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Second edition
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Information technology — Telecommunications and information exchange between systems — End System Routeing Information Exchange Protocol for use in conjunction with ISO/IEC 8878

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Technologies de l'information — Télécommunications et échange d'information entre systèmes — Protocole d'échange d'information pour le routage d'un système d'extrémité à utiliser conjointement avec l'ISO/CEI 8878

Reference number
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Contents

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ISO/IEC 10030:1995
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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

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International Standard ISO/IEC 10030 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 6, *Telecommunications and information exchange between systems*.

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This second edition cancels and replaces the first edition (ISO 10030:1990), which has been technically revised. It is a consolidation of Amendments 2 and 3 as well as Technical Corrigenda 1 and 2.

Annexes A and B form an integral part of this International Standard. Annex C is for information only.

Introduction

This International Standard is one of a number of standards concerned with Network Layer Routeing Protocols. An overall framework for routeing is described in ISO/IEC TR 9575. This International Standard specifically relates to that part of the framework which deals with Single Subnetwork Routeing.

This International Standard is related to ISO/IEC 8878 which specifies the use of X.25 to provide the ISO connection-mode Network Service. This Protocol provides solutions for the following practical problems:

a) How do End Systems discover the reachability of Intermediate Systems that can route NPDUs to destinations on subnetworks other than the one(s) to which the End System is directly connected?

b) How do End Systems discover the reachability of other End Systems on the same subnetwork (when direct examination of the destination NSAP address does not provide information about the destination subnetwork address)?

c) How does a Subnetwork Address Resolution Entity discover the reachability of End Systems on the subnetwork to which it is directly connected?

d) How does an end System, which has not been pre-configured with its own Network Address, request the temporary assignment of a Network Entity Title (NET) and thus, derive the necessary Network Address(es), from a SNARE located on a common subnetwork?

e) How do Intermediate systems discover the reachability of End Systems on the same subnetwork (when direct examination of the NSAP destination address does not provide information about the destination subnetwork address)?

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The Protocol assumes that:

a) Routeing to a specified subnetwork point of attachment (SNPA) address on the same subnetwork is carried out satisfactorily by the subnetwork itself.

b) The subnetwork is not, however, capable of routeing on a global basis using the NSAP address alone to achieve communication with a requested destination.

c) End Systems and Intermediate Systems using this protocol require to know at least one SNPA address that can be used to access a SNARE.

The protocol is designed to:

a) minimize the amount of a priori state information needed by End Systems before they can begin to communicate with other End Systems;

b) minimize the amount of memory needed to store routeing information in End Systems; and

c) minimize the computational complexity of End Systems routeing algorithms.

This Protocol performs similar functions to the ones specified in ISO 9542. However, the characteristics of environments operating ISO/IEC 8208 (X.25/PLP) and the actual functionality of ISO/IEC 8208 (X.25/PLP) in itself invalidate the operation of ISO 9542 as follows:

a) In general non-broadcast environments, the Configuration subset of ISO 9542 is inadequate.

b) In broadcast environments operating ISO/IEC 8208 (X.25/PLP), the Redirection subset of ISO 9542 is invalidated.

Therefore, this Protocol is developed to perform all the aforementioned functions in harmony with the operation of ISO/IEC 8208 (X.25/PLP).

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1 Scope

This International Standard defines a protocol for the exchange of routeing information between an End System and a Subnetwork Address Resolution Entity, and between an Intermediate System and a Subnetwork Address Resolution Entity.

This International Standard is applicable to:

a) End Systems which operate according to the main body of ISO/IEC 8878 to provide and support the OSI Connection-mode Network Service using ISO/IEC 8208.

b) Subnetwork Address Resolution Entities which operate ISO/IEC 8208.

NOTE — The Subnetwork Address Resolution Entity defined in this International Standard may be associated with relay functions as defined in ISO/IEC 10028 and ISO/IEC 10177.

c) Intermediate systems which operate ISO/IEC 8208.

End Systems which provide and support the OSI CONS using the fast select 1980 procedures or the alternative 1980 procedures in annex A of ISO/IEC 8878 are outside the scope of this International Standard.

