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INTERWORKING BETWEEN NETWORKS: GENERAL

DESCRIPTION OF THE GENERAL ARRANGEMENTS FOR CALL CONTROL WITHIN A SUBNETWORK AND BETWEEN SUBNETWORKS FOR THE PROVISION OF DATA TRANSMISSION SERVICES

ITU-T Recommendation X.301

(Previously "CCITT Recommendation")

FOREWORD

The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of the International Telecommunication Union. The 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 Conference (WTSC), which meets every four years, established the topics for study by the ITU-T Study Groups which, in their turn, produce Recommendations on these topics.

ITU-T Recommendation X.301 was revised by the ITU-T Study Group VII (1988-1993) and was approved by the WTSC (Helsinki, March 1-12, 1993).

NOTES

1 As a consequence of a reform process within the International Telecommunication Union (ITU), the CCITT ceased to exist as of 28 February 1993. In its place, the ITU Telecommunication Standardization Sector (ITU-T) was created as of 1 March 1993. Similarly, in this reform process, the CCIR and the IFRB have been replaced by the Radiocommunication Sector.

In order not to delay publication of this Recommendation, no change has been made in the text to references containing the acronyms "CCITT, CCIR, or IFRB" or their associated entities such as Plenary Assembly, Secretariat, etc. Future editions of this Recommendation will contain the proper terminology related to the new ITU structure.

2 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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DESCRIPTION OF THE GENERAL ARRANGEMENTS FOR CALL CONTROL WITHIN A SUBNETWORK AND BETWEEN SUBNETWORKS FOR THE PROVISION OF DATA TRANSMISSION SERVICES

(Formerly Part of Recommendation X.300, Malaga-Torremolinos, 1984; amended at Melbourne, 1988 and Helsinki, 1993)

The CCITT,

considering

(a) that Recommendation X.1 defines the international user classes of service, in and the different categories of access to, public data networks and ISDN;

(b) that Recommendation X.2 defines the international user services and facilities in PDNs and ISDN;

(c) that Recommendation X.96 defines call progress signals including those used in conjunction with international user facilities;

(d) that Recommendations X.20, X.20 *bis*, X.21, X.21 *bis*, X.25, X.28, X.29, X.32, X.351 and X.352 already specify the detailed procedures applicable to different types of DTE/DCE interfaces on PDNs and that Recommendations X.30, X.31, I.420 and I.421 specify detailed procedures applicable for access to ISDN;

(e) that Recommendations X.61, X.70, X.71 and X.75 already specify the detailed procedures applicable to call control between two PDNs on the same type and that Recommendation X.75 can also be applied for interworking between different PDNs and for interworking involving ISDN;

(f) that PDNs and ISDNs may be used to support CCITT recommended services (in particular, Telematic services);

(g) that Recommendation X.200 specifies the reference model of open systems interconnection for CCITT applications;

(h) that Recommendation X.213 defines the connection-mode network service (NS) of open systems interconnection for CCITT applications;

(i) that Recommendations X.130, X.131, X.134, X.135, X.136, X.137 and X.140 define the quality of service parameters and values required for public data transmission services;

(j) that Recommendation X.300 defines the general principles for interworking between public networks and between public networks and other networks for the provision of data transmission services;

(k) that Recommendation X.302 describes the general arrangements for internal network utilities within subnetwork and intermediate utilities between subnetworks for the provision of data transmission services;

(l) that interworking with common channel signalling network (CCSN) needs to be considered, in view of the requirements for transferring operational information between Administrations;

(m) the need that DTEs can communicate through different networks, and through different interworking conditions between networks;

(n) the need for arrangements for interworking between public networks and between public networks and other public networks for the provision of data transmission services;

(o) the need, in particular:

- for certain user facilities and network utilities for communication through the national networks between the internationally designed data terminal equipment interface protocols and international inter-exchange control and signalling procedures;
- for certain internationally defined network utilities for international operation of public networks;
- for compatibility and uniformity in the principle for realization of international user facilities and network utilities in public networks,

unanimously recommends

that arrangements for call control interworking between public networks and between public networks and other networks, and that the necessary elements:

- for realization of interworking between different networks providing data transmission service, and
- for realization of international user facilities and network utilities for data transmission services,

be in accordance with the principles and procedures specified in this Recommendation.

Introduction

This Recommendation is one of a set of Recommendations produced to facilitate consideration of interworking between networks. It is related to Recommendation X.300, which defines the general principles for interworking between public networks, and between public networks and other networks for the provision of data transmission services. Recommendation X.300 indicates, in particular, how collections of physical equipment can be considered as "subnetworks" for consideration of interworking situations.

This Recommendation describes general arrangements for call control within and between subnetworks for the provision of data transmission services. Only those arrangements are described that may (also) have significance for end users of a call. Facilities that are not visible to end users of a call are the subject of other Recommendations (e.g. those arrangements described in Recommendation X.302).

1 Scope and field of application

The purpose of this Recommendation is to describe detailed internetwork arrangements for call control applicable to interworking at the OSI network layer, including some of the arrangements necessary to provide support for the capability of the OSI connection-mode NS.

These arrangements are not applicable to interworking involving communication capability as described in 7.2/X.300.

It is for further study whether or not any of these arrangements are also applicable to other types of interworking, for example interworking by port access as described in Recommendation X.300.

Arrangements that are solely used for internal or internetwork operation, and which are not visible for end-users, are not described in this Recommendation. For such arrangements, see Recommendation X.302.

2 References

The following 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; all 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 Recommendations is regularly published.

E.164/I.331 *The numbering plan for the ISDN era*.

I.230-Series *Bearer services supported by an ISDN.*

I.250-Series *Supplementary services supported by an ISDN.*

I.420 *Basic user-network interface.*

I.421 *Primary rate user-network interface.*

Q.699 *Interworking of Signalling Systems – Interworking between the Digital Subscriber Signalling System layer 3 protocol and the Signalling System No. 7 ISDN user part.*

Q.931/I.451 *ISDN user-network interface layer 3 specification for basic call control.*

X.1 *International user classes of service in and categories of access to public data networks and integrated services digital networks (ISDNs).*

X.2 *International data transmission services and optional user facilities in PDNs and ISDNs.*

X.20 *Interface between data terminal equipment (DTE) and data circuit-terminating equipment (DCE) for start-stop transmission services on PDNs.*

X.20 *bis* *Use on PDNs of DTE which is designed for interfacing to asynchronous duplex V-Series modems.*

X.21 *Interface between data terminal equipment (DTE) and data circuit-terminating equipment (DCE) for synchronous operation on PDNs.*

X.21 *bis* *Use on PDNs of DTE which is designed for interfacing to synchronous V-Series modems.*

X.22 *Multiplex DTE/DCE interface for user classes 3-6.*

X.25 *Interface between data terminal equipment (DTE) and data circuit-terminating equipment (DCE) for terminals operating in the packet-mode and connected to public data networks by dedicated circuit.*

X.28 *DTE/DCE interface for a start-stop mode DTE accessing the packet assembly/disassembly (PAD) facility in a PDN situated in the same country.*

X.29 *Procedures for the exchange of control information and user data between PAD facility and packet-mode DTE or another PAD.*

X.30/I.461 *Support of X.21, X.21 bis and X.20 bis based data terminal equipment (DTEs) by an integrated services digital network (ISDN).*

X.31/I.462 *Support of packet-mode terminal equipment by an ISDN.*

X.32 *Interface between data terminal equipment (DTE) and data circuit-terminating equipment (DCE) for terminals operating in the packet-mode and accessing a packet-switched public data network through a public switched telephone network or an integrated services digital network or a circuit-switched public data network.*

X.61 *Signalling System No. 7 – Data user part.*

X.70 *Terminal and transit control signalling system for start-stop services on international circuits between anisochronous data networks.*

X.71 *Decentralized terminal and transit control signalling system on international circuits between synchronous data networks.*

X.75 *Packet-switched signalling system between public networks providing data transmission services.*

X.80 *Interworking of inter-exchange signalling systems for circuit-switched data services.*

X.96 *Call progress signals in PDNs.*

X.110 *International routing principles and routing plan for public data networks.*

X.121 *International numbering plan for public data networks.*

X.130 *Call processing delays in public data networks when providing international synchronous circuit-switched data services.*

X.131 *Call blocking in public data networks when providing international synchronous circuit-switched data services.*

X.134 *Portion boundaries and packet layer reference events: basis for defining packet-switched performance parameters.*

X.135 *Speed of service (delay and throughput) performance values for public data networks when providing international packet-switched service.*

X.136 *Accuracy and dependability performance values for public data networks when providing international packet-switched service.*

X.137 *Availability performance values for public data networks when providing international packet-switched service.*

X.140 *General quality of service parameters for communication via PDNs.*

X.180 *Administrative arrangements for international closed user groups (CUGs).*

X.200 *Reference model for open systems interconnection for CCITT applications.*

X.213 *Network service definition for open systems interconnection for CCITT applications.*

X.300 *General principles for interworking between public networks, and between public networks and other networks for the provision of data transmission services.*

X.302 *Description of the general arrangements for internal network utilities within a subnetwork and intermediate utilities between subnetworks for the provision of data transmission services.*

X.351 *Special requirements to be met for packet assembly/disassembly facilities (PADs) located at or in association with coast earth stations in the public mobile satellite service.*

X.352 *Interworking between packet-switched public data networks and public maritime mobile satellite data transmission systems.*

3 Definitions

This Recommendation makes use of the following terms defined in Recommendation X.300:

a) Transmission capability.

b) Communication capability.

c) Data transmission service.

This Recommendation makes use of the following term defined in Recommendation X.135:

– Transit delay.

This Recommendation makes use of the following term defined in Recommendation X.140:

– User information transfer rate.

This Recommendation makes use of the following term defined in Fascicle I.3:

– Optional user facility.

4 Abbreviations

For the purpose of this Recommendation the following abbreviations are used:

BCUG	Bilateral closed user group
BCUGOA	Bilateral closed user group with outgoing access
CC	Country code
CSPDN	Circuit-switched public data network
CTD	Cumulative transit delay
CUG	Closed user group
DCC	Data country code
DCE	Data circuit-terminating equipment
DNIC	Data network identification code
DSE	Data switching exchange
DTE	Data terminating equipment
EETDN	End-to-end transit delay negotiation
FS	Further study
IA	Incoming access
IC	Interlock code
ICB	Incoming calls barred
ICCM	Interworking by call control mapping
IDSE	International data switching exchange
IPA	Interworking by port access
ISDN	Integrated services digital network
IWF	Interworking function
MATD	Maximum acceptable transit delay
MSS	Maritime satellite service
NA	Not applicable
NAE	Network address extension
NAPI/TOA	Numbering and addressing plan indicator/Type of address (equivalent to NPI/TOA used in X.25)
NC	Network connection
NDC	National destination code
NPI/TOA	Numbering plan indicator/TOA (equivalent to NPI/TON used in Rec. Q.931)
NS	Network service (pertaining to OSI)
NTN	Network terminal number
NUI	Network user identification

OA	Outgoing access
OCB	Outgoing calls barred
OSI	Open systems interconnection
PSDN	Packet-switched data network
PSPDN	Packet-switched public data network
PSTN	Public-switched telephone network
QOS	Quality of service
QRP	QOS reference point
ROA	Recognized operating agency
SN	Subscriber number
TDI	Transit delay indication
TDS	Transit delay selection
TDSAI	Transit delay selection and indication
TOA	Type of address
TTD	Target transit delay

5 General aspects of call control

The internetwork arrangements described in this clause relate to the general aspects of call control.

5.1 Model applicable to internetwork arrangements

The internetwork arrangements for call control are established according to the model illustrated in Figures 5-1 and 5-2.

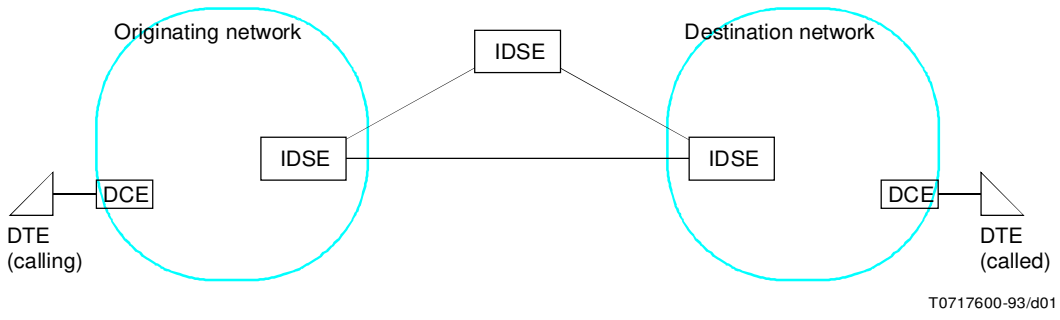


FIGURE 5-1/X.301

Model for call establishment

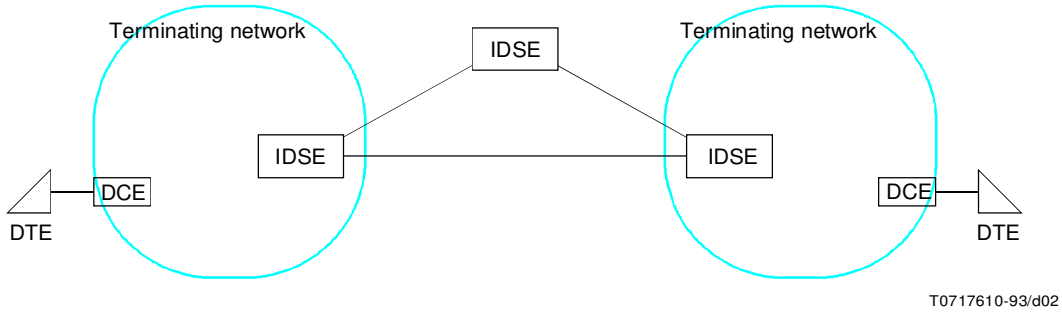


FIGURE 5-2/X.301

Model for data transfer and call clearing phases

5.2 Classification of internetwork signals

Recommendations dealing with internetwork signalling systems describe various signals that can be classified as follows:

5.2.1 Internetwork data link control signals

Data link control signals (e.g. availability of physical circuit(s)) are related to the particularly considered data link and therefore are normally confined within the two ends of the link itself. Thus, these signals do not normally pass across the interworking function.

An exception to this may be when, for example, a large number of data links in a network are unavailable or faulty, so as to prejudge routing of the calls from an interconnected network. In this case, appropriate operational signals may be generated towards the interconnected network to the extent allowed by the signalling arrangements provided in the interconnected network.

NOTES

1 A given data link may convey signalling data and/or user data.

2 Between two packet switching networks, Recommendation X.75 indicates that a given data link may employ several physical circuits.

5.2.2 Internetwork call control signals

This type of signal includes all signals that convey between two networks the appropriate data and control information for a given call. These signals are essentially related to:

– call establishment;

– data transfer;

– call release.

NOTES

1 Some signals are essential for call establishment, for example: DTE addresses, indications for user facilities whenever required, and call progress signals. These signals are subject to general descriptions in the relevant Recommendations (for example, DTE addresses in Recommendation X.121, call progress signals in Recommendation X.96). Also, the way to convey these signals between two networks is described in the Recommendations dealing with the internetwork signalling systems.

2 Some internetwork signalling systems specify that all call control signals employ a unique data link; this is the case in the signalling system defined in Recommendation X.75. Some other internetwork signalling systems specify that the call control signals employ more than one data link; this is the case in the common channel signalling system, where both a signalling channel and a data channel are used for the same call.

5.2.3 Internetwork operation signals

This type of signal would consist of all signals that are not directly related to the control of a specific data link or a specific call between two networks; these operation signals would provide the necessary general information for a satisfactory operation of the internetwork connections such as:

- system availability;
- circuit efficiency;
- congestion or failure conditions, etc.

NOTES

1 The transmission of some internetwork operation signals may cause a network to modify general rules applying to the network operation, such as: change in routing scheme, control of data flow when applicable, clearing of some calls, etc.

2 The transmission of such internetwork operation signals does not prevent networks from processing some of these signals used for internetwork operation. In particular, a network may wish to note the exact circumstances of a call clearing related to a remote network failure, in order to take necessary actions as soon as possible (change in routing scheme, etc.).

5.3 General principles concerning internetwork signals

This subclause describes some general principles that could be used as a basic for the interworking between different types of networks.

5.3.1 Basic status of a data link

On every data link established in a network, the data link control signals should provide both ends with the capability of controlling at any time the status of the link. In particular, each end should be able to know whether or not the data link is fully operational; in the case the data link is not fully operational whether or not it is still available for additional data transmission signals related to existing call(s), signals related to new call(s); also whether or not existing call(s) should be cleared (or reset), due to that data link problem.

NOTE – Following that principle, provision should be made within the appropriate internetwork signalling Recommendations, so that each network could be aware of the status of the links in an interconnected network whenever required.

5.3.2 Call request and call confirmation phases

The establishment of a call between two subscribers should consist of two consecutive phases:

a) first a CALL REQUEST phase, when:
   - a call is requested by a subscriber, with specific parameters;
   - this call request is processed and routed through the network(s), unless it cannot be accepted by the network(s);
   - the call request is indicated to the called subscriber;

b) then a CALL CONFIRMATION phase, when:
   - a call acceptance is reported by the called subscriber, unless this subscriber does not accept the call;
   - final arrangements are made through the network(s) for that call;
   - the call establishment is confirmed to the calling subscriber.

NOTES

1 During each one of those two phases, the various actions are not necessarily carried on separately. For example, network equipment may process some call request signals received from a subscriber, before further parameters for the call request are transmitted by that subscriber.

2 Currently, the establishment of a call through certain combinations of networks necessitates more than the two phases mentioned in this subclause; for example, when accessing a packet switching network from a circuit switched network, the complete establishment of the switched access is usually required before the virtual call can be requested. Following the principle indicated in this subclause, provision should be made within the appropriate internetwork signalling Recommendations, for the establishment of direct calls between both end users whenever it is possible. Consequently, provision should also be made within the numbering plan so that a subscriber line could be directly and uniquely identified from any network.

3 The way to accept and route a call through different networks may depend not only on the called DTE address, but also on parameters or facilities defined for that call. Following the principle indicated in this subclause, in the case where some parameters or facilities may require negotiation during the call establishment:

– the calling DTE can only indicate its specific requirements for the call when it requests the call;

– the called DTE can only modify the call characteristics when it accepts the call.

5.3.3 Data transfer phase

Different types of networks may provide different functionalities in this phase, e.g. transfer capabilities of continuous bit streams, transfer of blocks of data, and features like flow control, sequencing, error notification, reset services, receipt confirmation and expedited data transfer.

5.3.4 Call clearing phase

Any network or user involved in a call should have the possibility to clear immediately that call.

At the time a call is cleared, any network involved in the call would immediately stop transmitting user data for the call, and report the call clearing to the adjacent networks, unless they are already informed of that clearing. The clearing signal should then be transmitted with all necessary details, i.e. cause and diagnostic codes.

As soon as a call clearing is locally completed any resource used for that call can be re-used by the network for other calls.

NOTES

1 Following that principle, the receipt of a clear confirmation does not necessarily mean that the end user was already informed of the clearing, and confirmed it.

2 The call clearing principle indicated in this subclause does not prevent both users from exchanging end-to-end information about the clearing of the call, if they wish to do so at the end of data transfer (example: invitation to clear data packet in Recommendation X.29).

3 In some cases of clearing collisions, for example when both a DTE and a network initiate the Call Clearing Phase simultaneously, parameter information provided by the DTE may be lost.

For the purpose of this Recommendation, a DTE that initiates the Call Clearing Phase is labelled “Clearing DTE”. A DTE that does not initiate the Call Clearing Phase, but is informed of this phase by the network, is labelled “Cleared DTE”.

6 Transfer of addressing information

The internetwork arrangements described in this clause provide the capability to transfer all elements of addressing information for the provision of data transmission services. This comprises addressing information defined in Recommendation E.164, Recommendation X.121 and any additional addressing information defined at the Network Layer of OSI. Table 6-1 lists the optional user facilities relating to addressing information described in this clause.

TABLE 6-1/X.301

Optional user facilities relating to the transfer of addressing informations

Optional user facility	Period of time	Applies per call	Applies to circuit switched data transmission service			Applies to packet switched data transmission service		
			PSTN	CSPDN	ISDN	ISDN	PSPDN	MSS
Calling line identification	X			X	FS			
Called line identification	X	X (Note)		X	FS			
Network address extension (NAE)/ sub-address		X			FS	X	X	X
NOTE – This facility cannot be used unless the corresponding facility has been agreed for a period of time.								

6.1 General

For the provision of data transmission services, different numbering plans are considered. These are the Recommendation X.121 numbering plan and the Recommendation E.164 numbering plan. Currently Recommendation X.121 is used by PDNs and Recommendation E.164 is used by the telephony network ISDN Recommendation E.164 will be used by ISDNs. Because of this, this subclause will refer to networks that make use of X.121 numbering as an X.121 domain (PDNs) and networks that make use of E.164 as an E.164 domain (ISDNs).

