format is required in the case of terminals on Packet Switched Public Data Networks (ITU-T Rec. X.25) interworking with terminals identified by a 15-digit E.164 number.

An alternative to the use of the X.121 escape codes for numbering plan interworking is the use of the Type of Address/Numbering Plan Identifier (ToA/NPI) which is carried in the address field

within a call set-up signalling message. Within the PSPDN domain, the ToA/NPI approach is required when the called E.164 address length field (including prefixes and escape codes) is greater than 15 digits. PSPDNs/ISDNs will route calls by analyzing the appropriate digits (e.g. DCC, DNIC or PNIC).

Networks and terminals should where possible, evolve towards supporting the ToA/NPI address format/signalling protocol mechanisms in order to avoid the use of escape codes. It is recommended that the development of any new signalling protocols for Public Data Networks should not use the escape code mechanism as a means of number plan interworking.

NOTE – ITU-T Rec. E.164 formally discontinued the use of escape codes within the E.164 numbering plan as of 31 December 2000.

Interworking from a terminal on a PSPDN (numbered under X.121) to a terminal on an ISDN/PSTN numbered under the E.164 numbering plan can only be achieved by use of the X.121 escape code method in the calling PSPDN when the called address (including prefixes and escape codes) is not greater than 15 digits. The escape code method can be used to signal a 14-digit E.164 number if a prefix is not used or a 13-digit E.164 number if a prefix is used (see ITU-T Rec. X.122).

9.2.2 Significance of escape codes for routing

The presence of an escape code, 0 or 9, as defined in Table 2/X.121 will have special significance for PSPDN to ISDN and PSTN routing as follows:

i) a value of 0 for the escape code will require that the IDSE route the call either to a digital interface to an ISDN or to a transit IDSE (see Note);

ii) a value of 9 for the escape code will require that the IDSE route the call either to an analogue interface to a PSTN, an ISDN or to a transit IDSE (see Note).

NOTE – To select a route, an IDSE may choose to examine up to 5 digits (escape code and **first** four digits of E.164 number).

9.3 Number plan interworking for frame relay and ATM Networks

Specific details and procedures on numbering plan interworking between Public Frame Relay Data Networks and ATM networks for the E.164 and X.121 numbering plans are outlined in ITU-T Rec. X.124. Transit cases are considered in ITU-T Rec. X.124. Escape codes are not used within the Frame Relay (ITU-T Rec. X.36, ITU-T Rec. X.76) and ATM signalling protocols (ITU-T Rec. Q.2931) for the purposes of number plan interworking as these protocols utilize a ToN/NPI mechanism for number plan interworking.

9.4 The selection of links (e.g. satellite and/or submarine cable) for a given call route should be determined by the Networks concerned on a per call basis.

9.5 The same call route will be maintained for the duration of a call.

9.6 Barring procedures for particular call routes will be provided by each Network and will be the subject of bilateral agreement.

9.7 Transit networks will check routing information of each call to prevent circular routings.

10 Identification of IDSEs and ISDNs involved in an international call

Any Network involved in providing transit IDSE(s) or ISDN(s) for an international call should be identified at the time of the call establishment by means of a DNIC or 4-digit ISDN Identification Code allocated to that Network (see Notes 1, 2 and 3).

NOTE 1 – Exceptionally, a DNIC or ISDN Identification Code may need to be allocated to a network that would offer transit only and no direct subscriber access, for the purpose of identifying the transit ISDE(s) or ISDN(s).

NOTE 2 – For Networks numbered under X.121, the originating and destination networks are already identified within the calling and called DTE terminal addresses, and therefore do not require any additional identification at the time of the call establishment.

NOTE 3 – Public Frame Relay Data Networks may be numbered under either the X.121 or the E.164 numbering plan. Networks numbered under E.164 would not necessarily have a DNIC. A protocol specific mechanism has been defined with ITU-T Recs. X.36 and X.76 in order to uniquely identify specific Public Frame Relay Network numbered under E.164. These identifiers are known as an International Network Identification Code and are allocated according to procedures defined in ITU-T Rec. X.125. Use may be made of the International Network Identification Code for selecting a transit network.

There may be more than one IDSE provided by the same Network Operator. Several independently operated networks may be provided by the same Network Operator. Independently operated networks may need to be identified even when the same Network Operator is concerned. Two or more IDSEs provided within the same independently operated network should be identified by the same DNIC (see Note 4).