This International Standard does not specify any protocol elements nor algorithms for facilitating routeing and relaying among SNAREs. Such functions are intentionally outside the scope of this International Standard.

To evaluate conformance of a particular implementation, it is necessary to have a statement of which capabilities and options have been implemented. Such a statement is called Protocol Implementation Conformance Statement (PICS), as defined in ISO/IEC 9646-1. This International Standard provides the PICS proforma in compliance with the relevant requirements, and in accordance with the relevant guidance, given in ISO 9646-7.

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2 Normative references

The following standards contain provisions which, through reference in the text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO/IEC 7498-1 : 1994, *Information technology — Open Systems Interconnection — Basic Reference Model — Part 1: The Basic Model.*

ISO/IEC 8208 : 1990, *Information technology — Data communications — X.25 Packet Layer Protocol for Data Terminal Equipment.*

ISO/IEC 8208 : 1990/Amd. 3 : 1991 *Information technology — Data communications — X.25 Packet Layer Protocol for Data Terminal Equipment — Amendment 3: Conformance requirements.*

ISO/IEC 8348 : 1993, *Information technology — Open Systems Interconnection — Network Service Definition.*

ISO 8648 : 1988, *Information processing systems — Open Systems Interconnection — Internal organization of the Network Layer.*

ISO 8802-2 : 1989, *Information processing systems — Local area networks — Part 2: Logical link control.*

ISO/IEC 8878 : 1992, *Information technology — Telecommunications and information exchange between systems — Use of X.25 to provide the OSI Connection-mode Network Service.*

ISO/IEC 8880-1 : 1990, *Information technology — Telecommunications and information exchange between systems — Protocol combinations to provide and support the OSI Network Service — Part 1: General principles.*

ISO/IEC 8880-2 : 1992, *Information technology — Telecommunications and information exchange between systems — Protocol combinations to provide and support the OSI Network Service — Part 2: Provision and support of the connection-mode Network Service.*

ISO/IEC 8881 : 1989, *Information processing systems — Data communications — Use of the X.25 packet level protocol in local area networks.*

ISO/IEC 8886 : 1992, *Information technology — Telecommunications and information exchange between systems — Data link service definition for Open Systems Interconnection.*

ISO 9542 : 1988, *Information processing systems — Telecommunications and information exchange between systems — End system to Intermediate system routeing exchange protocol for use in conjunction with the Protocol for providing the connectionless-mode network service (ISO 8473).*

ISO/IEC TR 9575 : 1990, *Information technology — Telecommunications and information exchange between systems — OSI Routeing Framework.*

ISO/IEC TR 9577 : 1993, *Information technology — Telecommunications and information exchange between systems — Protocol identification in the network layer.*

ISO/IEC 9646-1 : 1994, *Information technology — Open Systems Interconnection — Conformance testing methodology and framework — Part 1: General concepts.*

ISO/IEC 9646-7 : _______[1], *Information technology — Open Systems Interconnection — Conformance testing methodology and framework — Part 7: Implementation conformance statements.*

ISO/IEC 10028 : 1993, *Information technology — Telecommunications and information exchange between systems — Definition of the relaying functions of a Network layer intermediate system.*

ISO/IEC 10039 : 1991, *Information technology — Open Systems Interconnection — Local area networks — Medium Access Control (MAC) service definition.*

ISO/IEC 10177 : 1993, *Information technology — Telecommunications and information exchange between systems — Provision of the connection-mode Network internal layer service by intermediate systems using ISO/IEC 8208, the X.25 Packet Layer Protocol.*

ISO/IEC TR 10178 : 1992, *Information technology — Telecommunications and information exchange between systems — The structure and coding of Logical Link Control addresses in Local Area Networks.*

3 Definitions

3.1 Reference Model Definitions

This International Standard makes use of the following terms defined in ISO/IEC 7498-1:

a) Network Layer
b) Network Service Access Point
c) Network Service Access Point address
d) Network Entity
e) Routeing
f) Network Protocol
g) Network Relay
h) Network Protocol Data Unit