For interworking between X.121 domains and E.164 domains, some indication is needed in the protocol of the numbering plan of the address present in the address protocol element(s). This indication can take the form of an escape associated directly with the address or a protocol element indication separate from the address protocol element. This latter method will be referred to as a Numbering Plan Indicator/Type of Address (NPI/TOA) in which case the domains can be considered as one combined domain. The actual value of the escape in PDNs and ISDNs is defined in X.121 and X.122/E.166. The form of the NPI/TOA depends on the actual network access protocol used.

It should be noted that no indication of address type or numbering plan is needed if the call is contained solely within one numbering plan domain. Some networks may require the indication to be present at all cases.

The model shown in Figure 6-1 is used to describe internetwork arrangements for the treatment of address information conveyance.

In the figure the following cases terms are used:

a) international data number: DNIC + NTN or DCC + NN, as defined in Recommendation X.121;

b) international X.121 format: case a), or Escape + other international number, as defined in Recommendation X.121;

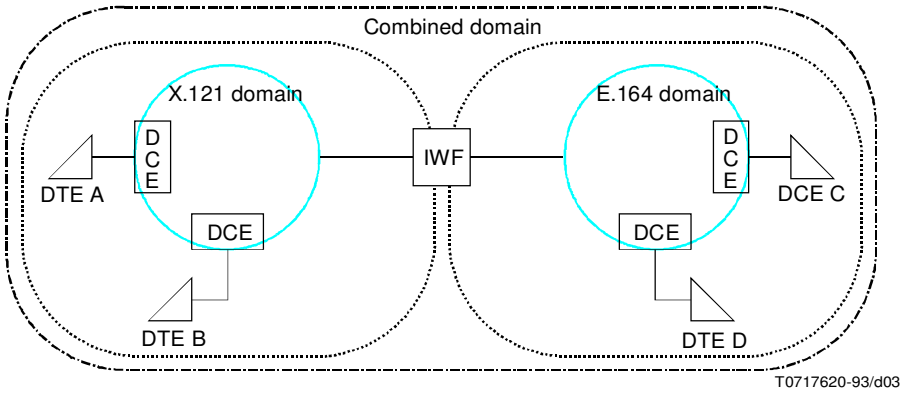
c) X.121 formats: Prefix (if any) + case b), or other national format;

d) E.164 international number: CC + N(S)N, as defined in Recommendation E.164;

e) international E.164 format: case d) or Escape + other international number;

f) E.164 format: prefix (if any) + case e), or other national format;

g) combined domain address: the domain is determined by NPI/TOA.



NOTE – This figure is a functional domain diagram and is not intended to imply a real internetwork implementation.

Direction	Form of address	Extent of validity	Case Term
A to B	NTN	Network	c)
A to B	P1 + NTN	Network	c)
A to B	DNIC + NTN	Internetwork	a)
A to B	P2 + DNIC + NTN	Internetwork	c)
A to B	[NPI/TOA] + NTN	Network	g)
A to B	[NPI/TOA] + DNIC + NTN	Internetwork	g)
C to D	SN	Network	f)
C to D	P3 + SN	Network	f)
C to D	CC + N(S)N	Internetwork	d)
C to D	P4 + CC + N(S)N	Internetwork	f)
C to D	[NPI/TOA] + SN	Network	g)
C to D	[NPI/TOA] + CC + N(S)N	Internetwork	g)
A to C	E1 + CC + N(S)N	Internetwork escape to Recommendation E.164	b)
A to C	P5 + E1 + CC + N(S)N	Internetwork escape to Recommendation E.164	c)
A to C	[NPI/TOA] + CC + N(S)N	Internetwork	g)
C to A	E2 + DNIC + NTN	Internetwork escape to Recommendation X.121	e)
C to A	P6 + E2 + DNIC + NTN	Internetwork escape to Recommendation X.121	f)
C to A	[NPI/TOA] + DNIC + NTN	Internetwork	g)

NOTES

1 Refer to 6.6 for more details on an X.121 address.

2 Refer to 6.7 for more details on an E.164 address.

3 Prefixes are indicated by P. P1, P2, P3 and P4 are distinct decimal digits. P5 may or may not be equal to P2. P6 may or may not be equal to P4. The use and form of the prefix is a national matter. Prefixes are not passed over internetwork gateways.

4 DNIC can also be replaced by DCC as appropriate.

5 The form of the NPI/TOA depends on the actual network access protocol used.

6 E1 and E2 indicate escape codes internationally standardized that function as an indication that the digits behind the escape are from a different numbering plan. Prefixes may or may not precede the escape code.

7 For protocol elements used, see Appendix I to this Recommendation.

FIGURE 6-1/X.301

Address forms for the Call Establishment Phase

6.2 Transfer of X.121 calling address

This subclause describes arrangements for the transfer of calling address information defined in Recommendation X.121 through PDNs and ISDNs. Such information is referred to in this subclause as the "X.121 calling address". In this subclause, it is assumed that the originating network is a PDN (X.121 domain).

6.2.1 Transfer during call request phase

The X.121 calling address shall be provided by the originating PDN. In some cases this will occur automatically, and in others it will be provided only when requested by the destination PDN. The originating PDN is responsible for the accuracy of the X.121 calling address when it is provided.

However, the following particular situations occur:

In some cases of interworking with an E.164 domain, a method of indicating that the calling address is an X.121 address must be employed. This shall be done either by using a standardized escape code to indicate an X.121 address follows or by some form of NPI/TOA indicating the calling address is an X.121 address.

In some cases, even where the transfer of the X.121 calling address is technically possible, there may be administrative reasons why the identity of the calling user, and therefore the X.121 calling address related to it, cannot be passed over an international boundary. In such a case, the identification of the originating network shall be provided instead of the X.121 calling address.

Networks other than PDNs and ISDNs, whenever they are used in conjunction with the PDN for offering data transmission services, should, if possible, provide for the transfer of an X.121 calling address. However, this transfer is not technically possible through some current networks; for example, for a call passing through a PSTN, into a PDN, the telephone network is not always able to indicate the X.121 calling address to the data network. In such a case, information transferred through the PDN instead of the X.121 calling address is for further study.

In the circuit switched service in CSPDNs, the X.121 calling address can be transferred as the calling line identification. It is transferred to the called DTE only if the called DTE is a subscriber to the *calling line identification* facility (see 6.2.4).

In packet switched service in PSPDNs, ISDNs, and in the circuit-switched data transmission service in ISDNs, the X.121 calling address is transferred to the called DTE in the address field (appropriate to the relevant protocol) signalled to the called DTE (see Appendix I to this Recommendation).

6.2.2 Transfer during call confirmation phase

Provided the route for the call is selected during the call request phase, the X.121 calling address does not need to be transferred back through the PDNs and ISDNs during the call confirmation phase.

6.2.3 Transfer during other phases of the call

The X.121 calling address may not need to be transferred through the PDNs during any other phase of the call.

6.2.4 Calling line identification

6.2.4.1 General

Calling line identification is an optional user facility, standardized for circuit-switched data transmission services on a CSPDN, that enables a user to be informed of the identity of the calling user for incoming calls. When provided, the facility applies to all incoming calls.

Calling line identification is an optional user facility assigned to the user for an agreed contractual period.

The calling line identity is the X.121 data number of the calling user. For international calls, the identity is the complete X.121 international data number including the DNIC or DCC component as applicable.

NOTE – The implications of a possible combination of *calling line identification* and the *bilateral closed user group* facility are for further study.

Information indicating that a user has the *calling line identification* facility is stored at the exchange to which the user is connected. The identity sent to the called user is originating under control of the exchange to which the calling user is connected.

Facility registration is controlled by the Administration or Recognized Operating Agency (ROA).

6.2.4.2 Call establishment procedure

The procedure for a call to a user having the *calling line identification* facility varies depending on whether the calling line identity is included in the initial call control information received by the destination exchange at call establishment.

a) In the case where the calling line identity is included in the call control information received by the destination exchange, this identity is sent to the called user in accordance with the applicable DTE/DCE interface protocol.

b) In the case where the calling line identity is not included in the call control information received by the destination exchange, it sends a request for identification towards the originating exchange.

   i) In the case where the originating network does provide the *calling line identification* facility, the originating exchange responds with the calling line which is forwarded by the destination exchange to the called user in accordance with the applicable DTE/DCE interface protocol.

   ii) In the case where the originating network does not provide the *calling line identification* facility, the originating exchange responds with the originating network identity (see Recommendation X.302). In this case, the identification sent by the destination exchange to the called user is in accordance with the applicable DTE/DCE interface protocol.

The destination exchange must not connect through until the identity has been completely sent to the called user. Also, in the case where decentralized signalling is used, transit exchanges have to delay through-connection in certain situations until a possible identification has been completed in accordance with the applicable interexchange signalling procedures (see Recommendations X.70 and X.71).

6.3 Transfer of E.164 calling address

This subclause describes arrangements for the transfer of calling address information defined in Recommendation E.164.

6.3.1 Transfer during call request phase

The E.164 calling address shall be provided by the originating E.164 network for data-mode calls, when calling line identification is provided. The originating E.164 network is responsible for validating the E.164 calling address, when provided. In the case where the calling address is conveyed transparent for the E.164 network (e.g. part access), such validation, if any, will be done outside the E.164 network.

However, the following particular situations occur:

In case of interworking with a non-E.164 network, a method of indicating that the calling address is an E.164 address must be employed. This shall be done either by using a standardized escape code to indicate an E.164 address follows or by some form of NPI/TOA indicating the calling address is an E.164 address.

In some cases, even where the transfer of the E.164 calling address is technically possible, there may be administrative reasons why the identity of the calling user, and therefore the E.164 calling address related to it, cannot be passed over an international boundary. In such a case, the procedures are for further study.

Networks other than PDNs and ISDNs, whenever they are used in conjunction with the PDN and ISDN for offering data transmission services, should, if possible, provide for the transfer of E.164 calling address. However, this transfer may not be technically possible through some current networks; for example, for a call passing through a PSTN, into a PDN or ISDN, the telephone network is not always able to indicate the E.164 calling address to the E.164 network. In such a case, alternate calling address information transferred through the PDN or ISDN instead of the E.164 calling address is for further study.

In a PDN or ISDN, the E.164 calling address can be transferred to the called DTE in calling address field (appropriate to the relevant protocol) signalling to the called DTE (see Appendix I).

NOTE – Not all DTEs will be able to accept the TOA/NPI address format that will be required for full E.164 addresses in post Time "T". The calling address could not be delivered to such DTEs.

In an ISDN, the E.164 calling address is transferred to the called DTE primarily in the calling DTE address field signalled to the called DTE. It can also be transferred in a duplicate manner using notification procedures in the calling party number information element contained in the Q.931 SETUP message sent to the called party across the D-Channel (see Recommendation X.31). In this case, the calling party number information element must be so coded as to indicate that the calling address is an E.164 address.

NOTE – Not all DTEs will be able to accept the TOA/NPI address format that will be required for full E.164 addresses in post Time "T". The calling address could not be delivered to such DTEs.

6.4 Transfer of X.121 called address

This subclause describes arrangements for the transfer of called address information defined in Recommendation X.121 through PDNs and ISDNs. Such information is referred to in this subclause as the "X.121 called address".

NOTE – The X.121 called address resides only on a PDN.

6.4.1 Transfer during call request phase

As it is essential for the purposes of call establishment, including routing, the X.121 called address is systematically transferred through the PDNs and ISDNs during the call request phase.

6.4.2 Transfer during call confirmation phase

The destination network does not need to provide the X.121 called address (or called line identity) if not requested. When provided, the destination PDN is responsible for validating the X.121 called address.

However, the following particular situations occur:

In the circuit switched data transmission service in CSPDNs, the X.121 called address can be transferred to the calling DTE as the called line identity. It is transferred if the calling DTE requests the *called line identification* facility (see 6.4.4). If the call has been redirected or if a *hunt group* facility has been invoked in the destination PDN, the address of the called DTE/DCE interface over which the call is established shall be transferred.

In PSPDNs and ISDNs, the X.121 called address can be transferred to the calling DTE. In the case of *call redirection* facility, the address of the called DTE/DCE interface over which the call is established is always transferred. In the case of *hunt group* facility, this address is always transferred, if a specific address has been assigned to the individual DTE/DCE interface over which the call is established.

6.4.3 Transfer during other phases of the call

The X.121 called address does not need to be transferred through the network during any other phase of the call.

However, the following particular situation occurs:

In the packet switched data transmission service, a clear request issued by a DTE, to which a call has been redirected or distributed among a hunt group as a direct response to the call request phase, should contain the address of the DTE/DCE interface. This is mandatory in the *hunt group* facility case only if specific addresses have been assigned to the individual DTE/DCE interfaces of the hunt group. When this clear request is destined for an E.164 network, some method of indicating this in an X.121 number must be used (see 6.1).

6.4.4 Called line identification

6.4.4.1 General

Called line identification is a user facility, standardized for circuit-switched data transmission services on a CSPDN, that enables a user to be informed for outgoing calls of the identity of the user to which the call has been connected. When provided, the facility applies to all outgoing calls.

It is an optional user facility assigned to the user for an agreed contractual period.

The called line identification is the X.121 data number of the user to which the call has been connected. For international calls, the identity is the complete X.121 international data number including the DNIC or DCC component as applicable.

Information indicating that a user has the *called line identification* facility is stored at the exchange to which the user is connected. The identity sent to the calling user is originated under control of the exchange to which the called user is connected.

6.4.4.2 Call establishment procedures

In the case of a call from a user having the *called line identification* facility, the call control information forwarded by the originating exchange at call establishment includes a request for called line identification. The procedure then depends on whether or not the destination network provides the facility.

a) In the case where the destination network does provide the *called line identification* facility, the destination exchange responds with the called line identity, which is returned by the originating exchange to the calling user in accordance with applicable DTE/DCE interface protocol.

b) In the case where the destination network does not provide the *called line identification* facility, the destination network responds, depending on what type of signalling is used, with the destination network identity (Recommendation X.302) or with a “dummy” identification (Recommendation X.70 or X.71). The information sent by the originating exchange to the calling user is in accordance with the applicable DTE/DCE interface protocol.

For circuit switched calls, the originating exchange must not connect through until the identity has been completely sent to the called user. Also, in the case where decentralized signalling is used, transit exchanges have to delay through-connection in certain situations until a possible identification has been completed in accordance with the applicable interexchange signalling procedures (see Recommendations X.70 and X.71).

6.5 Transfer of E.164 called address

This subclause describes the arrangements for the transfer of called address information defined in Recommendation E.164.

6.5.1 Transfer during call request phase

As it is essential for the purposes of call establishment, including routing, the E.164 called address is systematically transferred through the PDNs and ISDNs during the call request phase.

However, the following particular situation occurs:

In the case of interworking with a non-E.164 network where the transit network is a PDN, a method of indicating that the called address is an E.164 address must be employed. This shall be done either by using a standardized escape digit to indicate an E.164 address follows or by some form of NPI/TOA indicating the called address is an E.164 address.

6.5.2 Transfer during call confirmation phase

The destination network does not need to provide the E.164 called address (or called line identity) if not requested. When provided, the destination network is responsible for validating the E.164 called address.

However, the following particular situation occurs:

In PDNs and ISDNs, the E.164 called address can be transferred to the calling DTE as the called line identification. In the case of *call re-direction* facility, the address of the called DTE/DCE interface over which the call is established is always transferred. In the case of the *hunt group* facility, this address is always transferred, if a specific address has been assigned to the individual DTE/DCE interface over which the call is established.

NOTE – Not all DTEs will be able to accept the TOA/NPI address format that will be required for full E.164 addresses in post Time "T". The calling address could not be delivered to such DTEs.

6.5.3 Transfer during other phases of the call

The E.164 called address does not need to be transferred through the network during any other phase of the call.

However, the following particular situation occurs:

In the packet switched data transmission service, a clear request issued by a DTE, to which a call has been redirected or distributed among a hunt group as a direct response to the call request phase, should contain the address of the DTE/DCE interface. This is mandatory in the *hunt group* facility case only if specific addresses have been assigned to the individual DTE/DCE interfaces of the hunt group. When this clear request is destined for an X.121 network, some method of indicating this in an E.164 number must be used (see 6.1).

6.6 Format of X.121 addresses

Subclause 6.1 describes the different cases for the format of X.121 addresses.

Address information defined in Recommendation X.121 is referred to in this subclause as the "X.121 address".

Whenever an X.121 address has to be conveyed across a DTE/DCE interface or an IDSE X/Y interface, according to the requirements mentioned in this Recommendation, this transfer should be done according to the following principles:

For international calls, the X.121 address shall be given explicitly in the form of the complete international data number including the DNIC or DCC component as applicable.

The exact format of an address signal may not necessarily be the same nationally. Such a format is a matter for specific arrangement at each interface involved in the call: calling DTE/DCE interface, called DTE/DCE interface and interexchange interfaces.

For example, on an X.21 or X.25 interface, the same address may be represented in either one of the ways illustrated in a) or b) and/or c) or d) and/or e) of Figure 6-2.

This example illustrates the use of a prefix, as recognized in Recommendation X.121, as one way to distinguish between different formats of the same address.

In the case of mobile services, a conversion between different address formats may be required at various interfaces throughout the network, for roaming subscribers.

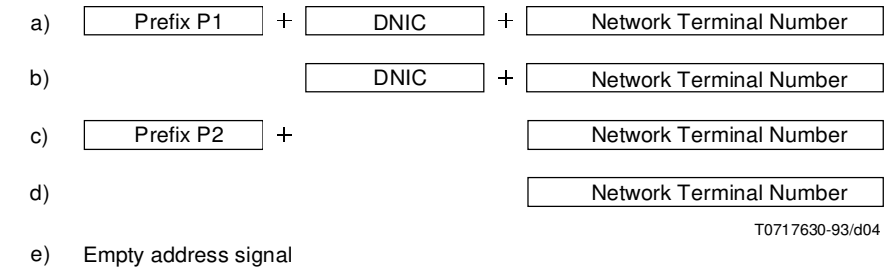
NOTE – A roaming mobile subscriber is a subscriber who may obtain fully automatic connections, even when he moves out of his normal area of operation.

The specific format(s) that can be used at a given interface are defined in the appropriate Recommendations dealing with the interface.

6.7 Format of E.164 addresses

Subclause 6.1 describes the different cases for the format of E.164 addresses.

Address information defined in Recommendation E.164 is referred to in this subclause as the "E.164 address".



NOTES
1 P1 and P2 are distinct decimal digits.
2 Case e) would only occur when the address is already known on the other side of the interface, e.g. at a DTE/DCE interface for the address corresponding to that DTE/DCE interface.
3 For cases b) and d), the prefix information could be indicated in an NPI/TOA element.

FIGURE 6-2/X.301

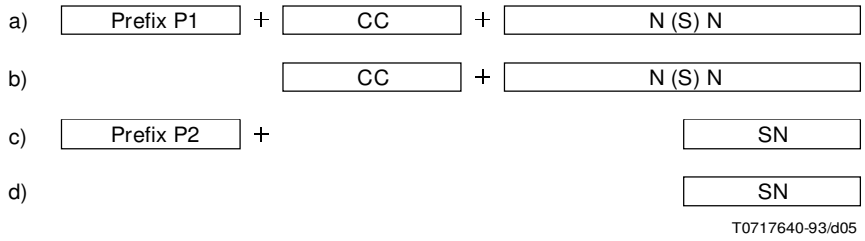
Examples of possible address combinations at the X.21 or X.25 DTE/DCE interface

Whenever an E.164 address has to be conveyed across a network/user interface or an interexchange interface, according to the requirements mentioned in this Recommendation, this transfer should be done according to the following principles:

For internetwork calls, the E.164 address shall be given explicitly in the form of the complete international subscriber number including the CC and N(S)N.

The exact coding (format) of an address signal may not necessarily be the same nationally. Such a format is a matter for specific arrangement at each interface involved in the call: calling network/user interface, called network/user interface and interexchange interfaces.

For example, on an ISDN interface, the same address may be represented in either one of the ways illustrated in a) or b) and/or c) or d) of Figure 6-3.



NOTES
1 P1 and P2 are distinct decimal digits.
2 For cases b) and d) the prefix information could be contained in NPI/TOA field.

FIGURE 6-3/X.301

Examples of possible address combinations at an ISDN S/T interface

This example illustrates the use of a prefix, as recognized in Recommendation E.164 as one way to distinguish between codings (or formats) of the same address.

The specific formats that can be used at a given interface are defined in the appropriate CCITT Recommendation dealing with that interface.

6.8 Transfer of address information additional to Recommendations X.121 and E.164

This subclause describes arrangements for the transfer of address information additional to that defined in Recommendations X.121 and E.164.

6.8.1 General

The Network Addressing Extension (NAE)/subaddress (see Note) mechanism allows the transfer through PDNs on a per call basis of addressing information beyond the total limit established for X.121/E.164 addresses. This mechanism is standardized for circuit and packet switching data transmission service as shown in Table 6-2.

TABLE 6-2/X.301

Optional user facilities standardized for different data transmission services, related to addressing information additional to Recommendations X.121 and E.164

Optional user facility	Period of time	Applies per call	Applies to circuit switched data transmission service			Applies to packet switched data transmission service		
			PSTN	CSPDN	ISDN	ISDN	PSPDN	MSS
Calling NAE/ sub-address		X			X	X	X	X
Called NAE/ sub-address		X			X	X	X	X

If sufficient space exists in the fields carrying X.121/E.164 address information, and an arrangement exists between users and networks concerned, this constitutes an alternative capability, available on a per call basis without requiring the NAE mechanism, for the transfer of addressing information additional to that defined in Recommendation X.121/E.164.