NOTE 4 – The provision of one DNIC, one International Network Identification Code for an E.164 Frame Relay Network or one ISDN Identification Code for a transit, independently operated network is considered to be sufficient for covering the international accounting requirements, and for avoiding unexpected loops of calls between independently operated networks. The identifications needed for tracing the exact path of a call for maintenance are outside the scope of this Recommendation.

11 Multiple IDSEs provided within one Country or Administration

11.1 In the originating or destination country

Since there is the possibility that a number of networks operators could provide data services within a single country, it is likely that multiple IDSEs could exist within a country. The use/provision of multiple originating and/or destination IDSEs could, in some cases, result in the routing of a call over a circuit between two IDSEs in the originating or destination country. Such circuits may be regarded as national links in applying the principles defined in this Recommendation.

11.2 In a transit country

Some Network Operators may find it desirable to route international transit traffic between two IDSEs located in their own country. Such circuits need not be counted as one of the four international links allowed in this Recommendation, but from a transmission point of view must be counted as an additional international circuit.

12 International routing plan

12.1 Network Operators may plan any traffic route providing it conforms to the principles in this Recommendation.

12.2 Since traffic routes can comprise direct and alternative routes, as a general principle individual call routes should use the minimum number of IDSEs.

12.3 Many combinations of call routes are possible, some examples of which are contained in Annex D.

12.4 Call rerouting can be planned if the required network management signals are available. An example of call rerouting is contained in Annex D.

13 Network information required to enable optimum routings to be planned

Network Operators should compile information concerning the quality of service parameters and network status of their networks for dissemination, on request, to those other interested Network Operators (or Administrations) who may wish to utilize it. These exchanges of information will enable Network Operators to make optimum routing decisions when planning networks. Annex C contains a typical list of information of the type that should be available.

Annex A

Terms and definitions related to routing in the PDN

This annex contains terms and definitions that will be utilized in the PDN routing plan. These terms and definitions are based, as far as possible, on the currently available documentation both with ITU-T and IEC (International Electrotechnical Commission, Chapter 701).

To aid understanding, Figure A.1 records the relationship between the terms traffic route, alternative traffic route, call route, originating IDSE (IDSE-O), destination IDSE (IDSE-D), transit IDSEs (IDSE-X and IDSE-Y).

A.1 traffic route: A predetermined sequence of *trunk circuits* that is used to carry traffic between two points.

A.2 alternative traffic route: Between two given points more than one *traffic route* may exist. The availability of the option of using one of several routes is referred to as alternative traffic route.

A.3 call route: The sequence of circuits that is used to provide a *connection* between two points.

A.4 call routing: The action taken by an exchange of selecting a given *call route* from a number of *traffic routes.*

A.5 call rerouting: The action of changing a proposed *call route* during the attempted establishment of a *connection.*

A.6 originating PDN: A set of equipment and/or circuits which enable connection of a calling DTE to the originating IDSE.

A.7 destination PDN: A set of equipment and/or circuits which enable connection of a destination IDSE to the called DTE.