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3.2 Network Layer Architecture Definitions

This International Standard makes use of the following terms defined in ISO 8648:

a) Subnetwork
b) End System
c) Intermediate System
d) Subnetwork Service
e) Subnetwork Access Protocol

3.3 Network Layer Addressing Definitions

This International Standard makes use of the following terms defined in ISO/IEC 8348:

a) Network Entity Titles
b) Subnetwork address
c) Subnetwork Point of Attachment

3.4 Local Area Network Definitions

This international Standard makes use of the following terms defined in ISO 8802-2:

a) Multicast address
b) Broadcast address

3.5 Additional Definitions

For the purposes of the International Standard, the following definitions apply:

3.5.1 configuration information: Information about the collection of End Systems and Intermediate Systems attached to a subnetwork defined in

1. To be published.

terms of the system types, Network Addresses present, Network Entity Titles present, and the correspondence between systems, SNPA addresses, and potential routes.

3.5.2 redirection information: Information supplied when a Call Request fails to achieve establishment of a Network Connection, indicating an SNPA which could be used to establish such a connection.

3.5.3 subnetwork address resolution entity: Supplier of information concerning routeing within a single subnetwork.

3.6 PICS Definitions

This International Standard makes use of the following terms defined in ISO/IEC 9646-7.

a) Protocol Implementation Conformance Statement (PICS)
b) PICS proforma

4 Abbreviations

4.1 Systems

DTE	Data Terminal Equipment
ES	End System
IS	Intermediate System
SNARE	Subnetwork Address Resolution Entity

4.2 Protocol Data Units

ECQ PDU	End/Intermediate System Configuration Query Protocol Data Unit
ENC PDU	End/Intermediate System Notification Complete Protocol Data Unit
ERA PDU	End System Request Address Protocol Data Unit
ESC PDU	End/Intermediate System Connect Protocol Data Unit
ESH PDU	End/Intermediate System Hello Protocol Data Unit
RD PDU	Redirect Protocol Data Unit
SAA PDU	SNARE Assign Address Protocol Data Unit
SCC PDU	SNARE Configuration Complete Protocol Data Unit
SCR PDU	SNARE Configuration Response Protocol Data Unit
SHL PDU	SNARE Hello Protocol Data Unit
SNC PDU	SNARE Notification Complete Protocol Data Unit
SRH PDU	SNARE Request Hello Protocol Data Unit
SRN PDU	SNARE Received Notification Protocol Data Unit

NOTE — The name of the PDU should not be construed as implying a definition of the PDU's function. For example an ECQ PDU can be transmitted by an IS.

4.3 Miscellaneous

BCD	Binary Coded Decimal
LLC	Logical Link Control
MAC	Medium Access Control
NA	Network Address
NPDU	Network Protocol Data Unit
QOS	Quality of Service
SNPA	Subnetwork Point of Attachment

5 Overview of the Protocol

The protocol specified in this International Standard comprises two subsets:

a) The Configuration Information subset
b) The Redirection Information subset

The functions of the Configuration Information subset are:

a) To enable ESs to notify a SNARE of the existence and reachability of their Network Addresses (NAs).
b) To enable ESs to discover, for certain remote NAs, the SNPA addresses of systems on the subnetwork via which communications may potentially be routed.
c) To enable ESs to obtain their own Network Addresses without manual intervention.
d) To enable ISs to obtain, for NAs identifying NSAPs located within End Systems directly attached to the same subnetwork, the SNPA address of these systems.

The function of the Redirection Information subset is to enable ESs which are attempting to establish a connection to be directed to a specific appropriate SNPA address via which the connection should be routed and to permit ISs which are attempting to establish a connection to an ES on the subnetwork to be directed to the appropriate SNPA address via which the connection can be established.

The two subsets are complementary in that the information obtained from the Redirection Information subset implicitly carries associated Configuration Information, and in that the information obtained from the Configuration Information subset may be used to derive a suitable SNPA address and so avoid the need for use of the Redirection Information subset. The choice of which subset to use to obtain Routeing Information for any individual instance of communication is a local ES or IS decision, which may be different for different instances of communication and may be varied freely during ES or IS operation without impacting the ability to interwork.