NOTE – Different terms exist: in general, NAE is used in X-Series Recommendations, and subaddress is used in I-Series Recommendations.

6.8.2 Realization

The detailed realization of the NAE mechanism at each type of internetwork and user interface is independently defined in the appropriate signalling and interface Recommendations.

6.8.3 Principles

The following principles apply equally and independently to both called and calling address information:

The transfer of addressing information at the OSI Network Layer additional to that defined in Recommendation X.121/E.164 is possible during any phase of the call in which address information defined in X.121/E.164 can also be transferred (see 6.1 and 6.7).

The addressing information in the NAE/subaddress can be of variable length. It can comprise up to 20 octets of binary coded information (see Note). The content of the information is unrestricted with respect to the grouping of digits.

NOTE – The maximum length of 40 decimal digits is derived from the maximum length of the OSI Network Service Access Point (NSAP) address defined in Recommendation X.213 [see also ISO 8348 AD2]. Exact arrangements for treatment of the OSI NSAP address are for further study.

Public networks are not required to look at or operate on an NAE/subaddress for any purpose including routing; however, some public networks may look at the NAE/subaddress, if they wish.

In cases where it is possible, and an arrangement exists between users and public networks concerned, the conveyance of the complete addressing information (i.e. all elements of OSI Network Addressing) may be performed without NAE/subaddress mechanism.

Each internetwork interface should simultaneously accommodate the following partitions of the addressing information between existing protocol elements for addressing and NAEs/subaddresses:

a) All elements of addressing information are contained in the existing protocol elements for addressing; no NAE/subaddress is needed; the complete DTE Network Address is contained in the existing protocol elements.

b) The complete DTE Address is contained in the NAE/subaddress; all elements of addressing information needed by the public networks involved in the call are contained in the existing protocol elements for addressing. The information used by public networks may be derived from the NAE/subaddress.

   NOTE – In this case, for some OSI Network Addresses, part of the OSI Network Address information may be duplicated in the existing protocol elements for addressing.

c) The addressing information is split into two elements, one contained in the existing protocol elements for addressing, the other contained in the NAE/subaddress. The complete DTE address is the concatenation of the two elements.

d) The addressing information is contained in the NAE/subaddress only. This case is typical for private networks since public networks act typically on X.121/E.164 numbers.

The use of the NAE/subaddress is either:

– as defined in Recommendation X.213 (see also ISO 8348 AD2); or

– differently.

When the use of the NAE/subaddress is as defined in Recommendation X.213 (see also ISO 8348 AD2), case c) in 6.8.3 does not apply.

7 Arrangements for user facilities (see Note 1)

The internetwork arrangements described in this clause relate to the optional user facilities defined in Recommendation X.2 and I.250-Series Recommendations (see Note 4).

NOTES

1 Different terms: in general *optional user facilities* is used in X-Series Recommendations, and *supplementary services* is used in I-Series Recommendations.

2 Support of these facilities by the ISDN in other modes of operation than packet-mode is for further study (see I.230-Series Recommendations).

3 General arrangements for treatment of registration procedures (e.g. Recommendation X.32) are for further study.

4 Alignment/interworking between facilities defined in X.2 and supplementary services defined in I.250-Series Recommendations is for further study.

Alphabetical list of facilities contained in this clause

Bilateral closed user group	7.6.2
Call deflection	7.5.1.2
Call redirection	7.5.1.1
Call redirection or deflection notification	7.5.1.4
Called line address modified notification	7.5.2
Charging information	7.4.3
Closed user group	7.6.1
Connect when free and waiting allowed	7.8.2
Fast select	7.7.2
Hunt group	7.5.3
Incoming calls barred	7.6.3
Internetwork call redirection or deflection	7.5.1.3
Local charging prevention	7.4.2
Manual answer	7.8.1
Network user identification (NUI)	7.6.5
NUI override	7.6.6
Outgoing calls barred	7.6.4
Receipt confirmation	7.8.3
Reverse charging and reverse charging acceptance	7.4.1
ROA selection	7.5.4
Throughput class negotiation	7.3.1
Transit delay selection and indication	7.2.1

7.1 Facilities related to the quality of service (QOS) for the call

This subclause describes arrangements required for quality of service related to the transmission capability.

7.1.1 Quality of OSI network service and of data transmission service

The term "Quality of Service" (QOS) refers to the specification of certain characteristics of a Network Connection (NC) as defined in the OSI network service (X.213). However, QOS can also be specified in relation to the data transmission service which is used to support the OSI network service. Each of these QOS specifications, and the relationship between them is described in the following subclauses.

7.1.1.1 QOS Specification in the OSI network service

The OSI network service including a detailed definition of QOS parameters is specified in Recommendation X.213. The reference points between which the QOS parameters apply are the network service access points (NSAPs).

The value of QOS applies to an entire NC. When determined or measured at both ends of an NC, the QOS observed by the NS users at the two ends of the NC is the same. This is true even in the case where the Network Connection is provided through the interworking of different types of networks.

Two interworking categories related to the transmission capabilities exist, i.e. interworking at the network layer, and interworking by port access. The reference point between which the QOS parameters apply are in both cases of interworking the two NSAPs involved (see Figures 7-1 and 7-2). However, the method of interworking may impact the value of QOS between the reference points.

The Transport Layer may make a request to the OSI network service provider for a network layer connection with certain QOS characteristics (e.g. in order to decide the class of transport protocol to be used). In response to such a request, the OSI network service provider may offer a network layer connection with QOS characteristics that meet (the margins of) the request, or the OSI network service provider may reject the request, if the QOS characteristics cannot be met.

The QOS Reference Points between which the QOS has to be measured for this instance of communication, are the NSAPs between which the network layer connection has to be established.

Recommendation X.224 (Transport Protocol) classifies network connections in terms of QOS with respect to error behaviour in relation to user requirements; its main purpose is to provide a basis for the decision regarding which class of transport protocol should be used on top of a given network connection.

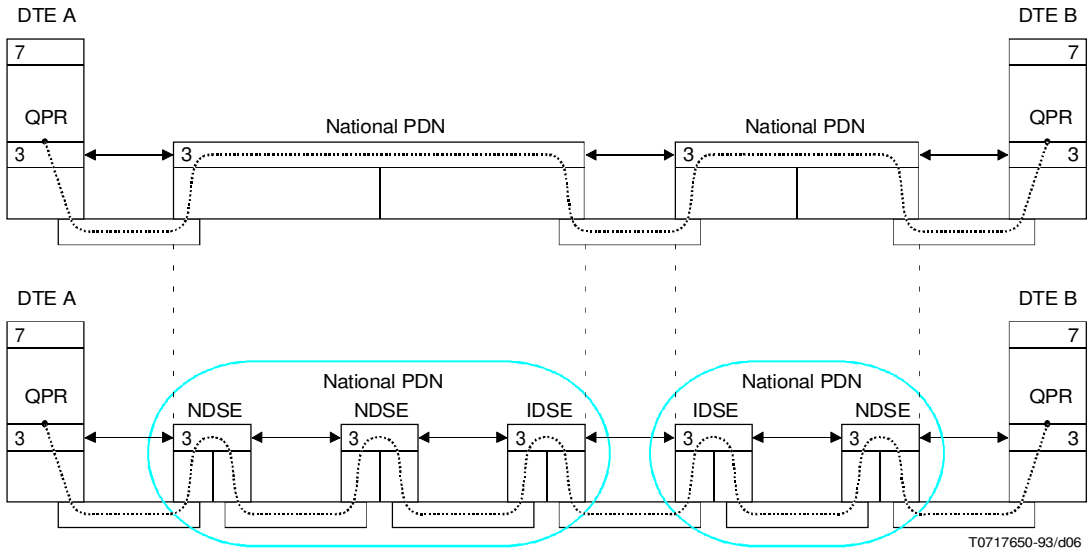


FIGURE 7-1/X.301

QOS Reference Points (QRPs) in an example of interworking at the network layer to provide the OSI connection-mode network service

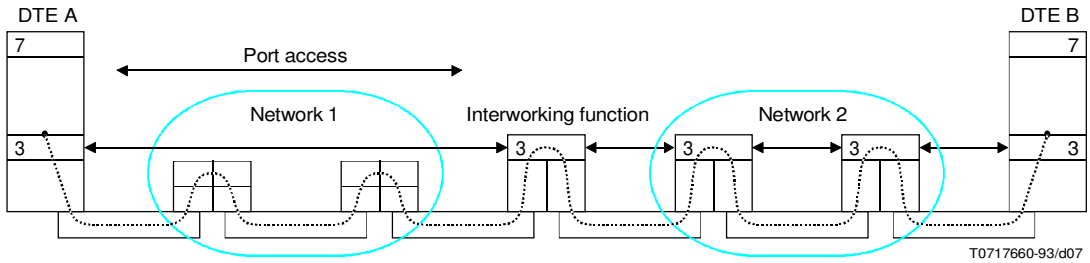


FIGURE 7-2/X.301

QOS Reference Points in an example of interworking by port access

7.1.1.2 QOS Specification in the data transmission service

Figure 7-3 illustrates an example of the data transmission service in the case where the data transmission service is provided by a public data network (PDN). The QOS parameters which are specified for the data transmission service can be specified in terms of event occurring within the network layer at the DTE/DCE interface. The QOS Reference Points are defined to be inside the network layer entities through which the PDN may be accessed (e.g. the DCEs) and where these network layer events are observed.

These reference points apply both to interworking at the network layer and to interworking by port access.

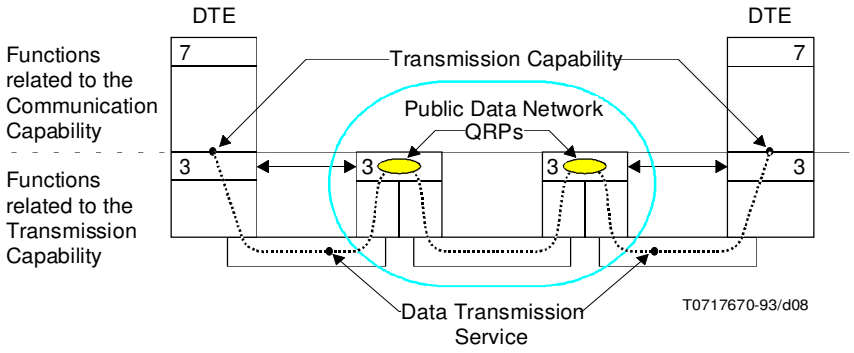


FIGURE 7-3/X.301

QOS Reference Points in an example of data transmission services offered by a PDN to participate in the provision of transmission capability

7.1.1.3 Relationship between QOS in OSI network service and data transmission service

Relationships between OSI network service QOS and data transmission service QOS is illustrated in Figure 7-4. The network service QOS includes a component which is the data transmission service QOS and also a component which is due to the operation of the network service provider outside the data transmission service (i.e. the network service provider between the data transmission service QRPs and the relevant NSAPs). The operation of the network service

provider outside the data transmission service may have the effect of either devaluing or improving the QOS depending upon the circumstances and the aspect of QOS involved. In any case, for an instance of communication, the QOS of the network service is different from the QOS of the data transmission service. The relationship between such QOS values is the responsibility of the network service provider outside the data transmission service.

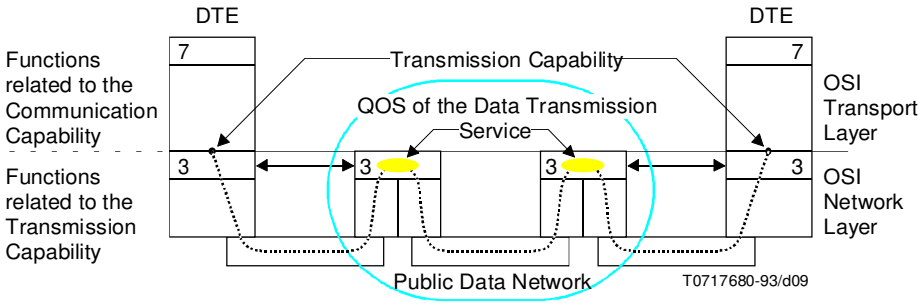


FIGURE 7-4/X.301

Relation of the QOS of the network service and data transmission service

7.1.2 QOS Parameters

7.1.2.1 OSI network service QOS Parameters

Network service QOS is described by means of QOS parameters. The definition of each parameter specifies the way in which the parameter's value is measured or determined, making reference where appropriate to the events represented by service primitives in the network service.

It is in terms of network service QOS parameters that information about QOS is exchanged among the network service provider and the NS users.

Examples of QOS parameters which are defined in the network service are throughput, transit delay, and residual error rate. Recommendation X.213 contains the definitions of the complete set of QOS parameters which apply to the network service.

7.1.2.1.1 QOS Parameter Values

In some circumstances, only a single value for a QOS parameter is conveyed (e.g. the target value desired by the network service user or the value being made available by the network service provider). In other cases however, it may be possible to specify a pair of values which define an applicable range of values (e.g. the network service user may be able to specify a range bounded by a target value which is desired and the minimum acceptable value which the user is willing to agree to). The number of values which may be conveyed is dependent upon the specific QOS parameter.

7.1.2.1.2 QOS Parameter Categories

The network service QOS parameters can be divided into two categories as follows:

1) parameters negotiated on a per-connection basis – the values of these parameters can be conveyed between peer NS users by means of the NS during the establishment phase of an NC; as part of this conveyance, a three-party negotiation among the NS users and the NS provider for the purpose of agreeing upon a particular QOS parameter value may take place; and

2) parameters not negotiated on a "per-connection" basis – the values of these parameters cannot be conveyed or negotiated among the NS users and the NS provider, for these QOS parameters, however, information about the values which is useful to the NS provider and each NS user may be made known by local means.

Only two QOS parameters of the NS, throughput and transit delay, are classified in the first category, and thus are conveyed and negotiated by means of the NS.

The negotiation procedures and constraints are described in Recommendation X.213. The mechanisms related to the negotiation of these parameters are described in 7.1.3.1.

All of the remaining QOS parameters are classified as belonging to the second category. The values of these QOS parameters for a particular NC are not negotiated in a three-party fashion nor are they directly conveyed from NS user to NS user. As a local matter, however, there may be means by which the values of one or more of these QOS parameters are known and utilized by the NS provider and each NS user.

The mechanisms related to this category of parameters are described in 7.1.3.2.

7.1.2.2 Data transmission service QOS Parameters

This subclause is for further study.

7.1.3 Mechanisms related to QOS

7.1.3.1 Types of mechanisms related to parameters negotiated on a per-connection basis

Three parties are involved in the specification of these QOS parameters:

a) the service user at the calling QOS reference point;

b) the service provider between the QOS reference points;

c) the service user at the called QOS reference point.

The service user at the calling QOS reference point will initiate these QOS parameters.

Both the service provider between the reference points and the service user at the called QOS reference point may devalue these QOS parameters according to their capabilities.

After possible subsequent devaluation, these QOS parameters will be returned to the service user at the calling QOS reference point without further adjustment.

The returned QOS parameters specify the QOS between the two QOS reference points.

NOTE – The guarantee of the QOS during the lifetime of the connection between the two QOS reference points is subject for further study.

7.1.3.2 Types of mechanisms related to parameters not negotiated on a per-connection basis

Determination of the value of these types of parameters occurs somewhere within the service provider but does not require that the values be negotiated between QRPs. Values of these parameters may be requested through the calling QRP by a service user. It is also possible that the service provider may convey indications of these values to the service user at the calling QRP, called QRP or both QRPs. Unlike the parameters negotiated on a per-connection basis, the values of these parameters are not subject to negotiation mechanisms as described in 7.1.3.1.

7.1.3.3 Minimum and target QOS parameters

The specification of QOS parameters (if present) always contains a target QOS value. In addition, this specification may contain a minimum QOS value.

For parameters negotiated on a per-connection basis, target QOS values are subject to negotiation rules specified in 7.1.3.1.

Minimum QOS values specify the least value the service user at the calling QOS reference point agrees to for establishment of a connection between the two QOS reference points. The minimum QOS value may be used by the service provider between the QOS reference points to abort the connection establishment, if the target QOS value is devalued to a value less than the minimum QOS value in the case of parameters negotiated on a per-connection basis.

NOTE – It is for further study whether the mechanism using minimum QOS parameters is a general applicable mechanism for all parameters.

7.1.3.4 Specific mechanisms related to QOS

Some mechanisms have already been defined that relate to the quality of service on a call (e.g. flow control parameters negotiation mechanism in Recommendations X.25 and X.75).

NOTE – It is for further study whether there is a need to introduce new user facilities to request a target quality of service for a call and new network utilities to control that target quality of service.

The optional user facilities already standardized for different data transmission services, and related to the QOS of the call, are shown in Table 7-1.

TABLE 7-1/X.301

Optional user facilities, standardized for different data transmission services, related to the QOS of the call

Optional user facility	Period of time	Applies per call	Applies to circuit switched data transmission service			Applies to packet switched data transmission service		
			PSTN	CSPDN	ISDN	ISDN	PSPDN	MSS
Transit delay selection and indication		X			FS	X	X	X
Throughput class negotiation	X	X (Note)			FS	X	X	X
Default throughput class assignment	X				FS	X	X	X
NOTE – This facility cannot be used unless the corresponding facility has been agreed for a period of time.								

Utilization of these facilities, and their mutual relationship is described in subclauses 7.2 and 7.3.

7.2 Transit delay

For calculation and negotiation of transit delay, the *Transit delay selection and indication* facility can be utilized.

7.2.1 Transit delay selection and indication

Transit delay selection and indication is an optional user facility that permits selection and indication, on a per call basis, of the nominal maximum permissible transit delay applicable to that virtual call.

A DTE wishing to select a nominal maximum permissible transit delay for a virtual call indicates the desired nominal maximum permissible value in the call request phase.

During the call request phase, the nominal transit delay applicable to the call will be indicated to the called DTE. This transit delay may be smaller than, equal to, or greater than the desired nominal maximum permissible transit delay requested in the call request phase by the calling DTE.

During the call confirmation phase, the nominal transit delay applicable to the call will also be sent to the calling DTE.

NOTE – This facility specifies the transit delay between the QRPs applicable for the data transmission service (see 7.1.1.2). Provision of transit delay values applicable for the OSI network service (see 7.1.1.3) may require the use of an additional parameter, the end-to-end transit delay negotiation facility.

For internetwork communication, two utilities are defined to handle these facilities:

1) The nominal maximum permissible transit delay value requested by the DTE is signalled between networks by the transit delay selection utility in the call request phase.

2) The accumulated expected nominal transit delay up to, and including the outgoing link is signalled in the transit delay indication utility in the call request phase. The accumulated expected nominal transit delay is signalled back in the transit delay indication utility of the call confirmation phase.

7.2.2 Transit delay definition

This transit delay is the *data* packet transfer delay as defined in 3.1/X.135, measured between boundaries B_2 and B_{n-1}, as defined in Figure 2/X.135 (that means, excluding the access lines), with the conditions given in 3.2/X.135, and is expressed in terms of a mean value.

Nominal maximum permissible transit delay and the expected nominal transit delay is signalled provisionally in milliseconds and expresses the mean value for the packets (128 octet size) sent by the user on that call.

NOTES

1 It is for further study whether the transit delay values shall apply only for busy hour condition.

2 The range and the number of reasonable values of the nominal maximum permissible transit delay and the expected nominal transit delay are for further study.

7.2.3 Call request and call confirmation phases

a) In the call request phase, a network, when able to do so, should allocate resources and route the virtual call in a manner such that the nominal transit delay applicable to that call does not exceed the desired nominal maximum permissible transit delay.

   1) In the call request phase, the calling DTE indicates the nominal maximum permissible transit delay in the *transit delay selection and indication facility*.

   2) In the call request phase on an internetwork link, the network shall, if routing on transit delay is performed, take into consideration both of the values given in the *transit delay selection and transit delay indication* utilities.

b) The network shall determine the expected nominal transit delay for the network part of the virtual circuit in question, based on the definition in 7.2.2.

   In accordance with the definition of *t3c*, this includes the expected nominal transit delay for all DSEs and links that the call passes through, taking into consideration such elements as size of DSEs, transmission speed and type of links.

   However, determination of the actual values is a national matter.

   If the call in question is resulting from an incoming internetwork link call, the determined expected nominal transit delay shall be added to the received value in the *transit delay indication* utility.

   1) In the case of an incoming call to a DTE, the expected nominal transit delay shall be transmitted to the DTE in the *transit delay selection and indication* facility.

   2) In the case of a call request on an internetwork link, the expected nominal transit delay shall be signalled in the *transit delay indication* utility. The transit delay originally requested by the DTE is optionally signalled in the *transit delay selection* utility.

c) The total accumulated expected nominal transit delay is signalled back in the *transit delay indication* utility in the call confirmation phase. This value is transferred by the originating network to the calling DTE in the *transit delay selection and indication* facility in the call confirmation phase.