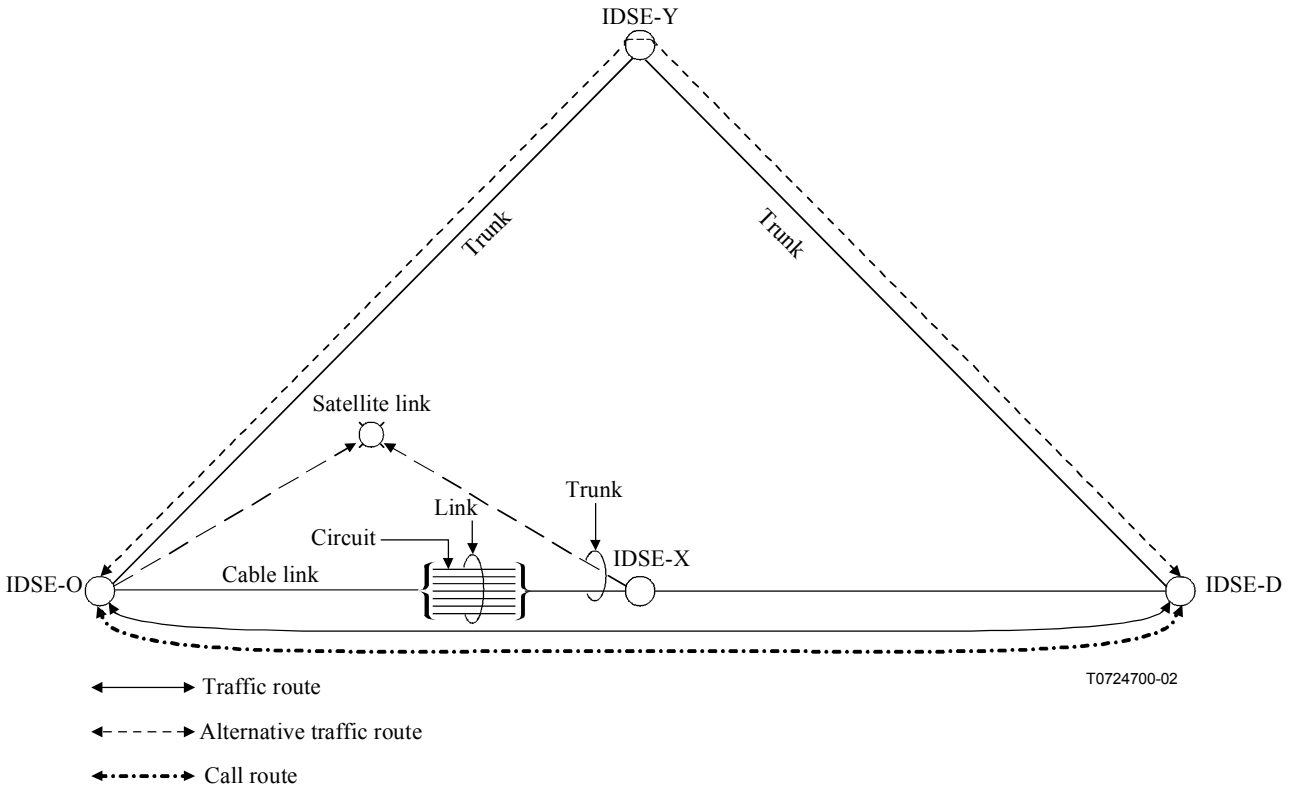


Figure A.1/X.110 – The network part of the International Public Data Network

Annex B

The use of satellite links in overall PDN routes

B.1 General considerations

1) When a satellite circuit is selected as the transmission path in an international connection, it should be noted that satellite circuits have some specific characteristics which need to be taken into account when used in PDNs.

2) It is allowed to include a satellite link in the transmission path of a national network part of an international connection, recognizing that, in some cases, subscriber access may only be available via national or regional satellite systems.

3) It should be noted that in the international maritime satellite system for data communication services, only satellite paths are available in each ocean region.

4) In the planning of international routes which may involve the use of satellites, consideration may also need to be given to the performance objectives as defined in the X.130 and X.140 series of Recommendations.

In considering the above, and in accordance with ITU-T Rec. X.92, the maximum number of satellite links allowed in an international connection, including both the international and the national network parts, should be three.

B.2 Principles in each PDN

B.2.1 Originating national PDN

In the planning of routes for international data connections, it is preferable to select routes which have a higher quality and minimum transfer delay for the national network part in the international connection. This would afford the maximum flexibility in the selection of the international links.

B.2.2 Originating/transit IDSEs

In accordance with ITU-T Rec. X.92, no more than two satellite links should be used in the international network part of the connection.

For calls to and from the maritime satellite data transmission system, no more than one satellite link should be used in the international network part of the connection.

B.2.3 Destination IDSE

If three satellite links have already been used in the connection so far, the use of a further satellite link in the destination Network to complete the call should only be allowed with the consent of the Networks concerned.

B.2.4 Destination national PDN

If three satellites have been used in establishing the international connection to the destination national network, a further satellite link should not be utilized except in the case where no other possible route is available to establish the call.

Annex C

Routing information

The following information is typical of that which may be exchanged by Networks Operators when negotiating bilateral agreements for the routing of traffic:

1) name of country and DNIC to which their IDSEs are connected, indicating 1, 2, 3 or 4 link connections;
2) number of circuits (or virtual connections) and speed of transmission on each transmission link using satellite or cable;
3) mode of working;
4) busy hour for each trunk and IDSE;
5) alternative traffic routes;
6) quality of service requirements;
7) facilities provided;
8) internetworking arrangements;
9) Transit traffic arrangements.

Annex D

International routing plan – Examples of routes

D.1 Introduction

Network Operators will wish to provide their routes in the most economical (both financial and technical) manner. Accordingly, when high volumes of traffic are forecast, a direct route with no intermediate IDSE will be planned. Whereas, routes with low traffic volumes may be more economically switched through one or more transit IDSEs. In addition, alternative routes will generally be provided over which the traffic will be carried when the direct route is unavailable due to either traffic congestion or equipment failure. Note, that in assessing expected traffic volumes it would be necessary to take into consideration both the static transmission and switching capacity and the dynamic utilization aspects of the route.