5.1 The SNARE Function

A SNARE is an entity which collects configuration information from ESs, and which distributes

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configuration and redirection information to them.

The SNARE also distributes configuration and redirection information to the ISs.

NOTE — A SNARE may also interact with Intermediate Systems for the purpose of collecting configuration information but the details of such interactions are outside the scope of this International Standard.

The function of a SNARE may be carried out by one or more ESs or ISs attached to the subnetwork. Where the subnetwork is one which itself acts on the X.25 protocol, it is also possible that some or all of the SNARE operations may be performed by functions integrated with the subnetwork itself.

In order for an ES (or IS) to use this protocol, it requires knowledge of at least one SNPA address which can be used to access a SNARE. In general, this address is pre-configured in the ESs (or ISs). Annex A describes techniques which may be used in certain circumstances to avoid the need for such pre-configuration.

5.2 Overview of Configuration Information

The protocol exchanges which constitute the Configuration Information subset begin with the ES establishing an X.25 connection to a SNARE by issuing an X.25 Call Request. The first octet of the call user data contains a protocol identifier indicating the protocol defined in this International Standard. When the SNARE accepts the call, the ES may then transmit to the SNARE details of its Network Addresses. Once the information concerning all of its Network Addresses is transmitted the ES explicitly notifies the SNARE that the notification is complete so that the SNARE can ensure that all the information received is secure to the extent required for its use. Optionally, following acceptance of the call by the SNARE, a non-configured End System may request a NET for itself. Once it obtains this information it may derive additional Network addresses for subsequent interactions with other End Systems. However, it is not necessary or even permitted for an End System to use a NET obtained in this manner indefinitely. The ES may also request information about remote Network Addresses. For each requested Network Address the SNARE supplies details of the SNPA or SNPAs on the subnetwork via which the Network Address can be reached, and the associated potential Quality of Service. Having received information about one Network Address, the ES can request information about another. When it has all the information it requires, the ES clears the call.

An IS also may request information about Network Addresses. In the present context this request will strictly take place within the realm of Single Network Routeing, as defined in ISO/TR 9575, and is thus hierarchically placed under any IS-IS routeing activity. Therefore this request can only occur for Network Addresses corresponding to End Systems directly attached to the subnetwork. However, this protocol contains no provisions to ensure that this is so, and relies instead on the processes effected above it in the routeing hierarchy.

The protocol exchanges begin with the IS establishing an X.25 connection to a SNARE by issuing an X.25 Call Request. When the SNARE accepts the call, the IS may request information about one or several Network Addresses. For each requested Network Address the SNARE supplies details of the SNPA (or SNPAs) of the system at which the Network Address resides. Having received information about one Network Address, the IS can request information about another. When it has all the information it requires, the IS clears the call."

5.3 Overview of Redirection Information

The redirection information functions can be considered as two parts.

The first part takes place when an ES (or IS) is about to establish a Network Connection according to ISO/IEC 8878, but does not have the information necessary to determine the appropriate subnetwork address to which the Call Request should be transmitted. The action of the ES (or IS) in this case is simply to use the address of a SNARE. The Call Request packet is constructed exactly in accordance with ISO/IEC 8878 and is transmitted to the SNARE.

The ES (or IS) subsequently continues to operate the connection in accordance with ISO/IEC 8878. In the event that the SNARE is an ES or IS attached to the subnetwork, rather than having functionality integrated with the subnetwork itself, it may:

— use the X.25 Call Deflection facility to deflect the call to an appropriate ES or IS;

— clear the call, supplying information about the appropriate SNPA which should be used for future attempts; or

— if it contains relay functions, accept the call itself and take part in the connection as a relay.

If the SNARE function is integrated with the subnetwork itself, then in addition to the above it may be able to deliver the call to an appropriate SNPA by other means which are outside the scope of this International Standard (for example, by invoking the X.25 Call Redirection facility).

Since, therefore, the connection establishment may now be going to proceed satisfactorily without the originating ES (or IS) doing any further routeing operations, the ES (or IS) continues to process the Network Connection in accordance with ISO/IEC 8878 unless a Clear Indication is received.