During the call request phase, the nominal transit delay applicable to the call will be indicated to the called DTE. This transit delay may be smaller than, equal to, or greater than the desired nominal maximum permissible transit delay requested in the call request phase by the calling DTE.

During the call confirmation phase, the nominal transit delay applicable to the call will also be sent to the calling DTE.

7.3 Throughput

7.3.1 **Throughput class negotiation** (see Note)

NOTE – Different terms exist for this facility:

The present term is as denoted in Recommendations X.2, X.25 and X.75.

Recommendation X.213 uses the term "Throughput".

Recommendation X.140 uses the term "User information transfer rate".

Recommendation Q.931 uses the term "Information rate".

Throughput class negotiation is an optional user facility that permits negotiation on a per call basis of the throughput classes. The throughput classes are considered independently for each direction of data transmission.

Default values are agreed between the DTE and the Administration (see 7.3.5). The default values correspond to the maximum throughput classes which may be associated with any virtual call at the DTE/DCE interface.

This facility corresponds with the target QOS parameter (see 7.1.3.3) for throughput.

7.3.2 Throughput definition

The throughput parameter is defined in Recommendation X.140 (under the term user information transfer rate).

Throughput is signalled in bits per second. Provisionally, the throughput value negotiated for a call, is achieved, as measured over the lifetime of the call, in 95% of all cases (calls) during busy hour conditions. Details are for further study.

7.3.3 Call request and call confirmation phases

When the calling DTE has subscribed to the *throughput class negotiation* facility, it may request the throughput classes of the virtual call in the call request phase for both directions of data transmission. If particular throughput classes are not explicitly requested, the DCE will assume that the default values were requested for both direction of data transmission.

When a called DTE has subscribed to the *throughput class negotiation* facility, the throughput classes from which DTE negotiation may start will be indicated to the called DTE during the call request phase. These throughput classes are less than or equal to the ones selected at the calling DTE/DCE interface, either explicitly, or by default if the calling DTE has not subscribed to the *throughput class negotiation* facility or has not explicitly requested throughput class values in the call request phase. These throughput classes indicate to the called DTE will also not be higher than the default throughput classes, respectively for each direction of data transmission, at the calling and the called DTE/DCE interfaces. They may be further constrained by internal limitations of the network.

The called DTE may request with a facility in the call confirmation phase the throughput classes that should finally apply to the virtual call. The only valid throughput classes in the call confirmation phase are lower than or equal to the ones (respectively) indicated to the call DTE in the call request phase. If the called DTE does not make any throughput class facility request in the call confirmation phase, the throughput classes finally applying to the virtual call will be the ones indicated to the called DTE in the call request phase.

If the called DTE has not subscribed to the *throughput class negotiation* facility, the throughput classes finally applying to the virtual call are less than or equal to the ones selected at the calling DTE/DCE interface, and less than or equal to the default values defined at the called DTE/DCE interface.

When the calling DTE has subscribed to the *throughput class negotiation* facility, the call confirmation phase of each call will indicate the throughput classes finally applying to the call.

When neither calling DTE nor called DTE has subscribed to the *throughput class negotiation* facility, the throughput classes applying to the virtual call will not be higher than the ones agreed as defaults at the calling and called DTE/DCE interfaces. They may be further constrained to lower values by the network, e.g. for international service.

In the case of internetwork calls, any DSE, including the DSEs associated with the originating and destination networks, may reduce, but not raise, the throughput class values requested in the call request phase. Thus, the throughput classes from which the negotiation may start with the called DTE will be indicated to the DSE associated with the destination network.

If particular throughput classes are not explicitly requested, the DSE is assumed to request the default throughput class values agreed between both Administrations.

When the called DTE has accepted the call, the DSE associated with the destination network may convey, in the call confirmation phase, the throughput class values that finally apply to the call following the negotiation with the called DTE.

If particular throughput classes are not explicitly confirmed, the DSE is assumed to confirm the default class values agreed between both Administrations.

NOTE – In the process of determining whether or not throughput class values should be reduced by networks or by the user, different criteria can be envisioned, e.g. the resources available. For packet switched data transmission services, flow control parameters like window and packet size may affect the attainable throughput class.

7.3.4 Call clearing phase

No indication of throughput class should be present during the call clearing phase.

7.3.5 Default throughput class assignments

Default throughput classes assignment is an optional user facility agreed for a period of time. This facility, if subscribed to, provides for the selection of default throughput classes from the list of throughput classes supported by the Administration. Some networks may constrain the default throughput classes to be the same for each direction of data transmission. In the absence of this facility, the default throughput classes correspond to the user class of service of the DTE (see Recommendation X.1) but does not exceed the maximum throughput class supported by the network.

The default throughput classes are the maximum throughput classes which may be associated with any call at the DTE/DCE interface. Values other than the default throughput classes may be negotiated for a call by means of the *throughput classes negotiation* facility (see 7.3.1). Values other than the default throughput classes may be agreed for a period of time for each permanent virtual circuit.

7.4 Facilities relating to the charging conditions applying to the call

The optional user facilities which are standardized for different data transmission services, and are related to the charging conditions applying to the call are shown in Table 7-2.

7.4.1 Reverse charging and reverse charging acceptance

7.4.1.1 General

Reverse charging is an optional user facility that may be requested by the user on a per-call basis. It enables a calling user to request that the call should be charged to the called user.

TABLE 7-2/X.301

Optional user facilities, standardized for different data transmission services, related to charging conditions applying to the call

Optional user facility	Period of time	Applies per call	Applies to circuit switched data transmission service			Applies to packet switched data transmission service		
			PSTN	CSPDN	ISDN	ISDN	PSPDN	MSS
Reverse charging		X		X	FS	X	X	X
Reverse charging acceptance	X			X	FS	X	X	X
Local charging prevention	X				FS	X	X	X
Charging information	X	X		X	FS	X	X	X

Reverse charging acceptance is an optional user facility assigned to the user for an agreed contractual period. It enables the user to accept reverse charging calls.

NOTES

1 The international accounting arrangements for reverse charging calls and the consequent implications on network capabilities have not yet been defined.

2 All requirements of the *reverse charging* and *reverse charging acceptance* facilities have not yet been covered in the DTE/DCE interface and interexchange signalling specifications.

7.4.1.2 Call set-up procedure

A calling user may request reverse charging by means of a facility request over the DTE/DCE interface.

a) In the case where reverse charging is allowed by the originating network, the call control information forwarded to the succeeding exchange will include a *reverse charging request* indication.

b) In the case where reverse charging is not allowed by the originating network, the call is rejected and an *invalid facility request* call progress signal is returned to the calling user.

When receiving a call including a reverse charging request indication, the destination exchange will act as follows:

a) In the case where the called user subscribes to the *reverse charging acceptance* facility, the incoming call information, including an indication that reverse charging is requested, is sent to the called user.

b) In the case where the called user does not subscribe to the *reverse charging acceptance* facility, the call is rejected and a *reverse charging acceptance not subscribed* signal is sent towards the originating exchange.

The call may also be rejected for other reasons not related to the *reverse charging* or *reverse charging acceptance* facilities.

When the incoming call information is sent to the called user, the called user may deny establishment of the call by clearing, if the called user is not willing to accept reverse charging for this particular call.

NOTE – The DTE/DCE interface arrangements necessary in the circuit-switched service in CSPDNs to allow the called user to deny establishment of a reverse charging call, for example after *calling line identification*, have not yet been defined. The procedure chosen is likely to affect the network procedures for reverse charging calls.

7.4.2 Local charging prevention

Local charging prevention is an optional user facility agreed to for a period of time. This user facility, when subscribed to, authorizes the DCE to prevent the establishment of calls which the subscriber must pay for by:

a) not transmitting to the DTE incoming calls which request the *reverse charging* facility; and

b) insuring that the charges are made to another party whenever a call is requested by the DTE. This other party can be determined by using any of a number of actions, both procedural and administrative. The procedural methods include:

   – the use of reverse charging;

   – identification of a third party using the *network user identification* facility (see 7.6.5).

When the party to be charged has not been established for a call request, the DCE will apply *reverse charging* to this call.

NOTE – For an interim period of time, some networks may choose to enforce local charging prevention by clearing the call when the party to be charged has not been established.

7.4.3 Charging information

Charging information is an optional user facility which may be either agreed for a period of time or requested by the DTE for a given call.

If the DTE is the DTE to be charged, the DTE can request the *charging information* facility on a per call-basis by means of an appropriate facility request in the call request phase or call confirmation phase.

If a DTE subscribes to the *charging information* facility for a contractual period, the facility is in effect for the DTE, whenever the DTE is the DTE to be charged, without sending the facility request in a call request phase or call confirmation phase.

During the call clearing phase, the DCE will send to the charged DTE information about the charge for that call and/or other information which makes it possible for the user to calculate the charge.

The charging information parameter may be expressed in any of the following measures: monetary unit, distance, segment count, call duration.

7.5 Facilities relating to specific routing conditions requested by the user of the call

The optional user facilities which are standardized for different data transmission services, and are related to specific routing conditions requested by the user of the call are shown in Table 7-3.

7.5.1 Redirection/Deflection of Calls

The set of call redirection and call deflection optional facilities enables the redirection or the deflection of calls destined for one DTE (the “originally called DTE”) to another DTE (“the alternative DTE”). The call redirection facility allows the DCE, in certain circumstances, to redirect calls destined to the original DTE; no incoming call packet is transmitted to the originally called DTE when such a redirection is performed. The call deflection related facilities allow the originally called DTE to deflect individual incoming call packets by this originally called DTE. Internetwork call redirection or deflection (ICRD) allows the originally called DTE and the alternative DTE to be on different networks.

TABLE 7-3/X.301

Optional user facilities, standardized for different data transmission services, related to specific routing conditions requested by the user of the call

Optional user facility	Period of time	Applies per call	Applies to circuit switched data transmission service			Applies to packet switched data transmission service		
			PSTN	CSPDN	ISDN	ISDN	PSPDN	MSS
Call redirection	X			X	FS	X	X	X
Call deflection		X			FS	X	X	X
Hunt group	X			X	FS	X	X	X
ROA selection	X	X		X	FS	X	X	X
Called line address modified notification		X			FS	X	X	X
Call redirection or deflection notification		X		X	FS	X	X	X

7.5.1.1 Call redirection

Call redirection is an optional user facility assigned to the user for an agreed contractual period.

The facility enables a user to have calls to his address redirected to a predetermined address.

In the case of circuit-switched service in CSPDNs, this shall apply to all calls to the address. In the case of packet-switched data transmission service in PSPDNs and ISDNs, this shall apply to calls which encounter the out-of-order condition, or optionally other conditions, such as number busy.

Provision of the facility and registration of the address to which calls are to be redirected is controlled by the Administration.

It is for further study whether or not a facility is required to allow user control of the address registered to which calls are to be redirected.

Depending on the possibilities offered by the Administration, facility activation and deactivation may be made:

a) by the user by means of user controlled activation and deactivation procedures;

b) by the network at predetermined times;

c) by the Administration or Recognized Operating Agency (ROA) on request of the user;

d) by the Administration when providing and withdrawing the *call redirection* facility from the address.

User controlled procedures for inquiry of the status of the facility (i.e. whether the facility is activated or deactivated) may also be provided.

The basic service is limited to one call redirection. In addition, some networks may offer either one of the following (mutually exclusive) capabilities. In the case where DTE A is the calling DTE, and DTE B is the originally called DTE:

1) A list of alternate DTE's (C1, C2, . . .) is stored by the network of DTE B. Consecutive attempts of call redirection are tried to each of these addresses, in the order of the list, up to the completion of the call.

2) Call redirections may be logically chained; if DTE C has subscribed to call redirection to DTE D, a call redirected from DTE B to DTE C may be redirected to DTE D; call redirections and call deflections may also be chained.

In any case, networks will ensure that loops are avoided and that the *Call Request* Phase has a limited duration, consistent with a DTE time limit.

The *call redirection* facility will not violate the integrity of the *closed user group* facility.

For the packet switched networks, when the call is redirected, the called address of the alternate DTE and the *called line address modified notification* facility, indicating the reason why the called address is different from the one originally requested will be indicated to the calling DTE during the call confirmation phase or call clearing phase (see 7.5.2).

When the call is redirected, some networks may indicate to the alternate DTE the reason for redirection and the address of the originally called DTE, using the *call redirection notification* facility in the call request phase (see 7.5.1.4).

The order of call set-up processing at the originally called DCE as well as the alternate DCE will be according to the sequence of call progress signals in Table 1/X.96. For those networks that provide systematic call redirection with the prior request of the called DTE, the systematic call redirection request will have the highest priority in the call set-up processing sequence at the originally called DCE.

It is for further study whether there is a need for an optional user facility for the calling DTE to indicate whether or not it is permitted to redirect calls originated by this DTE.

7.5.1.1.1 Call set-up procedure for circuit switched data transmission services in CSPDNs

7.5.1.1.1.1 Calls not involving other facilities affecting the procedure

Information that a user has the *redirection of calls* facility activated is stored, together with the redirection address, at the exchange to which the user is connected. When such a user is called, the call is set up to the redirection address in accordance with the following.

7.5.1.1.1.1.1 The redirection address is at the same exchange

In this case the destination exchange connects the call to the redirection address and returns the *redirected call* signal unless the call is rejected for one of the reasons indicated below. When receiving the *redirected call* signal, the originating exchange sends the corresponding call progress signal to inform the calling user that the call has been redirected.

In the case where the user at the redirection address also has the *redirection of calls* facility activated, the destination exchange rejects the call and returns the *access barred* call progress signal. The call may also be rejected for other reasons (e.g. number busy) in accordance with the ordinary procedures.

7.5.1.1.1.1.2 The redirection address is at another exchange

In this case, the call is set up to the redirection address in accordance with one of the following procedures depending on the arrangements in the destination network.

The following procedure is based on the principle that the call is released back within the destination network and then set up to the new destination exchange. In the case of an international call, it is released back to the incoming gateway exchange. In the case of a national call, it is released back to the originating exchange. This procedure can be supported

by common channel signalling Recommendation X.61. The means necessary to support this procedure are not defined in Recommendations X.70 and X.71.

i) The first destination exchange returns the *redirection request* signal together with the redirection address towards the controlling exchange (i.e. the incoming gateway or originating exchange).

ii) In the case of an international call, the incoming gateway exchange upon receipt of the *redirection request* signal, set up a new forward connection to the redirection address. The call control information forwarded includes a *redirected call* indication. The forward connection to the first redirection exchange is released.

iii) In the case of a national call, the originating exchange acts in accordance with ii).

iv) Upon receipt of the redirected call, the new destination exchange connects the call or rejects the call in accordance with 7.5.1.1.1.1.1. The forward *redirected call* indication received by the new destination exchange is used to prevent further redirection.

v) In the case where the call is connected to the redirection address, the originating exchange will receive the *redirected call* signal. It then sends the *redirected call* call progress signal to inform the calling user that the call has been redirected.

The following procedure is based on the principle that the connection is extended forward from the first destination exchange to the new destination exchange. This procedure can be supported by common channel signalling and decentralized signalling in accordance with Recommendation X.61, and Recommendations X.70 and X.71, respectively.

i) The first destination exchange sets up the forward connection to the redirection address. The call control information forwarded will include a *redirected call* indication.

ii) Upon receipt of the redirected call, the new destination exchange connects or rejects the call in accordance with 7.5.1.1.1.1.1. The received *redirected call* indication is used to prevent further redirection.

iii) In the case where the call is connected to the redirection address, the originating exchange will receive a *redirected call* signal. It then sends the *redirected call* call progress signal to inform the calling user that the call has been redirected.

7.5.1.1.1.2 Calls involving a closed user group facility

Redirected calls are subject to the restrictions applying to the closed user group (CUG) facilities.

a) In the case where the call is a CUG call, or the originally called user has a CUG facility, the call is rejected before redirection unless the validation check requirements applicable for the CUG facility concerned are satisfied.

b) In the case where the call is a CUG call, or the user at the redirection address has a CUG facility, the call is rejected unless the validation check requirements applicable for the CUG facility concerned are satisfied.

c) In the case where:

   i) the call is a CUG call; and

   ii) the redirection address is at an exchange other than the first destination exchange; and

   iii) the procedure for setting up the call to the redirection address is in accordance with 7.5.1.1.1.1.2 (i.e. the call is released back), the first destination exchange has to send the CUG information received (e.g. the CUG call indication, and the interlock code) back to the controlling exchange together with the *redirected call* signal and the redirection address to enable the controlling exchange to include this CUG information in the call control information sent on the new forward connection.

7.5.1.1.1.3 The calling user has the called line identification facility

In the case where a call from a user that has the *called line identification* facility is redirected, the called line identity sent to the calling user is the data number of the redirection address.

7.5.1.2 Call deflection

Call deflection is an optional user facility assigned to the user for an agreed contractual period.

The facility enables a user to deflect incoming calls to another address on a per call basis for use on a packet switched virtual call service.

Upon receipt of an incoming call request, the originally called DTE responds with a clearing request including address of the DTE to which the call is to be deflected (i.e. data transfer phase never takes place between the calling DTE and originally called DTE). The network will consequently initiate an incoming call on the DTE interface to which the call is deflected.

The basic service is limited to one call deflection. In addition, in some networks call deflections and call redirections may be logically chained.

In this case, networks will ensure that loops are avoided and that the call request phase has a limited duration, consistent with a DTE time limit.

The *deflection of call* facility will not violate the integrity of the *closed user group* facility.

For the packet-switched networks, when the call is deflected, the called address of the alternate DTE and the *Called line address modified notification* facility, indicating the reason why the called address is different from the one originally requested will be indicated to the calling DTE during the call confirmation phase or call clearing phase (see 7.5.2).

When the call is deflected, some networks may indicate to the alternate DTE the reason for redirection and the address of the originally called DTE, using the *call redirection* or *deflection notification* facility in the call request phase (see 7.5.1.4).

7.5.1.3 Internetwork Call Redirection or Deflection (ICRD)

ICRD is the case of call redirection or deflection where the originally called DTE and the alternate DTE are on different networks. Figure 7-5 illustrates eight scenarios that are possible. In each scenario, A is the calling DTE, B is the originally called DTE and C is the alternate DTE.

ICRD appears to the calling user A as call redirection or call deflection within the destination network. The difference is apparent only to the networks which have implemented the service. Any interaction of the networks with the DTEs operate as in 7.5.1.1 and 7.5.1.2.

The following text describes the functions required of:

- Network I, the network that serves the Calling DTE A;
- Network II, the network that serves the originally called DTE B;
- Network III, the network that serves the alternative DTE C.

Network II begins the ICRD procedures by sending an X.75 *clear request* packet to Network I when DTE A and B are located on different networks (Scenarios 2 through 8). In scenario 1, an internal network means is used to determine that the call should be redirected or deflected.

Within the X.75 *clear request* packet, the *Call redirection or call deflection selection (CRCDS)* utility should be included which should contain the address of the alternative DTE C, the reason for redirection/deflection and copies of certain utilities passed in the original *call request* packet. Any transit network(s) between Network I and Network II should pass the *clear request* packet with the *CRCDS* utility unchanged.