The general routing algorithm will normally be: high usage route (direct), alternative route 1, alternative route 2. Note, the depiction of two alternative routes is for example only. No limitation in the number of alternative routes should be inferred. Network Operators can make use of their agreed routes by offering them to third party. However, care should be taken to ensure that no routes planned in this way would involve inclusion of any more than 4 international links; that is the transit traffic should pass through a maximum of three intermediate ISDEs.

D.2 Examples of typical routes

Figures D.1 to D.9 depict some typical routes that Network Operators are likely to plan.

D.2.1 Direct route (high usage route)

Figure D.1/X.110 – Direct route

D.2.2 Routes via intermediate countries (low volumes of traffic)

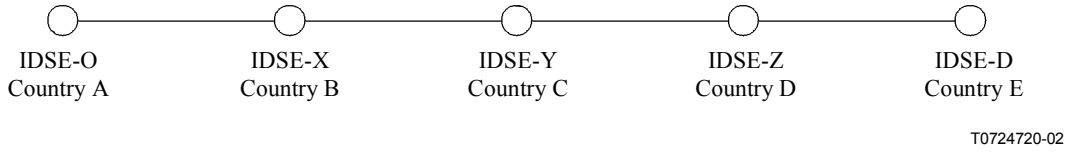
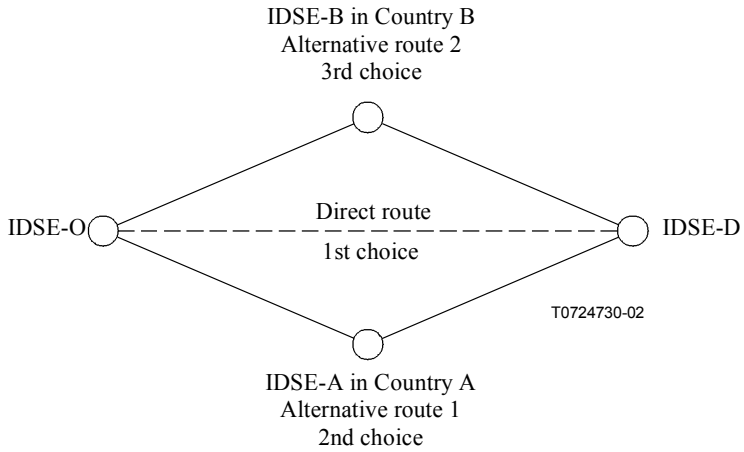


Figure D.2/X.110 – Limiting condition route via 3 intermediate IDSEs

D.2.3 Alternative route



NOTE 1 – Likely routing selection process:

– First choice – Direct route.
– Second choice – Alternative 1 via IDSE-A.
– Third choice – Alternative 2 via IDSE-B.

NOTE 2 – A similar routing algorithm may exist at intermediate IDSEs and care should be taken to ensure that the call is not routed using more than four links.

Figure D.3/X.110 – Alternative route

D.2.4 Routing plan in cases where direct routes are provisioned

Within the economic and political constraints of a country, the alternative routes should be selected with the following sequences for some particular connections.

The first alternative route selection would be made in the originating IDSE to one of the transit IDSEs which have direct routes to the destination IDSE (see Figure D.4). If this is not the case, selection will be made to the transit IDSE without a direct route to the destination.

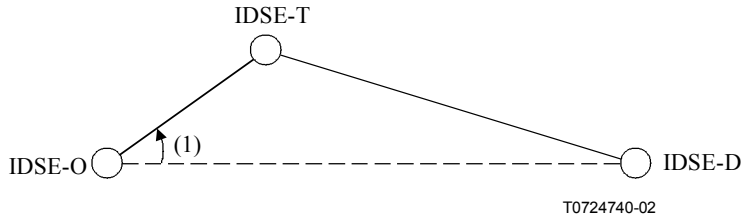


Figure D.4/X.110

The second alternative routing will be made in the first transit IDSE IDSE-T_1 to the second transit IDSE IDSE-T_2 with a direct route to the destination of this connection (see Figure D.5).

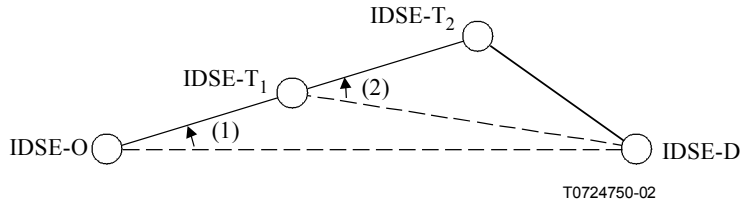


Figure D.5/X.110

The third alternative routing should be made in the same way, indicated in Figure D.6.