Receipt of a Clear Indication in response to a Call Request causes the second part of the redirection information procedure to take place. At this point, provided the cause and diagnostic codes in the clear indication packet show that the disconnection was not initiated by the Network Service user, the ES (or IS) checks whether there is user data in the packet containing information encoded according to this International Standard indicating an appropriate

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subnetwork address via which a Network Connection equivalent to that being rejected could be established. An equivalent Network Connection is one between the same NSAPs with the same Quality of Service parameters. The ES (or IS) may use this information either to retry the connection establishment, according to the provisions of ISO/IEC 8878, or in establishing future equivalent network connections.

6 Conformance

6.1 Static Conformance Requirements

An ES for which conformance to this International Standard is claimed shall implement one or more of the following:

a) The procedures of the system Configuration Information Subset, specified in clause 8, that apply to an ES.

b) The procedures of the system Redirection Information Subset, specified in clause 9, that apply to an ES.

An IS for which conformance to this International Standard is claimed shall implement one or more of the following:

a) The procedures of the system Configuration Information Subset, specified in clause 8, that apply to an IS, in particular 8.2.3.3.

b) The procedures of the system Redirection Information Subset, specified in clause 9, that apply to an IS.

A SNARE for which conformance to this International Standard is claimed shall implement those procedures which clause 11 prescribes as requirements.

NOTE — Therefore a SNARE is required to process both Configuration and Redirection Information.

6.2 Dynamic Conformance Requirements

A system for which conformance to this International Standard is claimed shall exhibit external behavior consistent with having implemented:

a) for each supported function, the corresponding procedures and the encoding of any transmitted Protocol Data Units, as specified in the relevant subclauses of clauses 8, 9, 10, 11 and 12;

b) the X.25 Packet Layer Protocol in conformance with the requirements of ISO/IEC 8208 Amd. 3, and in conformance with the procedures invoked by ISO 8880 for the relevant environment.

7 SNARE Subnetwork Address

The use of this protocol requires an ES (or an IS) to be aware of at least one subnetwork address at which a SNARE can be reached. Local methods may be provided for determining such an address; alternate methods described in Annex A may be used where they are available.

In the event that an ES is aware of more than one SNPA at which a SNARE can be reached, the choice between them is a local matter.

8 Configuration Information Subset

8.1 Protocol Parameters

This clause defines parameters used in this protocol and, where applicable, specifies which values of these parameters are required to be supported by all conforming end systems. The ability to support values other than those specifically required, and the means of identifying that such a value is to be used in any particular instance, are local matters.

8.1.1 Response Time

This is the time limit used by an ES (or IS) during operation of the protocol.

Any implementation of the Configuration Information subset shall be capable of supporting a response time value of 180 s, accurate to within ± 30 s.

8.1.2 Notification Retry Time

This is the time interval at which an ES shall retry a failed attempt to convey its configuration to a SNARE.

Any implementation of the Configuration Information subset shall be capable of supporting a Notification Retry Time value of 900 s, accurate to within ± 120 s, if it supports any values of the Notification Required parameter other than that which indicates that notification is never required and that which indicates that no specific value is being suggested.

NOTE — There are no requirements on the support of Notification Retry Time by an implementation which does not support such values of the Notification Required parameter.

8.1.3 Notification Required

This parameter indicates the circumstances in which an ES shall attempt to notify its configuration to a SNARE.

Any implementation of the Configuration Information subset shall be capable of supporting a value of this parameter which indicates that notification is never required.

NOTE — Examples of other Notification Required parameter values which might optionally be supported include:

- A value indicating that notification is required each time the ES is initialized and subsequently at the expiry of the time specified by the SNARE at the end of each preceding notification.
- A value indicating that notification is required each time the ES is attached to a different subnetwork.

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It is emphasized that these are only examples — other values are permitted.

8.1.4 Address Holding Time

This is the time for which the End System may continue to use an NET that has been assigned to it by the SNARE.