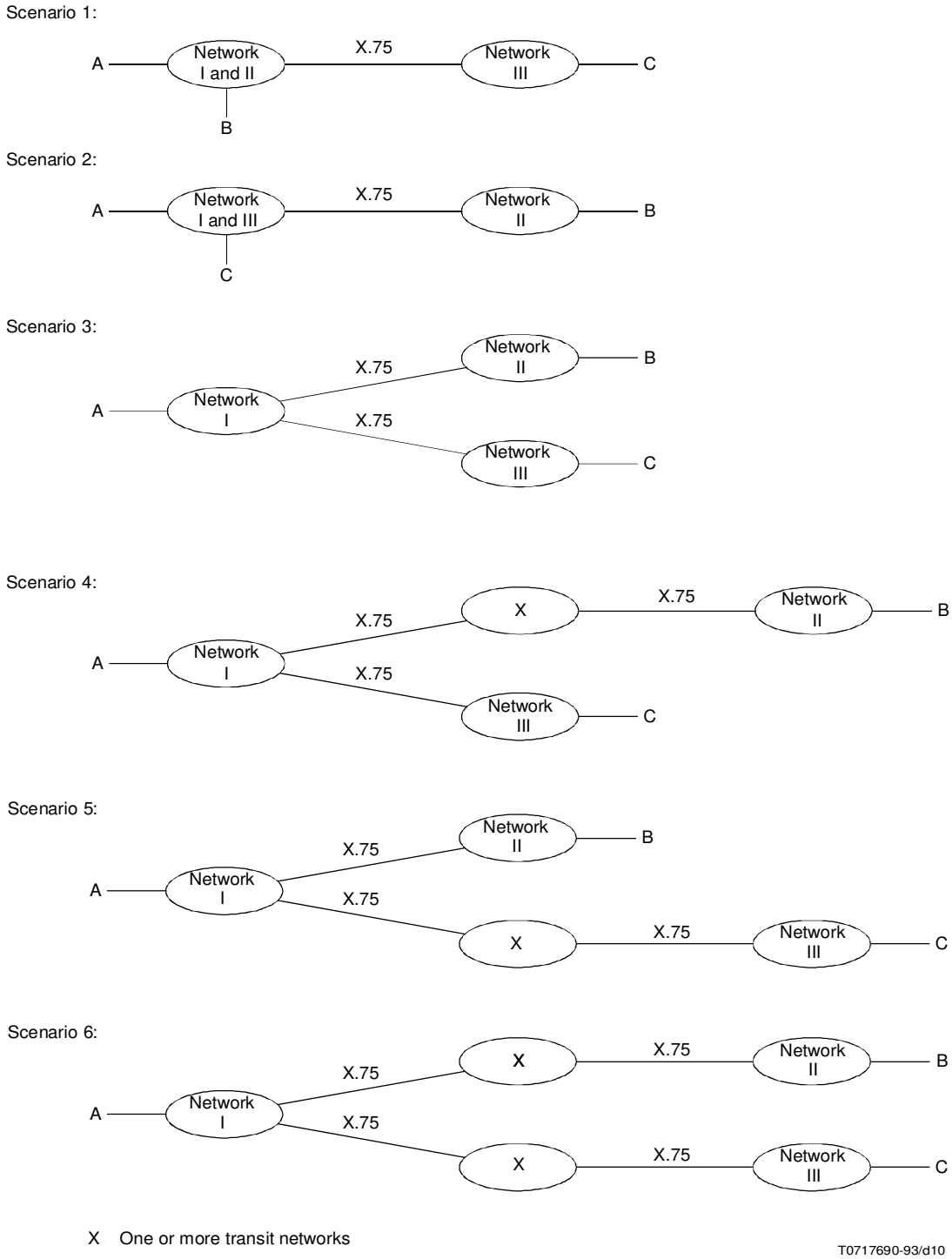


FIGURE 7-5/X.301

Internetwork Call Redirection and Deflection Scenarios

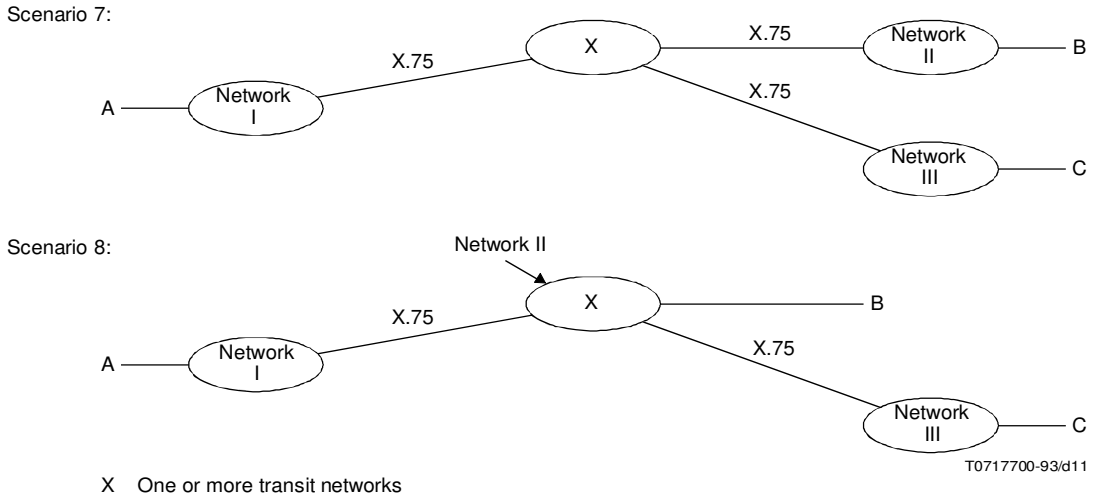


FIGURE 7-5/X.301*(end)*

Internetwork Call Redirection and Deflection Scenarios

If Network I does not support ICRD or if ICRD is prevented by the calling DTE A, Network I should clear the call to the calling DTE A upon receipt of the *clear request* packet with the *CRCDS* utility. The cause and diagnostic codes that should be used are for further study.

Upon receipt of the *clear request* packet by Network I which supports ICRD, that network should construct an X.75 *call request* packet if the alternative DTE C is not on the same network as the calling DTE A (Scenarios 1, 3 to 8). In scenario 2, an internal network means is used to direct the call to the alternative DTE C. The *call request* packet should be constructed with utilities included as specified in Table 7-4. The called DTE address should be that of the alternate DTE C coped from the *CRCDS* utility. The *call request* packet should also contain any facilities and user data passed back in the *clear request packet*. These facilities and user data should be copied unchanged from the *clear request* packet.

The *call request* packet should be routed to Network III. Any transit network(s) on route to Network III should pass but not modify the *CRCDN* utility.

The situation may occur where the alternative DTE C also has call redirection in effect or decides to deflect the call. In such a case, it is up to Network I whether to allow for a 2nd, 3rd, etc., ICRD. The basic ICRD service is limited to one redirection or deflection. However, if Network I chooses to allow multiple ICRDS, that network may also choose to set a limit for how many ICRDs it will allow before it will clear the call. That network can then keep a count of the number of times ICRD occurs. A limit on the number of times ICRD occurs will curtail infinite looping of a call request packet due to ICRD. When the maximum number of ICRDs occurs, the call should be cleared with cause code “access barred” and diagnostic #78 “excessive number of redirections or deflections detected for the call”.

TABLE 7-4/X.301

X.75 utilities in the reconstructed call request packet due to ICRD

Utility	Inclusion Condition	Utility Value
Transit network identification	Not applicable for originating network	Not applicable
Call identifier	Must include	May be derived from copy passed in the *CRCDS* utility included in the *clear request* packet.
Throughput class indication	May be included	Depends on the conditions at the X.75 interface and the originally requested throughput class at the DTE/DCE interface. (Note 1)
Window size indication	May be included	Depends on the conditions at the X.75 interface. (Note 1)
Packet size indication	May be included	Depends on the conditions at the X.75 interface. (Note 1)
Fast select indication	Included if returned in the *CRCDS* utility	Identical to copy passed in the *CRCDS* utility included in the *clear request* packet.
Reverse charging indication	Included if returned in the *CRCDS* utility	Identical to copy passed in the *CRCDS* utility included in the *clear request* packet.
Closed user group indication	Included if returned in the *CRCDS* utility	Identical to copy passed in the *CRCDS* utility included in the *clear request* packet.
Closed user group with outgoing access indication	Included if returned in the *CRCDS* utility	Identical to copy passed in the *CRCDS* utility included in the *clear request* packet.
Transit delay indication	Included if *Transit delay selection* facility was signalled by the calling user.	Value dependent on the characteristics of the originating network and the outgoing link.
Transit delay selection	Included if *Transit delay selection* facility was signalled by the calling user.	Identical to copy passed in the *CRCDS* utility included in the *clear request* packet.
Tariffs	May be included dependent upon bilateral agreements at the X.75 interface	Depends on the characteristics of the calling DTE/DCE interface
NUI	Included if sent in the original X.75 *call request* packet	Identical to that sent in the original X.75 *call request* packet (Note 2)
ROA selection	Included if the originating network decides that an ROA is necessary for routing the call	Appropriate value may be derived from: 1) value passed back in *TNIC* utility of the *clear request* packet; 2) *ROA subscription* facility; or 3) value chosen by originating network.
CRCDN	Must include	Reason for redirection/deflection and address of the originally called DTE (Note 3)
Utility marker	Included if non-X.75 utilities are present	

NOTES

1 The value should also depend on either the original value signalled by the calling DTE A, if Network I is capable of storing that value, or the default value for Network I.

2 If NUI is forwarded, without being validated in the original X.75 *call request* packet, Network I may store this NUI so that it can be included in the reconstructed *call request* packet in case of ICRD. If Network I cannot or does not store the NUI for such calls, the call must be cleared to the originating DTE with the cause and diagnostic code reflecting the reason for redirection or deflection given in the *CRCDS* utility.

3 If the *CRCDN* utility is not included in the *CRCDS* utility (i.e., there was no prior ICRD) passed in the *clear request* packet, the reason for redirection/deflection should be copied from the *CRCDS* utility and the address of the originally called DTE B should be copied from the called address field of the *clear request* packet. If the *CRCDN* utility is included in the *CRCDS* utility (i.e., one or more instances of ICRD have already occurred) passed in the *clear request* packet, the utility should be included in the new *call request* packet unchanged.

7.5.1.4 Call redirection or call deflection notification

Call redirection or *deflection notification* is an optional user facility, used by the DCE in the call request phase to inform the alternate DTE that the call has been redirected or deflected, why the call was redirected and the address of the originally called DTE.

The following reasons can be indicated with the *call redirection* or *deflection notification* facility:

1) Call redirection due to originally called DTE out of order;

2) Call redirection due to originally called DTE busy;

3) Call redirection due to prior request from the originally called DTE for systematic call redirection;

4) Call deflection by the originally called DTE; or

5) Call distribution within a hunt group.

7.5.2 Called line address modified notification

Called line address modified notification is an optional user facility used by the DCE in the call confirmation or call clearing phase to inform the calling DTE as to why the called address in this phase is different from that specified by the calling DTE in the call request phase.

When more than one address applies to a DTE/DCE interface, the called line address modified notification facility may be used by the responding DTE in the call clearing phase (when the call is rejected) or in the call confirmation phase, when the called address is presented by the responding DTE and different from that indicated to the DTE in the call request phase. When this facility is received from the responding DTE:

1) The DCE will clear the call if the called address is not one of those applying to the interface.

2) If call redirection has taken place in the PDN or ISDN, the DCE will replace the reason contained in the *called line address modified notification* facility with the reason reflecting the status of the originally called DTE; otherwise, the reason is passed transparently.

NOTE – The DTE should be aware that a modification of any part of the called DTE addresses field without notification by the *called line address modified notification* facility may cause the call to be cleared.

The following reasons can be indicated with the use of the *called line address modified notification* facility in *call confirmation* phase or *clearing* phase and transmitted to the calling DTE:

1) Call distribution with a hunt group;

2) Call redirection due to originally called DTE out of order;

3) Call redirection due to originally called DTE busy;

4) Call redirection due to prior request from the originally called DTE for systematic call redirection;

5) Called DTE originated; or

6) Call reflection by the originally called DTE.

In *call confirmation* or *clearing* phases, the reason indicated by the responding DTE in conjunction with the use of the *called line access modified notification* facility should be “DTE originated”.

7.5.3 Hunt group

7.5.3.1 General

The *hunt group* facility is an optional user facility which distributes incoming calls containing a hunt group address across the available DTE/DCE interfaces associated with the facility.

Once a call is assigned to a DTE/DCE interface, the call is treated as a regular call.

Calls originated on a DTE/DCE interface belonging to the hunt group are handled as normal calls.

NOTES

1 One or more addresses may be associated with the facility. If more than one address is associated with the facility, the selection procedure is performed irrespective of the particular called address.

2 A specific address may be assigned to each DTE/DCE interface associated with a hunt group. Calls placed directly to these specific addresses are treated normally (no distribution of calls). When distribution has been performed, and a specific address has been assigned in each DTE/DCE interface associated with the hunt group, this address should be returned to the calling DTE (as called line identification) together with an indicator indicating why the called line identification is different from the original called address.

7.5.3.2 Call set-up procedure

When receiving an incoming call having a hunt group address, the destination exchange performs the selection of DTE/DCE interface, if there is at least one idle circuit/channel available for incoming calls on any of the DTE/DCE interfaces in the group.

When calls are placed to a hunt group address, in the case specific addresses have also been assigned to the individual DTE/DCE interfaces, information is transferred to the calling DTE which contains:

1) the called address of the selected DTE/DCE interface; and

2) the reason why the called address is different from the one originally requested.

The exact arrangement is for further study.

For packet switching virtual call service, *called line address modified notification* facility is used for this purpose.

Some networks may apply call subscription time user facilities, common to all DTE/DCE interfaces in the hunt group, place a limit on the number of DTE/DCE interfaces in the hunt group, and/or constrain the size of the geographic region that can be served by a single hunt group.

7.5.4 ROA selection

7.5.4.1 General

This facility is an optional user facility which may be either agreed for a period of time or requested by a DTE on a per call basis for use on either circuit switched or packet-switched virtual call services.

In the countries that have more than one ROA transit network, there is a requirement for a user facility which, when requested, allows the calling DTE to select either one or a sequence of more than one ROA transit network(s) within the originating country. In the case of international calls, this facility, when requested, allows the calling DTE to select a particular international ROA within the country of that calling DTE.

NOTE – The procedure for selection of multiple ROAs is not yet specified in the circuit switching interface Recommendations.

7.5.4.2 Call set-up procedure

A user in a network providing the ROA selection facility may request selection of a particular, or a sequence of more than one ROA transit network within the originating country, either for an agreed period of time or on a per call basis by a facility request including the NI(s) (see Recommendation X.302) identifying the ROA transit network(s) selected.

In the case where a calling user requests selection of one or more ROA transit network(s), the originating network will route the call to the gateway exchange of the first ROA transit network selected. In the case where the call is routed via one or more transit exchanges within the originating network, an ROA selection request indication and the DNIC(s) identifying the ROA transit network(s) requested will be included in the internal network call control information forwarded by the originating exchange. In a similar manner, if the calling user selects a sequence of transit networks, the first transit network shall route the call to the gateway exchange of the second ROA transit network. Furthermore, the sequence of DNICs identifying the ROAs selected by the user will be passed across the internetwork interface. Pending further study, the facility/utility used to provide this information is subject to bilateral agreement between the connecting transit networks.

The call control information sent over the international network will be as for an ordinary call and will not contain any *ROA selection* related information.

In the case where the selected ROA transit network cannot accept the call, due to, for example, congestion or network failures, the call is rejected by the gateway exchange and an *ROA out-of-order* signal is returned towards the originating exchange which sends the corresponding call progress signal to the calling user.

7.6 Facilities related to protection mechanisms requested by the user of the call

The optional user facilities which are standardized for different data transmission services and are related to protection mechanisms requested by the user of the call are shown in Table 7-5.

7.6.1 Closed user group

7.6.1.1 General

The closed user group (CUG) facilities enable users to form groups with different combinations of restrictions for access from or to users having one or more of these facilities. The following CUG facilities are all optional user facilities that are assigned to the user for an agreed contracted period (see Note 1):

a) *Closed user group* – this is the basic facility that enables a user to belong to one or more CUGs;

b) *Closed user group with outgoing access* – this is an extension to a) which also enables the user to make outgoing calls to the open part of the network, and to DTEs having the incoming access capability [see c) below];

c) *Closed user group with incoming access* – this is a variant of a) which also enables the user to receive incoming calls from the open part of the network, and from DTEs having the outgoing access capability [see b) above];

d) *Incoming calls barred within the closed user group* – this is a supplementary facility to a), b) or c) which, when used, applies per user per CUG;

e) *Outgoing calls barred within the closed user group* – this is a supplementary facility to a), b) or c) which, when used, applies per user per CUG;

A user may belong to one or more CUGs. In the case where the user belongs to only one CUG, and the *closed user group* facility is subscribed to, it becomes the preferential CUG of that user. In the case where the user belongs to more than one CUG, and the closed user group facility is subscribed to, one of these CUGs is nominated as the preferential CUG of that user.

Each user belonging to at least one CUG has subscribed to either the *closed user group* facility or one of both of the closed user groups with outgoing access and the closed user group with incoming access. When the closed user group with outgoing access and/or the *closed user group with incoming access* facility is subscribed to, the DTE may choose whether or not to have a preferential CUG.

For each CUG to which a user belongs, either or none of the supplementary facilities incoming calls barred within the closed user group or outgoing calls barred within the closed user group facilities may apply for that user. Different combinations of CUG facilities may apply for different users belonging to the same CUG.

The realization of the CUG facilities is done by the provision of interlock codes and is based on various validation checks at call set-up, determining whether or not a requested call to or from a user having a CUG facility is allowed. In particular, a validation check is performed by verification that both the calling and called users belong to the same CUG as indicated by interlock codes.

Membership of closed user groups is controlled by the Administration or ROA in conjunction with user requests. Assignment of interlock codes is controlled by the Administration or ROA, and cannot be controlled by the user.

The international interlock code of an international CUG is specified in 7.6.1.3. The international interlock code expresses the international CUG number assigned to the CUG in accordance with the administrative rules defined in Recommendation X.180.

TABLE 7-5X.301

Optional user facilities, standardized for different data transmission services, related to protection mechanisms requested by the user of the call

Optional user facility	Period of time	Applies per call	Applies to circuit switched data transmission service			Applies to packet switched data transmission service		
			PSTN	CSPDN	ISDN	ISDN	PSPDN	MSS
CUG related facilities:								
– CUG	X			X	FS	X	X	X
– CUG with outgoing access	X			X	FS	X	X	X
– CUG with incoming access	X			X	FS	X	X	X
– Incoming calls barred within a CUG	X				FS	X	X	X
– Outgoing calls barred within a CUG	X				FS	X	X	X
– CUG selection		X (Note)		X	FS	X	X	X
– CUG with outgoing access selection		X (Note)			FS	X	X	X
Bilateral CUG related facilities:								
– Bilateral CUG	X			X	FS	X	X	X
– Bilateral CUG with outgoing access	X			X	FS	X	X	X
– Bilateral CUG selection		X (Note)			FS	X	X	X
Incoming calls barred	X			X	FS	X	X	X
Outgoing calls barred	X			X	FS	X	X	X
NUI	X	X (Note)			FS	X	X	X
NUI override		X (Note)			FS	X	X	X

NOTE – These facilities cannot be used unless the corresponding facilities are agreed for a period of time.

The originating network identification utility specified in Recommendation X.302 may be used for international CUG calls under control of the gateway exchange of the destination network (see 7.6.1.2.2).

NOTES

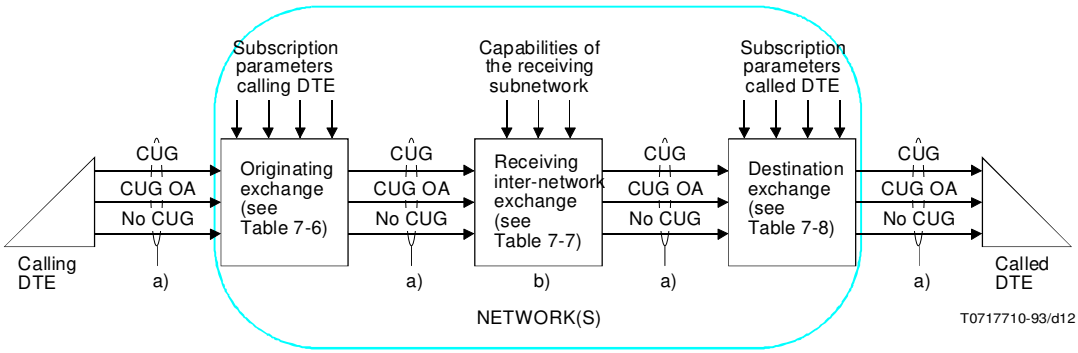
1 Outgoing access and/or incoming access applies to an individual user and not to a specific closed user group.

2 The requirements in 7.6.1.2 include cases which do not necessarily exist in a particular network, either because the Administration (or ROA) has chosen not to offer the full range of CUG facility combinations or because some combinations are not meaningful from the user's point of view.

3 A network should, also in the case where the *closed user group with outgoing access* facility is not provided, be capable of supporting the signalling necessary to complete incoming calls from users in another network providing that facility.

4 Private networks, including several different terminals and types of terminals will be connected to the public data network or ISDN. In these private networks, the different terminals may belong to different groups internally in the private networks, and may also have a need to communicate into different CUGs in the public data network or ISDN. The option by the private network not to have a preferential CUG when subscribing to the *closed user group with outgoing access* facility and/or the *closed user group with incoming access* facility allows for proper interpretation of the CUG facilities.

The signals related to the treatment of calls in relation to CUGs are illustrated in Figure 7-6 and summarized in Tables 7-6, 7-7 and 7-8.



CUG OA Closed user group with outgoing access

a) Possible different signals regarding CUG.

b) Not always present.

FIGURE 7-6/X.301

Treatment of calls in relation to CUGs

TABLE 7-6/X.301

CUG signals into the network by the originating exchange resulting from CUG signals by the calling DTE and subscription parameters of the calling DTE

Signalled by the calling DTE in the call request phase (see Note 1) Subscription of the calling DTE	CUG selection facility	CUG/OA selection facility	No CUG nor CUG/OA selection facility
CUG with preferential (see Note 2)	CUG utility (CUG specified) (see Note 3)	Not allowed (call cleared)	CUG utility (Preferential CUG) (see Note 3)
CUG/OA with preferential	CUG/OA utility (CUG specified) (see Note 3)	Not allowed (call cleared)	CUG/OA utility (Preferential CUG) (see Note 4)
CUG/IA with preferential	CUG utility (CUG specified) (see Note 3)	Not allowed (call cleared)	CUG utility (Preferential CUG) (see Note 3)
CUG/IA/OA with preferential	CUG/OA utility (CUG specified) (see Note 3)	Not allowed (call cleared)	CUG/OA utility (Preferential CUG) (see Note 4)
CUG/OA without preferential	CUG utility (CUG specified) (see Note 3)	CUG/OA utility (CUG specified) (see Note 4)	No CUG nor CUG/OA utility
CUG/IA without preferential	CUG utility (CUG specified) (see Note 3)	Not allowed (call cleared)	Not allowed (call cleared)
CUG/IA/OA without preferential	CUG utility (CUG specified) (see Note 3)	CUG/OA utility (CUG specified) (see Note 4)	No CUG nor CUG/OA utility
No CUG	Not allowed (call cleared)	Not allowed (call cleared)	No CUG nor CUG/OA utility

IA Incoming access.