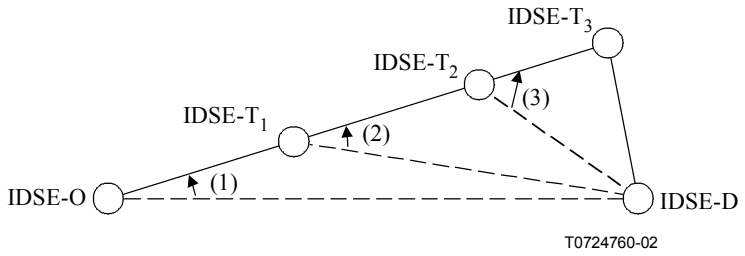


Figure D.6/X.110

D.2.5 Routing plan in cases where direct routes are not provisioned

In the case of traffic congestion between IDSE-O and IDSE-T_1, it is preferable to take another transit IDSE which has a direct route to the destination IDSE-D, if possible (see Figure D.7).

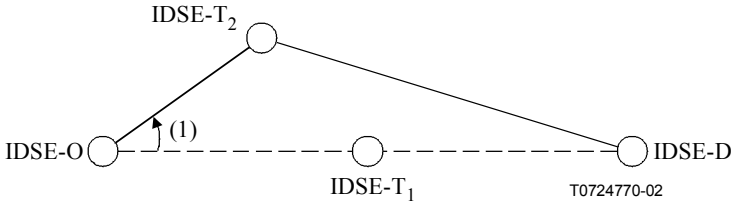


Figure D.7/X.110

If the originating IDSE-O must select a route to the transit IDSE-T_2 which has no direct route available to the destination IDSE-D, the subsequent transit IDSE may be the IDSE-T_1 (see Figure D.8) or IDSE-T_3 (see Figure D.9) if no direct route is available between IDSE-T_2 and IDSE-D.

The routing plan for the connection from IDSE-T_1 to IDSE-D would be the same as the plan indicated in D.2.4 above.

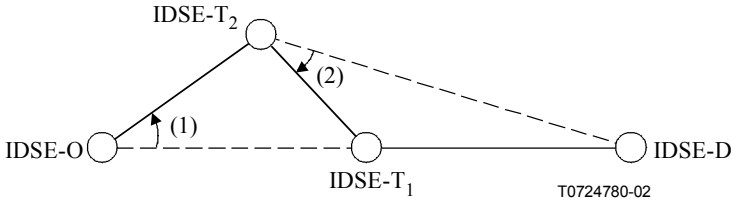


Figure D.8/X.110

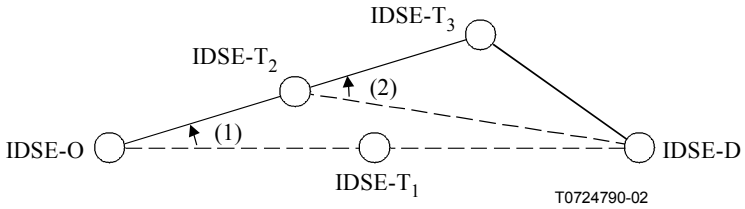
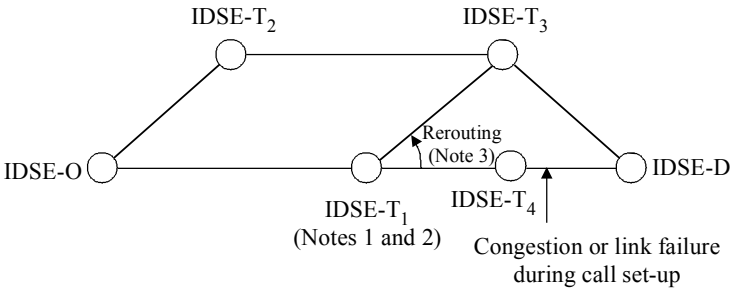


Figure D.9/X.110

D.3 Rerouting

The concept of rerouting considers calls that fail at an intermediate IDSE during call set-up. The details of call rerouting are likely to be network protocol dependent and are for further study; however, Figure D.10 records the concept.



NOTE 1 – Call attempt reaches IDSE-T_4.

NOTE 2 – Call fails due to congestion or link failure between IDSE-T_4 & IDSE-D.

NOTE 3 – Call rerouting is attempted via IDSE-T_1, IDSE-T_3 & IDSE-D.

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Figure D.10/X.110

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