8.2 Protocol Operation

This clause specifies the protocol making use of the X.25 Packet Layer Procedures specified in ISO/IEC 8208. Subject to the provisions of ISO/IEC 8208, the choice of values for X.25 fields which are not specified in this clause is a local matter.

8.2.1 Connection Establishment

An ES (or an IS) shall attempt to establish a connection whenever it needs to obtain configuration information from a SNARE. In addition, an ES shall attempt to establish connection to a SNARE when conditions specified in 8.1.3 make it necessary to notify configuration information to a SNARE. The ES shall attempt to establish a connection to a SNARE when it needs to obtain a NET when initially connecting to the subnetwork or upon expiration of the Address Holding Time value. However, neither an ES nor an IS shall attempt to establish a connection that have already a connection established or being established for the use for configuration information, and neither an ES nor an IS shall attempt to establish more than one connection to SNAREs from any one one system SNPA at any one time.

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ISO/IEC 10030:1995
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An ES (or an IS) shall attempt to establish a connection to the SNARE by originating a virtual call in accordance with the procedures for virtual call setup specified in ISO/IEC 8208. The SNPA address to which the Call Request shall be transmitted shall be one applicable to the SNARE, as described in clause 7. The Fast Select facility shall be specified, indicating no restriction on response. The User Data to be transmitted with the Call Request packet shall contain an ESC PDU.

If the virtual call setup procedure succeeds, the ES (or IS) shall examine the User Data received with the Call Connected packet.

If this contains a valid SNC PDU, then the ES (or IS) shall proceed to perform data transfer as specified in 8.2.3. Otherwise the ES (or IS) shall clear the call according to the procedures for virtual call clearing specified in ISO/IEC 8208 using a cause code of 0 and a diagnostic code of 242, and shall then act according to the procedure for failed connection establishment in 8.2.2.

If the virtual call setup procedure fails, the ES (or IS) may retry it provided that the failure was due to a cause which, if it occurred in an attempt to establish a Network Service connection, would have been interpreted according to ISO/IEC 8878 as "connection rejection — transient condition". However, attempts to retry shall not continue for longer than the value of the Response Time parameter. When it has finished retrying, the ES (or IS) shall proceed as specified in 8.2.2.

8.2.2 Connection Establishment Failure Procedure

When an attempt to establish a connection fails, if the ES (or IS) has knowledge of any alternative SNARE subnetwork address, it shall attempt to establish a connection to one which it has not previously tried in this establishment attempt.

When all known SNARE addresses have been tried unsuccessfully:

a) If the ES (or IS) needed to obtain Configuration Information from the SNARE, the time at which a further attempt is made (if any) or the invocation of other forms of action (e.g., fallback to default configuration, or use of Redirection subset as a basis for routeing) is a local matter.

b) If according to the provisions of 8.1.3 the ES was due to notify its configuration to a SNARE, the attempt at notification shall be considered to have failed. Another attempt shall be made after the expiry of the Notification Retry Time.

c) If the ES needed to obtain a NET, the time at which a further attempt is made (if any) is a local matter.

8.2.3 Data Transfer Procedure

This clause specifies the transfer of data once an acceptable connection to a SNARE has been achieved.

This clause requires transmission of a number of PDUs. Each PDU shall be transmitted as a single M-bit sequence without the Q-bit set, according to the procedures for data transfer specified in ISO/IEC 8208.

This clause also requires, in some circumstances, that the connection be abandonded before completion. This shall be done by clearing the call according to the procedures for virtual call clearing specified in ISO/IEC 8208, using a cause code of 0 and a diagnostic code of 242.

In the event that the virtual call is cleared (whether by the ES (or IS) itself abandoning the connection according to the provisions of this International Standard, or as a consequence of the operation of ISO/IEC 8208 procedures) before the normal completion of the data transfer procedure specified in this clause, the ES shall follow the procedure for failed connection specified in 8.2.4.

In the event that a Reset Indication, an Interrupt packet, or Q-bit data is received at any time during the operation of the data transfer procedure, the ES (or IS) shall abandon the connection.

The data transfer procedure consists of 3 parts -- address assignment, configuration notification and