OA Outgoing access.

NOTES

1 The inclusion of both CUG and CUG/OA selection facilities is not allowed in the call request phase.

2 CUG without preferential is not allowed.

3 If outgoing calls are barred within the preferential, specified CUG or only CUG then the call is cleared.

4 If outgoing calls are barred within the preferential, specified CUG or only CUG then only outgoing access applies. No CUG is signalled into the network.

TABLE 7-7/X.301

CUG signals into the receiving subnetwork by the receiving internetwork exchange resulting from CUG signals to the receiving internetwork exchange and receiving subnetwork capabilities

Signalled to the receiving internetwork exchange in the call request phase / Capabilities of the receiving subnetwork	CUG utility	CUG/OA selection facility	No CUG nor CUG/OA selection facility
No CUG nor CUG/OA utility is supported	Access barred (call cleared)	Access barred (call cleared)	No CUG nor CUG/OA utility
Only the CUG utility is supported	CUG utility (CUG specified)	Access barred[a] (call cleared)	No CUG nor CUG/OA utility
Both the CUG and CUG/OA utilities are supported	CUG utility (CUG specified)	CUG/OA utility (CUG specified)	No CUG nor CUG/OA utility

OA Outgoing access.

[a] This entry needs further study for alignment with Table 24/X.25, Note 6.

7.6.1.2 Call set-up procedure

7.6.1.2.1 Originating exchange

The DTE/DCE interface protocol and the actions at the originating exchange at call set-up from a user belonging to a CUG depend on whether the user belongs to one or more CUGs and on the combination of CUG facilities that applies (see also Figure 7-7).

7.6.1.2.1.1 CUG selection

For each CUG that a user belongs to, the interlock code assigned to the CUG is stored, and is associated to the user at the local exchange. In the case where a user belongs to more than one CUG, a selection of the CUG preferred, and thus of the corresponding interlock code, is required at call establishment. This selection is made on the following criteria.

In the case where the calling user makes a facility request including an index identifying a particular CUG, this CUG is selected by the originating exchange.

In the case where the calling user belongs to one or more CUGs and has a preferential closed user group, no facility request concerning CUG facilities is made in the case:

a) where the user belongs to one CUG only;

b) where a user belonging to more than one CUG with or without outgoing access, makes a call within the preferential CUG; or

c) where a user, having the *closed user group with outgoing access* facility, makes an outgoing access call, or a call within the preferential CUG.

A facility request is always required for a call within any CUG other than the preferential CUG.

In the case where the calling user belongs to one or more CUGs and does not have a preferential closed user group, no facility request concerning CUG facilities is made in the case where a user having the closed user group with outgoing access facility makes an outgoing access call.

TABLE 7-8/X.301

CUG signals to the called DTE by the destination exchange resulting from CUG signals from the network and subscription parameters of the called DTE

Signalled from the network to the destination exchange in the call request phase Subscription of the called DTE	CUG utility	CUG/OA utility	No CUG nor CUG/OA utility
CUG with preferential (see Note 1)	CUG sel. fac. (CUG specified) (see Notes 2,3,4)	CUG sel. fac. (CUG specified) (see Notes 2,3,4)	Access barred (call cleared)
CUG/OA with preferential	CUG sel. fac. (CUG specified) (see Notes 2,3,4)	CUG sel. fac. (CUG specified) (see Notes 2,3,4)	Access barred (call cleared)
CUG/IA with preferential	CUG sel. fac. (CUG specified) (see Notes 2,3,4)	CUG sel. fac. (CUG specified) (see Notes 2,3,4)	No CUG nor CUG/OA sel. fac.
CUG/IA/OA with preferential	CUG sel. fac. (CUG specified) (see Notes 2,3,4)	CUG sel. fac. (CUG specified) (see Notes 2,3,4)	No CUG nor CUG/OA sel. fac.
CUG/OA without preferential	CUG sel. fac. (CUG specified) (see Notes 2,3)	CUG sel. fac. (CUG specified) (see Notes 2,3)	Access barred (call cleared)
CUG/IA without preferential	CUG sel. fac. (CUG specified) (see Notes 2,3)	CUG sel. fac. (CUG specified) (see Notes 2,3)	No CUG nor CUG/OA sel. fac.
CUG/IA/OA without preferential	CUG sel. fac. (CUG specified) (see Notes 2,3)	CUG/OA sel. fac. (CUG specified) (see Notes 5,6)	No CUG nor CUG/OA sel. fac.
No CUG	Access barred (call cleared)	No CUG nor CUG/OA sel. fac.	No CUG nor CUG/OA sel. fac.

NOTES

1 CUG without preferential is not allowed.

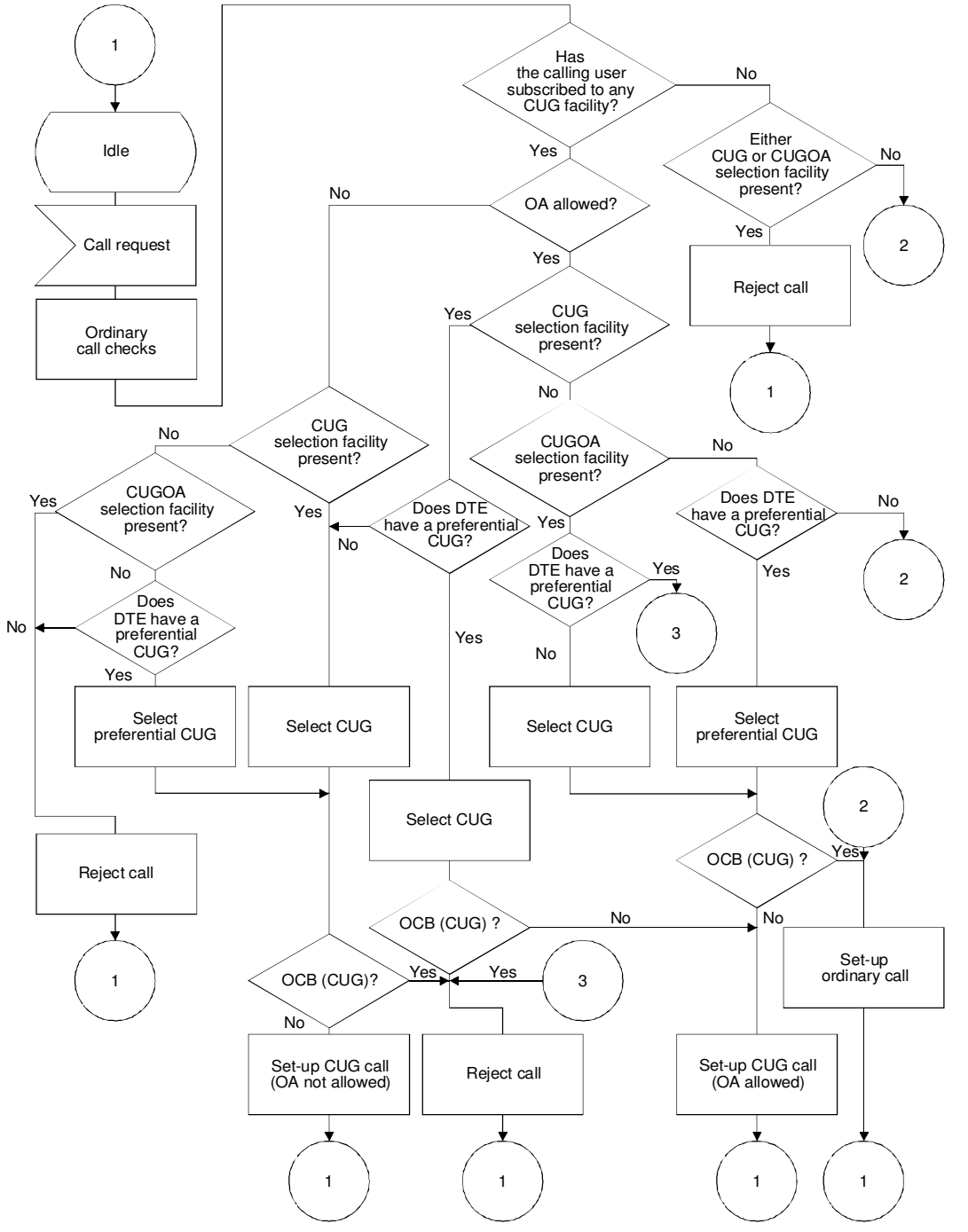
2 If the CUG specified to the destination exchange is not subscribed to by the called DTE, then the call is blocked.

3 If incoming calls are barred within the specified CUG, then the call is blocked.

4 If the specified CUG is the preferential CUG then the incoming call may contain no CUG nor CUG/OA facility.

5 If the CUG specified to the destination exchange is not subscribed to by the called DTE, then Incoming Access applies; the incoming call contains no CUG nor CUG/OA selection facility.

6 If incoming calls are barred within the specified CUG, then Incoming Access applies; the incoming call contains no CUG nor CUG/OA selection facility.



OCB (CUG) Outgoing calls barred in the closed user group

NOTE – The diagram is not a specification of a particular sequence of actions.

FIGURE 7-7/X.301

Closed user group facilities:
call set-up conditions at originating exchange

7.6.1.2.1.2 Call set-up from a user having the CUG or the CUG with incoming access facility

The case where a user has both the *closed user group with incoming access* and *closed user group with outgoing access* facilities is handled in accordance with 7.6.1.2.1.3.

In this case, CUG selection is performed in accordance with 7.6.1.2.1.1.

In the case where the *outgoing calls barred within the closed user group* facility does not apply for the selected CUG, the call is set-up at the originating exchange. The call control information forwarded to the next exchange then includes the interlock code of the selected CUG together with an indication that the call is a CUG call.

In the case where the outgoing calls barred within the closed user group facility applies for the selected CUG, the call is rejected and the access barred call progress signal is returned to the calling user.

7.6.1.2.1.3 Call set-up from a user having the closed user group with outgoing access facility

In the case where the calling user subscribes to the *closed user group with outgoing access* facility, and has a preferential (or only) CUG, the call is regarded as an outgoing access call and a call within the preferential (or only) CUG.

In the case where the *outgoing calls barred within the closed user group* facility does not apply for the preferential (or only) CUG, the call is set up at the originating exchange. The call control information forwarded to the next exchange then includes the interlock code of the preferential (or only) CUG together with an indication that the call is a CUG call for which outgoing access is allowed.

NOTE – With the above procedure, it is not necessary to distinguish at the originating exchange between a call within a CUG and an outgoing access call.

In the case where the *outgoing calls barred within the closed user group* facility applies for the preferential (or only) CUG, the call is regarded as an outgoing access call. In this case the call is set up at the originating exchange and no interlock code or CUG call indication is included in the call control information forwarded to the next exchange.

In the case where the calling user subscribes to the *closed user group with outgoing access* facility, and does not have a preferential closed user group, the call is regarded as an outgoing access call, unless the calling user makes a facility request identifying a particular CUG for the call.

7.6.1.2.2 Transit exchange

With the possible exception of some gateway exchanges, each transit exchange set-up a CUG call as an ordinary call. The information related to the CUG facilities received from the preceding exchange (i.e. an interlock code, a CUG call indication and possibly an indication that outgoing access is allowed) is forwarded to the succeeding exchange.

In the case of an international CUG call, no special functions are required at the gateway exchange provided that the international interlock code assigned to the international CUG concerned is used in the national network. However, in the case where a national interlock code other than the applicable international interlock code is used within a national network, interlock code conversion is required at the gateway (or corresponding) exchange.

In the case where a destination network has a requirement for identification of the originating network for CUG calls, the originating *network identification* utility specified in Recommendation X.302 may be employed.

7.6.1.2.3 Destination exchange

At the destination exchange, a validation check of the acceptability of a call is made where either the calling user (as indicated by a CUG call indication in the control information received) or the called user belongs to a CUG. The call is connected only in cases where the information received checks with the information stored at the destination exchange, associated to the called user, as specified in the following. In cases where a call is rejected because of incompatible CUG information an *access barred* call progress signal is sent towards the calling user.

The conditions for acceptance or rejection of calls because of the CUG facilities are illustrated in Figure 7-8.

NOTE – A call may be rejected for reasons other than those related to the CUG facilities.

7.6.1.2.3.1 Calls to a user having the CUG or the CUG with outgoing access facility

The case where a user has both *CUG with incoming access* and *CUG with outgoing access* facilities is handled in accordance with 7.6.1.2.3.2.

In this case, an incoming call is accepted only when

a) it is a CUG call, including the case where outgoing access is allowed; and

b) correspondence is found between the interlock code received and an interlock code associated with the called user; and

c) the incoming calls barred within the closed user group facility does not apply for the CUG identified by the interlock code received.

If all of the above conditions are not met, the call is rejected.

7.6.1.2.3.2 Calls to a user having the CUG with incoming access facility

An incoming call is accepted in the cases when

a) it is an ordinary call; or

b) it is a CUG call for which outgoing access is allowed; or

c) it is a CUG for which outgoing access is not allowed, and both conditions specified in 7.6.1.2.3.1 b) and c) apply.

In all other cases, the incoming call is rejected.

7.6.1.2.3.3 CUG calls to a user not belonging to any CUG

In the case where the incoming call is

a) a CUG call for which outgoing access is allowed, it is accepted; or

b) a CUG call for which outgoing access is not allowed, it is rejected.

7.6.1.3 International interlock code

Each international CUG is assigned a unique International CUG Number (ICN) according to the administrative rules defined in Recommendation X.180.

Each international interlock code includes:

a) four binary coded decimal digits expressing the DCC plus one digit, or DNIC, or the country or network of the coordinating Administration or Recognized Operating Agency, i.e. the decimal number A of the international CUG number; and

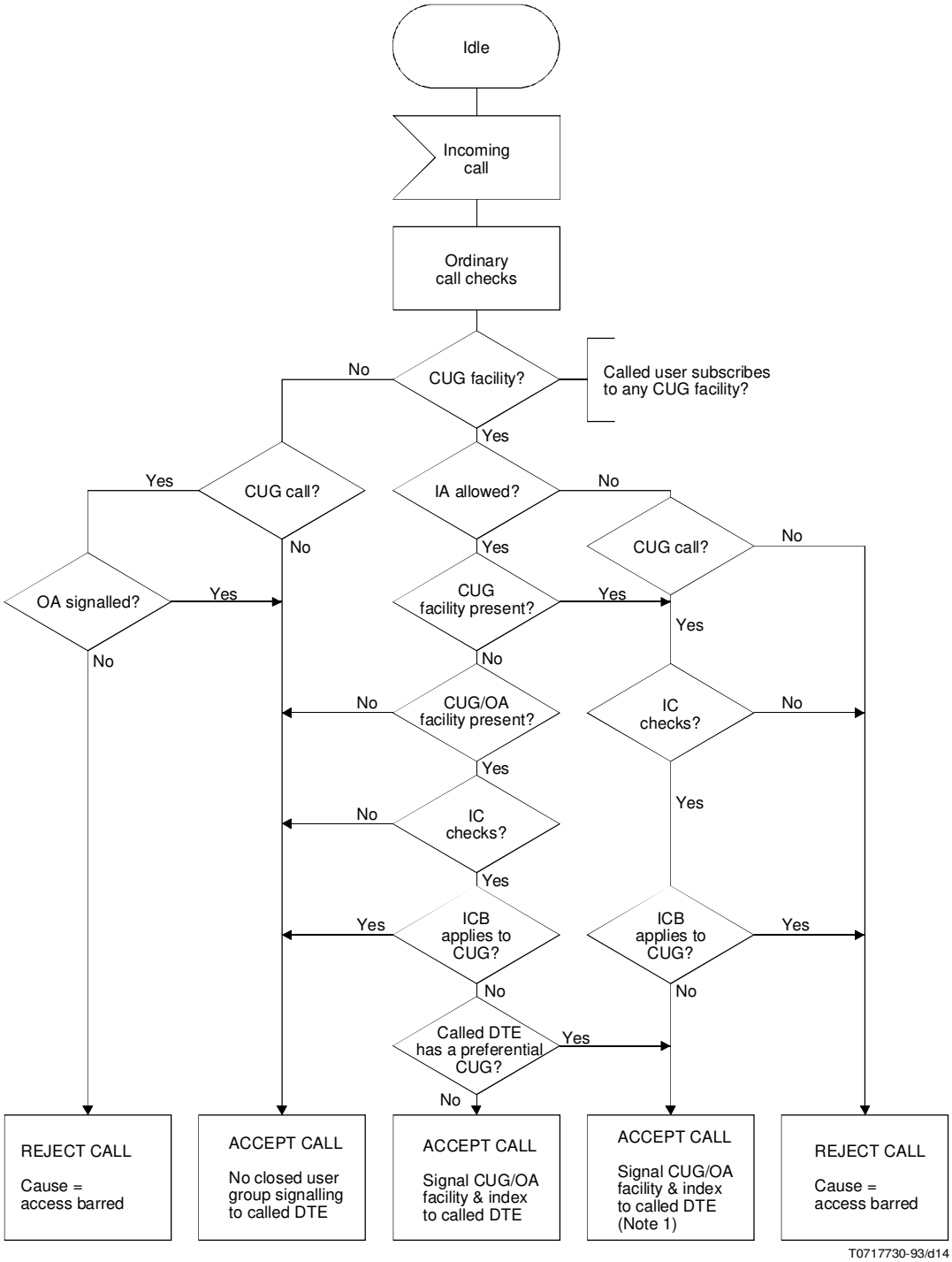
b) a 16-Bit code expressing in pure binary representation the value of the decimal number B of the international CUG number.

The interlock code is transferred, DNIC/DCC portion first, in accordance with the procedures specified by the relevant Recommendations X.61, X.70, X.71 or X.75.

NOTES

1 In some cases of signalling, all, some or none of the leading zeros are transmitted (see Recommendations X.70 and X.71). The binary code should then have the same meaning regardless of the number of leading zeros.

2 It is for further study whether or not the accommodation of international CUGs with members on public networks other than PDNs (e.g. ISDNs), will require any additional arrangements for handling international CUG interlock codes in PDNs.



NOTES
1 If the specified CUG is the preferential CUG, then the incoming call may contain no CUG facility.
2 The diagram is not a specification of a particular sequence of actions.

FIGURE 7-8/X.301

Closed user group facilities: call set-up conditions at destination exchange *(Note 2)*

7.6.2 Bilateral closed user group

7.6.2.1 General

Bilateral closed user group and *bilateral closed user group with outgoing access* are optional user facilities assigned to the user for an agreed contractual period.

The *Bilateral Closed User Group* (BCUG) facility is a user facility that enables pairs of users to form bilateral relations allowing access between each other while excluding access to or from other users with which such a relation has not been formed. A user may belong to more than one BCUG.

The *Bilateral Closed User Group with Outgoing access* (BCUGOA) facility is a user facility that enables a user to form BCUGs as with the *bilateral closed user group* facility, but at the same time allows the user to access by outgoing calls to open users not having the *bilateral closed user group* or *bilateral closed user group with outgoing access* facilities.

A user may simultaneously have the *bilateral closed user group* or *bilateral closed user group with outgoing access* facility and one or more of the *closed user group* (CUG) facilities. In such cases, a call within a CUG is handled separately from the *bilateral closed user group* facility and is not regarded as an outgoing access call in relation to the *bilateral closed user group* facility.

Registration and cancellation of a BCUG of two users to the *bilateral closed user group* or *bilateral closed user group with outgoing access* facilities are controlled by the users concerned by means of automatic registration and cancellation procedures.

The *bilateral closed user group* and *bilateral closed user group with outgoing access* facilities, including automatic user controlled facility registration and cancellation, can be supported by common channel signalling (Recommendation X.61) for the circuit-switched data transmission service. Decentralized signalling for the circuit-switched data transmission (Recommendations X.70 and X.71) and for the packet-switched data transmission service (Recommendation X.75) cannot support the facilities.

The procedures for the *bilateral closed user group* facility are based on the mutual registration method. This method makes use of the features of abbreviated address calling. Thus, a user having the *bilateral closed user group* facility uses a local index (i.e. an abbreviated address) for each remote user with which a BCUG is formed. In the exchange to which the user is connected, a table associated with that user is available. The local index used to address a remote user corresponds to a position in the table containing the data number (address) of the remote user, the local index used by that remote user to address the local user, and an indication (association bit) about the status of the BCUG.

7.6.2.2 Registration procedures

When requesting registration of a BCUG, the user *A* makes a facility request including the data number *B* of the remote user and the local index *x* used for that user. The originating exchange checks whether a data number has been registered or not in the position corresponding to the local index *x* received, in the local user *A* table.

a) In the case where a data number has not yet been registered in position *x* in the user *A* table, the originating exchange registers data number *B* in that position. The originating exchange then sends a BCUG registration request to the destination exchange, including a data number *B* as a destination address, data number *A* as a source address and the local index *x*.

b) In the case where data number *B* for the remote user has already been registered in position *x* in the user *A* table, and its association bit has not yet been set, indicating that registration has not yet been completed, the originating exchange sends a BCUG registration request to the destination exchange, including the same information as described in a) above.

c) In the case where data number *B* for the remote user has already been registered in position *x* in the user *A* table and its association bit has already been set, the originating exchange sends the *registration/cancellation confirmed* call progress signal to user *A*.

d) In the case where the data number registered in that position is different from the data number *B* received, the originating exchange sends the *local procedure error* call progress signal to user *A*.

When receiving the BCUG registration request, the destination exchange checks the addressed user *B* table.

a) In the case where user *B* has already registered user *A* in a position *y*, where *y* is the local index used by user *B* for user *A*, and its association bit has not yet been set, indicating that registration has not yet been completed, the destination exchange sets the association bit and registers local index *x* in that position. The destination exchange then responds to the originating exchange with a *registration completed* signal together with the local index *y*.

b) In the case where user *B* has already registered user *A* in position *y* and its association bit has already been set, the destination exchange checks the local index registered in that position. In the case where that local index is equal to the local index received, the destination exchange responds to the originating exchange as under item a) above.

c) In the case where user *B* has not registered data number *A* in any position, the destination exchange responds to the originating exchange with a *registration accepted* signal.

d) In the case where user *B* does not subscribe to the BCUG facility, the destination exchange responds to the originating exchange with an *access barred* call progress signal.

e) In the case where user *B* is not accessible by user A for any other reason, the destination exchange responds to the originating exchange with the appropriate call progress signal.

When receiving the response to a BCUG registration request from the destination exchange, the action at the originating exchange depends on the signal received.

a) In the case where a *registration completed* signal is received, the originating exchange sets the association bit and registers the local index *y* in position *x* in the user *A* table and send the *registration/cancellation confirmed* call progress signal confirming registration to user *A*.

b) In the case where a *registration accepted* signal is received, no further registration is made at the originating exchange and the *registration/cancellation confirmed* call progress signal is sent to user *A*.

c) In the case where a signal is received indicating that BCUG registration has been rejected by the destination exchange, the originating exchange clears all the information in position *x* in the user *A* table and sends the corresponding call progress signal to user *A*.

With the above procedures, registration of a BCUG is completed when both users concerned have requested registration of each other and have received positive responses.

7.6.2.3 Cancellation procedure

When requesting cancellation of a BCUG, user *A* makes a facility request, including local index *x*. The originating exchange checks the status of position *x* in the user *A* table.

a) In the case where a data number is registered in position *x*, the originating exchange sends a BCUG cancellation request with data number *B* as address and including remote local index *y* and the calling user number *A*. Also, the originating exchange resets the association bit if it was set.

b) In the case where no data number is registered in position *x*, the originating exchange returns the *registration/cancellation confirmed* call progress signal to user *A*.

When receiving the BCUG cancellation request, the destination exchange checks the addressed user *B* table.

a) In the case where the data number in position *y* in user *B* table is equal to the data number *A* received, the destination exchange clears all information in position *y*.

b) In all other cases, and in particular in the case where the data number stored in position *y* is different from the data number *A* received, the destination exchange does not alter any information stored in the user *B* table.

In cases a) and b), the destination exchange sends a *cancellation completed* signal to the originating exchange.

When receiving the *cancellation completed* signal in response to a BCUG cancellation request, the originating exchange clears all the information in position *x* in the user *A* table and sends the *registration/cancellation confirmed* call progress signal to user *A*.

With the above procedure, a BCUG is cancelled when either of the two users concerned has requested cancellation and has received the *registration/cancellation confirmed* call progress signal.

NOTE – Possible implications of abnormal conditions at cancellation may require further study.

7.6.2.4 Time-out supervision in registration/cancellation procedure

At the originating exchange in the facility registration/cancellation procedure, it is necessary to wait for receipt of the response from the destination exchange after sending a BCUG registration/cancellation request. The duration of such periods has to be controlled by appropriate time-outs.

The following time-outs are necessary:

T1 The time between the sending of the BCUG registration request and receipt of a response in accordance with 7.6.2.2.

T2 The time between the sending of the BCUG cancellation request and receipt of a *cancellation completed* signal.

On expiration of time-out T1 or T2, the originating exchange sends the *network congestion* call progress signal to user *A* thus indicating that the requested registration or cancellation has failed. User *A* then has to repeat the request for registration or cancellation.

The value of T1 and T2 should *(provisionally)* be 5-10 seconds.

7.6.2.5 Call set-up procedure

7.6.2.5.1 Originating exchange

When making a call within a BCUG, the calling user *A* uses the local index *x* as address for the called user (in accordance with the procedure for the abbreviated address calling facility). The originating exchange checks the position corresponding to the local index *x* registered in the calling user *A* table.

a) In the case where the association bit is set, indicating that the BCUG is registered by both the calling and called users, the originating exchange sets up the call towards the destination exchange, using the called user data number *B* stored in the calling user *A* table. The call control information forwarded by the originating exchange includes an indication that the call is a BCUG call.

b) In the case where the association bit is not set, indicating that the BCUG is not completely registered, the originating exchange rejects the call and sends the *access barred* call progress signal to the calling user.

In the case where a user having the *bilateral closed user group* facility makes a call with an ordinary data number or an abbreviated address not registered as a BCUG, the originating exchange rejects the call and sends *access barred* call progress signal to the calling user.

NOTE – In the case where the user also belongs to a closed user group (CUG), calls within a CUG are handled independently and are not rejected because of the *bilateral closed user group* facility.

In the case where a user having the *bilateral closed user group with outgoing access* facility makes a call with an ordinary data number or an abbreviated address not registered as a BCUG, the call is handled as an outgoing access call and is set up by the originating exchange in accordance with ordinary call set up procedure.

The possibility of transfer of the local index *x* (in the forward direction) and local index *y* (in the backward direction) and the possibility of additional verification checks at the destination exchange are for further study.

7.6.2.5.2 Transit exchange

A transit exchange handles a BCUG call as an ordinary call.

7.6.2.5.3 Destination exchange

When receiving a BCUG call, the destination exchange may accept the call without checking whether the called user has the *bilateral closed user group* facility.

When receiving an ordinary call (i.e. not a BCUG call) to a user having the *bilateral closed user group* facility, the destination exchange rejects the call and responds with the *access barred* call progress signal to the originating exchange.

The call may be rejected for other reasons not related to the *bilateral closed user group* facility. Closed user group calls can be accepted regardless of the above conditions, provided that the requirements of that facility are met (see clause 2).

7.6.2.5.4 Combination of BCUG and line or terminal identification facilities

The possible arrangements for combinations of the *bilateral closed user group* or *bilateral closed user group with outgoing access* facilities and the *calling line identification* and/or *called line identification* facilities and the form of calling or called DTE identification of BCUG calls are for further study.

7.6.3 Incoming calls barred

Incoming call barred is an optional user facility agreed for a period of time. This facility applies to all calls used at the DTE/DCE interface.

This facility, if subscribed to, prevents incoming calls from being presented to the DTE. The DTE may originate outgoing calls.

NOTE – Some Administrations may provide a capability that also allows a call to be presented to the DTE only in cases where the called address is the address of the calling DTE.

7.6.4 Outgoing calls barred

Outgoing calls barred is an optional user facility agreed for a period of time. This facility applies to all calls used at the DTE/DCE interface.

This user facility, if subscribed to, prevents the DCE from accepting outgoing calls from the DTE. The DTE may receive incoming calls.

7.6.5 Network User Identification

Network User Identification is an optional user facility agreed for a period of time. This facility, if subscribed to, enables the DTE to provide information to the network for billing, security or network management purpose on a per call basis. This information may be provided by the calling DTE in the call request phase or by the called DTE in the call confirmation phase. It may be used whether or not the DTE has also subscribed to the *local charging prevention* facility (see 7.4.2). If the DCE determines that the network user identifier is valid or not present when required by the network, it will clear the call.

Network user identification is never transmitted to the remote DTE. The calling DTE address transmitted to the remote DTE in the calling DTE address field should not be inferred from the network user identification transmitted by the DTE in the *call request* phase.

The contents and format of the NUI parameter is a national matter.

Use of this feature between networks is subject to bilateral agreement between Administrations.

7.6.6 NUI override facility

The *NUI override* facility is an optional user facility agreed to for a period of time. This facility, if subscribed to, permits an NUI facility, presented in the call request phase, to invoke features subscribed to by the DTE identified by that NUI and associated with the NUI. Facilities associated with the NUI shall override facilities which may apply to

the interface. This override does not apply to existing calls or subsequent calls on the interface. It remains in effect for the duration of the particular call to which it applies.

The optional subscription facilities that may be associated with an NUI are a national matter.

7.7 Facilities to convey user data in addition to the normal data flow in the data transfer phase

NOTE – Different terms exist; in general "user data" is used in X-Series Recommendations, and "user-to-user information" is used in I-Series Recommendations.

7.7.1 General

Conveyance of user data in addition to the normal data flow in the data transfer phase can be considered in the following phases of a call:

a) Call request phase (calling DTE to called DTE);

b) Call confirmation phase (called DTE to calling DTE);

c) Call clearing phase (clearing DTE to cleared DTE).

Support of conveyance of user data during these phases is shown in Table 7-9.

TABLE 7-9/X.301

Support by different networks to convey user data in addition to the normal data flow in the data transfer phase

Network / Phases	CSPDN or PSTN	PSPDN or MSS	ISDN	
			Circuit switched	Packet switched
Call request phase	No support	Up to 16 octets or Up to 128 octets (fast select)	Up to 128 octets	Up to 16 octets or Up to 128 octets (fast select)
Call confirmation phase	No support	Up to 128 octets (fast select)	Up to 128 octets	Up to 128 octets (fast select)
Call clearing phase	No support	Up to 128 octets (fast select)	Up to 128 octets	Up to 128 octets (fast select)
NOTE – Some networks require conveyance of an integral number of octets.				

For interworking between networks providing a different level of support of conveying user data in addition to the normal data flow in the data transfer phase, the following principles apply:

a) the objective is that in the future, all networks can support conveyance of up to 128 octets user data during the call request phase, call confirmation phase, and call clearing phase, for the provision of data transmission services;

b) in cases where conveyance of user data during these phases is requested, but where no support by the network is provided, an additional protocol mechanism, which is not operated by the network itself should be utilized (example: the use of packet procedures over the PSTN);

c) in cases where rule b) fails or is not provided, the data calls will be aborted; an appropriate call progress message is returned to the DTE initiating the phase.

7.7.2 Fast select

The optional user facilities which are standardized for different data transmission services, and are related to fast select are shown in Table 7-10.

TABLE 7-10/X.301

Optional user facilities standardized for different data transmission services, related to fast select

Optional user facility	Period of time	Applies per call	Applies to circuit switched data transmission service			Applies to packet switched data transmission service		
			PSTN	CSPDN	ISDN	ISDN	PSPDN	MSS
Fast select		X				X	X	X
Fast select acceptance	X					X	X	X

Calling DTEs can request the *fast select* facility on a per call basis by means of an appropriate facility request in the call request phase.

The *fast select* facility allows conveyance during the call request phase from calling DTE to called DTE of user data up to 128 octets.

If the *fast select* facility indicates "no Restriction on Response", it allows for either during the call confirmation phase or during the call clearing phase or during both phases the conveyance of up to 128 octets user data from called DTE (or clearing DTE) to calling DTE (or cleared DTE).

If the *fast select* facility indicates "Restriction on Response", it allows no call confirmation phase and data transfer phase. However, it does allow conveyance during the call clearing phase (if initiated by the called DTE) of up to 128 octets from called DTE to calling DTE.

Where a calling DTE requests a *fast select* facility, the incoming call should only be delivered to the called DTE if that DTE has subscribed to the *fast select acceptance* facility (see 7.7.3).

Where a calling DTE requests the *fast select* facility, and if the called DTE has subscribed to *fast select acceptance*, the *fast select* facility and whether or not there is a "Restriction on Response" will be conveyed during the call request phase from calling DTE to called DTE.

If the called DTE has not subscribed to the *fast select acceptance* facility, no calls containing the *fast select* facility will be delivered to the called DTE. Such calls will be cleared by the network and a call progress signal *fast select acceptance not subscribed* will be returned to the calling DTE.

NOTES

1 For an interim period, some networks may not allow a DTE to transmit any user data in the call clearing phase when this phase is not initiated as a response on the call request phase.

2 The user data conveyed in addition to the normal data flow in the data transfer phase will not be fragmented for delivery across the DTE/DCE interface.

3 The significance of the call confirmation phase, or the call clearing phase conveying the call progress signal DTE originated as a direct response to the call request phase where the *fast select* facility has been used, is that the user data in the call request phase has been received by the called DTE.

7.7.3 Fast select acceptance

Fast select acceptance is an optional user facility agreed for a period of time. This facility, if subscribed to, authorizes the DCE to transmit to the called DTE incoming calls which request the *fast select* facility. In the absence of this facility, the DCE will not transmit to the called DTE incoming calls which request the *fast select* facility.

7.8 Other facilities

The other optional user facilities which are standardized for different data transmission services are shown in Table 7-11.

TABLE 7-11/X.301

Other optional user facilities standardized for different data transmission services

Optional user facility	Period of time	Applies per call	Applies to circuit switched data transmission service			Applies to packet switched data transmission service		
			PSTN	CSPDN	ISDN	ISDN	PSPDN	MSS
Manual answer	X			X	FS			
Connect when free	X			X	FS			
Waiting allowed	X			X	FS			
Receipt confirmation selection		X			FS	X	X	X
Expedited data negotiation		X			FS	X	X	X
FS For further study.								

7.8.1 Manual answer

7.8.1.1 General

Manual answer is a DTE operating mode allowed by some networks for the circuit-switched service in CSPDNs. DTEs operating in this mode may, when called, delay responding by the *call accepted* signal. Information indicating that a DTE operates with *manual answer* is stored at the exchange to which the user is connected.

7.8.1.2 Call establishment procedure

In the case of a call to a user DTE operating with *manual answer*, the destination exchange sends the *terminal called* signal to the originating exchange at connection of the call. At the originating exchange, this results in sending of the *terminal called* call progress signal to the calling user. It also results in extending the value of any time-out applicable to this phase of the call.

The call is completed as an ordinary call when the *call accepted* signal is received from the called user by the destination exchange and a signal indicating that the call has been connected is sent towards the originating exchange. If the *call accepted* signal is not received by the destination exchange within the applicable DCE time-out after sending of the *incoming call* signal to the called user, the call is cleared from the destination exchange without sending any call progress type backward signal.

NOTE – In the case where the originating network does not allow *manual answer* and the called user operates with *manual answer*, the originating network may charge the calling user for the time from the receipt of the *terminal called* signal.

7.8.2 Connect when free and waiting allowed

7.8.2.1 General

Connect when free and *waiting allowed* are optional user facilities assigned to the user for an agreed contractual period.

A user subscribing to the *connect when free* facility is assigned a number of waiting positions at his local exchange at which incoming calls received can wait when the access line(s) to the user is busy. The *waiting allowed* facility enables a user calling a busy user having the *connect when free* facility to wait for the completion of the call when the called user becomes free. During waiting, the connection is maintained.

The two facilities thus provide an opportunity for users having certain data traffic characteristics to make more efficient use of the network than in the ordinary case when a call to a busy user is rejected.

Facility registration is controlled by the Administration or Recognized Operating Agency.

7.8.2.2 Call establishment procedure

When receiving a call to a busy user (i.e., at least one access line to the called user is occupied by a call in progress) having the *connect when free* facility, the destination exchange checks the waiting positions at the called user:

a) in the case where a free waiting position exists, the call is placed in the queue and the *connect when free* signal is sent towards the originating exchange;

b) in the case where all waiting positions are occupied, the call is rejected and the *number busy* signal is sent towards the originating exchange.

The call may be rejected for other reasons not related to the *connect when free* facility.

The action at the originating exchange depends on whether the calling user has the *waiting allowed* facility and which signal is received.

a) In the case where the *connect when free* signal is received and the calling user has the *waiting allowed* facility, the *connect when free* call progress signal is sent to the calling user. The calling user can then either wait for completion of the call or clear the call. In the case where the calling user chooses to wait, the connection is maintained but is not through-connected. The normal time-out for completion of the call at the originating exchange is inhibited. The calling user cannot make or receive another call on the same access line during waiting.

b) In the case where the *connect when free* signal is received and the calling user does not have the *waiting allowed* facility, the *number busy* signal is sent to the calling user and the call is cleared.

c) In the case where the *number busy* signal is received, the *number busy* call progress signal is sent to the calling user and the call is cleared; this is also the case when the calling user has the *waiting allowed* facility.

When an access line becomes free to the called user, the destination exchange connects the first call in the queue in the normal manner. A signal indicating that the call has been connected is sent towards the originating exchange.

When receiving the signal indicating that the call has been connected, the originating exchange through-connects the call in the normal manner.

The waiting time will be charged. The calling user may send a clear request at any time to terminate the waiting which will result in normal network clearing and removal of the call from the queue. The waiting may also be terminated by the destination exchange in some abnormal situations resulting in a clearing sequence towards the calling user.

NOTE – The possible provision of a network time-out to limit the waiting time is for further study.

7.8.3 Receipt confirmation selection

7.8.3.1 General

Receipt confirmation selection is an optional user facility that permits on a per call basis of whether or not the receipt of data units in the data transfer phase will be confirmed end-to-end.

NOTE – Realization of this facility in PSPDNs and ISDNs can be performed by using the D-bit procedures (see Recommendation X.25).

7.8.3.2 Call request phase and call confirmation phase

The calling DTE may request during the call request phase end-to-end acknowledgement of delivery of data units it will be transmitting in the data transfer phase, by setting the receipt selection parameter to *end-to-end acknowledgement*. During the call request phase, any (part of the) network involved in the call, as well as the called DTE, that cannot support this end-to-end acknowledgement will set the receipt selection parameter to "non end-to-end acknowledgement". The finally resulting value will be applicable for the call and will be conveyed by the called DTE to the calling DTE during the call confirmation phase.

7.8.3.3 Data transfer phase

Delivery of data units to the receiving DTE will be confirmed to the sending DTE if the receipt confirmation parameter, conveyed in the call confirmation phase, had the value "end-to-end acknowledgement".

NOTE – In some cases (e.g. in PSPDNs) end-to-end receipt confirmation in this phase could still be applied independently of the presence of the negotiation in the call request phase/call confirmation phase. However, definitions in Recommendation X.213 do also require the negotiation.

7.8.3.4 Call clearing phase

No end-to-end acknowledgement applies to this phase.

8 Arrangements for call progress signals

Table 8-1 indicates different networks using different sets of call progress signals.

TABLE 8-1/X.301

Use of different sets of call progress signals by different networks

Call Progress Signal	Applies to circuit switched data transmission service			Applies to packet switched data transmission service		
	PSTN	CSPDN	ISDN	ISDN	PSPDN	MSS
X.96		X		X	X	X
Q.931			X	X		
Q.699			X			

In the case of terminals connected to public networks via private networks, call progress signals originated in the private network are distinguished from those originated in the public data network. In CSPDN, the call progress signal "subaddress called" is sent by the destination PDN when it passes a call containing private network address information to the called DTE/DCE interface. Any subsequent call progress signals will have been originated by the private network. In PSPDN, a specific and distinct coding range is allocated for call progress signals originated in a private network.

The internetwork arrangements described in this clause relate to the transfer across networks of the call progress signals. Different categories of interworking are considered:

– interworking by call control mapping (ICCM);

– interworking by port access (IPA).

Table 8-2 shows the different cases of interworking with regard to call progress signals, referring to the appropriate subclauses.

TABLE 8-2/X.301

Different cases of interworking with regard to call progress signals

Q.699 (SS No. 7)	ICCM: 8.3.1 IPA: NA		
Q.931	ICCM: 8.6.1 IPA: NA	ICCM: 8.2.1 IPA: NA	
X.96	ICCM: 8.5.1 IPA: 8.5.2	ICCM: 8.4.1 IPA: 8.4.2	ICCM: 8.1.1 IPA: 8.1.2
	Q.699 (SS No. 7)	Q.931	X.96

8.1 Interworking arrangements involving call progress signals defined in Recommendation X.96 only

8.1.1 Interworking by call control mapping

8.1.1.1 Call progress signals during call establishment

8.1.1.1.1 Call progress signals originated by the calling DTE (call request phase)

At the time of the call request, the calling DTE is not transmitting any call progress signal.

8.1.1.1.2 Call progress signals generated by the originating PDN (call request phase)

At the time of the call request, the originating PDN (including the DCE associated with the calling DTE) may have to clear the call, due to constraints related to the DTE/DCE interface of that calling DTE.

8.1.1.1.2.1 Incorrect called DTE address in a call request

The originating PDN may receive from the calling DTE a call request with a called DTE address which is not correct. If the originating PDN detects such a difficulty, it should clear the call with NOT OBTAINABLE indication. A possible reason is that the DCC or DNIC is the one assigned to the originating PDN, but the remaining digits of the address are not assigned to any DTE on that PDN.

NOTE – The transmission by the calling DTE of an incorrect national prefix (see 2.5/X.121) should be considered as a local procedure error.

8.1.1.1.2.2 Invalid facility requested by the calling DTE

When receiving from the calling DTE a call request that requires an optional user facility which is not offered to that DTE, the originating PDN should CLEAR the call with an INVALID FACILITY REQUEST indication.

Possible reasons include:

a) request for a facility which has not been subscribed by the DTE;

b) request for a facility which is not available in the originating PDN;

c) facility request which has not been recognized as valid by the originating PDN.

The exact circumstances for such call clearing by the originating PDN with an indication of invalid facility request, are detailed in the relevant X-Series Recommendations, i.e. DTE/DCE interface Recommendations, interwork signalling Recommendations.

8.1.1.1.2.3 Calling DTE procedure error related to a call request

When receiving a call request from the calling DTE, the originating PDN may detect a procedure error caused by the DTE. The originating PDN should then CLEAR the call with LOCAL PROCEDURE ERROR indication. Detailed circumstances of such procedure errors in a call request are indicated in the relevant X-Series DTE/DCE interface Recommendations.

Possible circumstances include:

a) call request on a logical channel which is not in the ready state (in the case of an X.25 interface);

b) incorrect reference of a logical channel for the call (in the case of an X.25 interface);

c) incorrect format during call establishment.

8.1.1.1.3 Call progress signals generated by an IDSE (call request phase)

At the time of a call request, an International Data Switching Equipment (IDSE) involved in call establishment may have to clear the call.

8.1.1.1.3.1 Incorrect called DTE address

In some calls, an IDSE may receive a called DTE address which is not compatible with the numbering plan or not assigned to any DTE at that time. The IDSE should then clear the call with NOT OBTAINABLE indication. Possible reasons include: Unknown called DCC or DNIC.

However, it should also be noted that an IDSE should, if possible, not transmit to the next IDSE a call request with a called DTE address which does not correspond to a predetermined route. If an IDSE receives a called DTE address which does not conform to predetermined route, the call may be cleared with ACCESS BARRED indication.

8.1.1.1.3.2 Internal network failure or congestion

When an IDSE detects that all possible suitable routes, from the calling DTE to the called DTE via this IDSE, are temporarily unavailable, the IDSE will clear the call with NETWORK CONGESTION indication.

8.1.1.1.3.3 Internal network failure on the transit route(s)

A temporary network failure may force an IDSE to clear the call request passing through it, with NETWORK CONGESTION indication.

8.1.1.1.3.4 Facility not available on the transit route(s)

When an IDSE detects a request for a facility intentionally not available on the transit route(s), the IDSE clears the call with INCOMPATIBLE DESTINATION indication or NETWORK CONGESTION indication in the case of CSPDN.

8.1.1.1.3.5 Charging facility not available on the transit route(s)

When an IDSE detects that requested charging facilities are intentionally not available on the transit route(s), it clears the call with INCOMPATIBLE DESTINATION indication or NETWORK CONGESTION indication in the case of CSPDN.

8.1.1.1.3.6 Access protection facility not available on the transit route(s)

When an IDSE detects that requested access protection facilities are intentionally not available on the transit route(s), it clears the call with ACCESS BARRED indication.

8.1.1.1.4 Call progress signals generated by the destination PDN (call request phase)

At the time of a call request, the destination PDN (including the DCE associated with the called DTE) may have to clear the call, due to constraints related to the DTE/DCE interface of that called DTE.

8.1.1.1.4.1 DTE/DCE interface not operational

The DTE/DCE interface of the called DTE may be out of order. Possible reasons include:

a) DTE uncontrolled not ready;

b) DCE power off;

c) Network fault in the local loop;

d) Level 1 not functioning (X.25 only);

e) Level 2 not in operation (X.25 only).

If the called DTE interface is not operational, and an incoming call cannot therefore be transmitted to that DTE, the destination PDN should clear the call with OUT OF ORDER indication, or in CSPDN with either UNCONTROLLED NOT READY, DCE POWER OFF or NETWORK FAULT IN THE LOCAL LOOP indication.

NOTE – Special conditions may apply, if a call redirection facility is subscribed to the called DTE.

8.1.1.1.4.2 Busy DTE/DCE interface

When the called DTE is detected by the destination PDN as engaged on other call(s), and therefore as not being able to accept a new incoming call, the destination PDN should clear the call with NUMBER BUSY indication. The called DTE is not indicating the incoming call.

NOTES

1 In case of an X.25 interface, some logical channel may be reserved (e.g. for outgoing calls) and be unavailable for incoming calls (see also Annex B/X.25). The number busy condition described in this subclause applies if at least one logical channel supports incoming calls.

2 Special conditions may apply if a call redirection facility is subscribed to by the called DTE.

3 In the case where the called DTE subscribes to the Hunt group facility, the busy condition occurs when all available circuits/channels are busy in all DTE/DCE interfaces in the Hunt group.

When the called DTE interface is an X.25 interface, a call collision may occur on one of the logical channels. If such a collision occurs, it normally means that the X.25 interface is saturated and cannot therefore accept any additional calls at that time. The called DTE is then given priority for its call establishment, and the destination PDN should clear the incoming call with NUMBER BUSY indication. The incoming call is not transmitted to the called DTE.

8.1.1.1.4.3 Non-acceptance of a facility by the called DTE

Except in the cases specified in 8.1.1.1.4.4, and 8.1.1.1.4.5, and the case where the called DTE does not subscribe to fast select acceptance, when the called DTE interface does not support a function or facility requested in the incoming call, the destination PDN should clear the call with INCOMPATIBLE DESTINATION indication (for PSPDN). The incoming call is not transmitted to the called DTE. The call progress signal used in CSPDN is for further study.

The exact circumstances for such call clearing by the destination PDN are detailed in the relevant X-Series DTE/DCE interface Recommendations.

When the called DTE in PSPDN has not subscribed to the fast select acceptance facility, the destination PDN should clear a fast select call with FAST SELECT ACCEPTANCE NOT SUBSCRIBED indication. The incoming call is not transmitted to the called DTE.

8.1.1.1.4.4 Specific charging facility requested by the called DTE

When the called DTE has not subscribed to the reverse charging acceptance facility, and if an incoming call requests reverse charging, the destination PDN should clear that call with REVERSE CHARGING ACCEPTANCE NOT SUBSCRIBED indication. The incoming call is not transmitted to the called DTE.

8.1.1.1.4.5 Specific access protection conditions required by the called DTE

If an incoming call is destined for a DTE which has subscribed to the *incoming calls barred* facility, the destination PDN should clear the call with ACCESS BARRED indication. The incoming call is not transmitted to the called DTE.

If the destination PDN detects that the calling DTE is not permitted to make the connection to the called DTE, it should clear the call with ACCESS BARRED indication. The incoming call is not transmitted to the called DTE. Possible reasons include:

a) incompatible closed user group;

b) unauthorized access between the calling DTE and the called DTE. The possible exact circumstances of such restrictions are for further study.

NOTE – The fact that the calling DTE is not permitted to make the connection to the called DTE may be previously detected on the international part of the route where the call would then be cleared. In that case, the destination PDN is not aware of the incoming call.

8.1.1.1.5 Call progress signals generated by the called DTE (call request and call confirmation phases)

The called DTE may decide to refuse the incoming call. It will then clear the call with DTE ORIGINATED indication (in PSPDN). In CSPDN, the destination PDN may signal SUBADDRESS CALLED, following which a call progress signal may be indicated in a clearing signal from the DTE. Call progress signals generated by the called DTE are transferred to the calling DTE.

8.1.1.1.6 Call progress signals generated by the destination PDN (call confirmation phase)

8.1.1.1.6.1 Called DTE procedure error related to a call acceptance

When expecting a CALL ACCEPTED indication from the called DTE, the destination PDN may detect a procedure error caused by the DTE. The destination PDN should then clear the call, with LOCAL PROCEDURE ERROR indication to the called DTE, and REMOTE PROCEDURE ERROR to the calling DTE. Detailed circumstances of such procedure errors in a call accepted indication are described in the relevant X-Series DTE/DCE interface Recommendations. Possible circumstances include incorrect format of the CALL ACCEPTED indication.

8.1.1.1.7 Call progress signals generated by an IDSE (call confirmation phase)

For further study.

8.1.1.1.8 Call progress signals generated by the originating PDN (call confirmation phase)

For further study.

8.1.1.1.9 Call progress signals resulting of call abortion (call request and call confirmation phases)

For further study.

8.1.1.2 Clearing call progress signals during data transfer phase

8.1.1.2.1 Clearing call progress signals generated by a DTE (data transfer phase)

When a call clearing comes from an X.25 DTE, the following rules apply:

- The clearing cause should be DTE ORIGINATED.
- A diagnostic of one octet may be transmitted by the DTE, is passed unchanged from the clearing DTE to the other DTE.
- In CSPDN, no call progress signal is generated when initiating clearing during the data transfer phase.

8.1.1.2.2 Clearing call progress signals generated by a terminating PDN (data transfer phase)

After call establishment, either of the two terminating PDNs may have to clear the call, due to events occurring at the corresponding DTE/DCE interface.

8.1.1.2.2.1 DTE/DCE interface not operational

When a DTE/DCE interface on a PSPDN ceases to be operational, and cannot therefore convey any more signals for a call already established through that interface, the terminating PDN may clear that call with OUT OF ORDER indication. Possible reasons include:

a) Layer 1 not functioning;

b) Layer 2 not in operation.

NOTES

1 The exact circumstances, in which the terminating PDN would have to clear the virtual call because of the out of order condition of the DTE/DCE interface, are for further study.

2 In the case of packet switched services, although the basic out of order indication is transmitted for either condition a) or b) above, the diagnostic may give more detail.

3 When the network is ready to resume normal operation after a temporary failure or congestion, the terminating PDN may inform the DTE with a NETWORK OPERATIONAL indication. In the case of an X.25 interface, this information is passed in a restart indication packet.

8.1.1.2.2.2 Procedure error at a DTE/DCE interface

When a procedure error caused by the DTE on a PSPDN is detected that necessitates a call clearing, the terminating PDN should clear the call with LOCAL PROCEDURE ERROR indication to the local DTE, and with REMOTE PROCEDURE ERROR indication to the remote DTE. Detailed circumstances of such procedure errors are indicated in the relevant X-Series DTE/DCE interface Recommendations (e.g. incorrect format, expiration of a time-out).

8.1.1.2.3 Clearing call progress signals generated by an IDSE (data transfer phase)

After call establishment, an International Data Switching Equipment (IDSE) may have to clear a call due to some constraints in the international transit part of the route.

8.1.1.2.3.1 Internal network failure or congestion

A temporary network failure or congestion may force an IDSE to clear call passing through it, with NETWORK CONGESTION indication (PSPDN only).

8.1.1.2.3.2 Facility not available on the transit route(s)

When an IDSE detects that it is not possible to offer a facility at a certain time, it clears the call passing through it with NETWORK CONGESTION indication (PSPDN only).

8.1.1.2.4 Possible collisions between clearing call progress signals (data transfer phase)

For further study.

8.1.1.3 Reset call progress signals during data transfer

This subclause only applies to packet switched services, in which a virtual call or a permanent virtual circuit may be reset.

8.1.1.3.1 Reset call progress signals generated by a DTE (data transfer phase)

When a reset comes from an X.25 DTE, the following rules apply:

- The reset cause should be DTE ORIGINATED.
- A diagnostic of one octet may be transmitted by the DTE, and is passed unchanged from the resetting DTE to the other DTE.

8.1.1.3.2 Reset call progress signals generated by a terminating PDN (data transfer phase)

When a failure occurs at an X.25 DTE/DCE interface, without call clearing being necessary, the terminating PDN may reset the virtual call with OUT OF ORDER indication.

NOTE – The exact circumstances, in which the terminating PDN would have to reset the virtual call because of the out of order condition at the DTE/DCE interface, are for further study.

On an X.25 interface, certain procedure errors caused by the DTE may not necessitate a call clearing. The terminating PDN should then reset the virtual call with LOCAL PROCEDURE ERROR indication to the local DTE, and with REMOTE PROCEDURE ERROR indication to the remote DTE. Detailed circumstances of such procedure errors are indicated in Recommendation X.25.

When an X.25 interface is ready to resume normal data transfer on a permanent virtual circuit after a failure or out of order condition (e.g. restart), the terminating PDN should reset the permanent virtual circuit with REMOTE DTE OPERATIONAL indication.

8.1.1.3.3 Reset call progress signals generated by an IDSE (data transfer phase)

8.1.1.3.3.1 Internal network failure or congestion

In a permanent virtual circuit, a network failure or congestion may force an IDSE to send a reset packet with NETWORK OUT OF ORDER indication toward both DTEs involved.

8.1.1.3.4 Possible collisions between reset call progress signals (data transfer phase)

For further study.

8.1.2 Interworking by port access

For further study.

8.2 Internetwork arrangements involving call progress signals defined in Recommendation Q.931 only

8.2.1 Interworking by call control mapping

For further study.

8.3 Internetwork arrangements involving call progress signals defined in Recommendation Q.699 only

8.3.1 Interworking by call control mapping

For further study.

8.3.2 Interworking by port access

For further study.

8.4 Internetwork arrangements involving call progress signals defined in Recommendations X.96 and Q.931

8.4.1 Interworking by call control mapping

For further study.

8.4.2 Interworking by port access

For further study.

8.5 Internetwork arrangements involving call progress signals defined in Recommendations X.96 and Q.699

8.5.1 Interworking by call control mapping

For further study.

8.5.2 Interworking by port access

For further study.

8.6 Internetwork arrangements involving call progress signals defined in Recommendations Q.931 and Q.699

8.6.1 Interworking by call control mapping

See Recommendation Q.699.

Appendix I

(to Recommendation X.301)

PROTOCOL ELEMENTS OF DIFFERENT NETWORKS USED FOR THE FACILITIES AND ARRANGEMENTS DESCRIBED IN THIS RECOMMENDATION

(This appendix does not form an integral part of this Recommendation)

This appendix describes the protocol elements of different networks, used for the facilities and arrangements described in this Recommendation.

The following access protocols or protocol combinations are considered:

I.1 Circuit switched data transmission services

CSPDN	X.20, X.20 *bis,* X.21, X.21 *bis*, X.22
ISDN	I.420, I.421

I.2 Packet switched data transmission services

CSPDN	X.25, X.32
ISDN	X.31
Mobile data systems	X.350/X.352

The following Table I.1 shows the protocol elements in each of the protocol combinations, used in the call request phase, call confirmation phase, and call clearing phase of the call, and which can be utilized for conveyance of the parameters for the facilities and arrangements described in this Recommendation.

The following tables summarize how the arrangements and facilities described in this Recommendation apply to the call request phase, call confirmation phase, and call clearing phase of the call.

Conventions used in the Tables I.2 to I.7:

a) The arrangement or facility parameter (if requested) will be conveyed (by means of the protocol elements shown in Tables I.1).

B The arrangement or facility parameter (if requested) will be conveyed and has a boolean value.

(=) The conveyed parameter has the identical value as the parameter supplied by the remote DTE initiating this phase of the call.

(≥) The conveyed parameter has a greater or equal value than the parameter supplied by the remote DTE initiating this phase of the call.

(≤) The conveyed parameter has a smaller or equal value than the parameter supplied by the remote DTE initiating this phase of the call. In case of a boolean, the conveyed parameter value may have changed from **true** to **false** compared with the value supplied by the remote DTE initiating this phase of the call.

TABLE I.1/X.301

Protocol elements that can be used in the different phases of a call for the conveyance of facility parameters

Circuit Switched Data Transmission Service		Call Request Phase		Call Confirmation Phase		Call Clearing Phase	
Network	Protocol(s)	Calling DTE	Called DTE	Called DTE	Calling DTE	Clearing DTE	Cleared DTE
CSPDN	X.20	Call Request	Incoming Call	Call Accepted	Ready for Data	DTE Clear Request	DCE Clear Indication
	X.20 *bis*	108.1 ON (Note 3)	125 ON	108 ON	107 ON	108 OFF	107 OFF
	X.21	Call Request	Incoming Call	Call Accepted	Ready for Data	DTE Clear Request	DCE Clear Indication
	X.21 *bis*	108.1 ON (Note 3)	125 ON	108 ON	107 ON	108 OFF	107 OFF
	X.22	← See Recommendation X.21 →					
ISDN	I.420, I.421	FS	FS	FS	FS	FS	FS
Packet Switched Data Transmission Service							
Network	Protocol(s)						
PSPDN	X.25	Call request packet	Incoming call packet	Call accepted packet	Clear connected packet	Clear request packet	Clear indication packet
	X.32	Call request packet	Incoming call packet	Call accepted packet	Clear connected packet	Clear request packet	Clear indication packet
ISDN	X.31	Call request packet	Incoming call packet	Call accepted packet	Clear connected packet	Clear request packet	Clear indication packet
Mobile Data Systems	X.350/X.352	Call request packet	Incoming call packet	Call accepted packet	Clear connected packet	Clear request packet	Clear indication packet

FS For further study

NOTES

1 For conveyance of the facility parameters, utilization of the Incoming Call Packet is mandatory. However, in order to speed up the decision by the called DTE whether or not to accept the call, optionally all facility parameters may be copied in the SETUP message.

2 The RELease or RELease COMplete messages can only be utilized for facility parameter conveyance if such message is issued in direct response to a SETUP message.

3 Only for direct call facilities.

TABLE I.2/X.301

Arrangements and facilities related to the transfer of addressing information

Arrangement/Optional User Facility	Call Request Phase		Call Confirmation Phase		Call Clearing Phase	
	Calling DTE	Called DTE	Called DTE	Calling DTE	Clearing DTE	Cleared DTE
Transfer of X.121 Calling Address	a) (Note 1)	a)(=) (Note 2)				
Transfer of E.164 Calling Address	a) (Note 1)	a)(=) (Note 2)				
Transfer of X.121 Called Address	a)	a)(=) (Note 2)	a) (Notes 1, 3)	a)(=) (Note 2)	a) (Notes 1, 3)	a)(=) (Note 2)
Transfer of E.164 Called Address	a)	a)(=) (Note 2)	a) (Notes 1, 3)	a)(=) (Note 2)	a) (Notes 1, 3)	a)(=) (Note 2)
Transfer of Calling NAE/Subaddress	a)	a)(=)				
Transfer of Called NAE/Subaddress	a)	a)(=)	a) (Note 3)	a)(=)	a) (Note 3)	a)(=)

NOTES

1 The address may be provided by the network.

2 The value may have been changed, e.g. due to the use of prefixes, country codes.

3 May only be needed in cases where the responding address is different from the originally called address.

TABLE I.3/X.301

Arrangements and optional user facilities related to the QOS to the call

Arrangement/Optional User Facility	Call Request Phase		Call Confirmation Phase		Call Clearing Phase	
	Calling DTE	Called DTE	Called DTE	Calling DTE	Clearing DTE	Cleared DTE
Transit Delay Selection Indication	a)	a)(≤ ≥)		a)(≤ ≥)		
Throughput Class Negotiation	a)	a)(≥)	a)	a)(=)		

NOTE – Compared with the parameter value supplied in the Call Request Phase.

TABLE I.4/X.301

Arrangements and optional user facilities related to the charging conditions applying to the call

Arrangement/Optional User Facility	Call Request Phase		Call Confirmation Phase		Call Clearing Phase	
	Calling DTE	Called DTE	Called DTE	Calling DTE	Clearing DTE	Cleared DTE
Reverse Charging	B	B(=)				
Charging Information	B (Note)		B (Note)		a) (Note)	a) (Note)
NOTE – Charging Information is an arrangement between DTE and Network only. The request is made in the first message sent to the network. The response is provided in the first message from the network to the information requesting DTE in the Call Clearing Phase. In case that the information requesting DTE is also the clearing DTE, the requested information can only be conveyed if additional call clearing confirmation arrangements exist (e.g. in packet procedures the Clear Confirmation packet).						

TABLE I.5/X.301

Arrangements and optional user facilities related to specific routing conditions requested by the user of the call

Arrangement/Optional User Facility	Call Request Phase		Call Confirmation Phase		Call Clearing Phase	
	Calling DTE	Called DTE	Called DTE	Calling DTE	Clearing DTE	Cleared DTE
ROA Selection	a)					
Called Line Address, Modified Notification			a)	a)(=)	a) (Note)	a)(=) (Note)
Call Redirection or Deflection Notification		a)				
NOTE – Only conveyed when the call clearing phase follows directly after the call request phase.						

TABLE I.6/X.301

Arrangements and optional user facilities related to protection mechanisms requested by the user of the call

Arrangement/Optional User Facility	Call Request Phase		Call Confirmation Phase		Call Clearing Phase	
	Calling DTE	Called DTE	Called DTE	Calling DTE	Clearing DTE	Cleared DTE
CUG Selection	a)	a)(=) (Note)				
CUG with Outgoing Access Selection	a)	a)(=) (Note)				
Bilateral CUG Selection	a)	a)(=) (Note)				
NUI	a)		a)			
NUI Override	a)					
NOTE – The value could have been changed due to international interworking.						

TABLE I.7/X.301

Arrangements and optional user facilities to convey user data in addition to the normal data flow in the data transfer phase

Arrangement/Optional User Facility	Call Request Phase		Call Confirmation Phase		Call Clearing Phase	
	Calling DTE	Called DTE	Called DTE	Calling DTE	Clearing DTE	Cleared DTE
User Data conveyed in the Call Request Phase	a)	a)(=)				
User Data conveyed in the Call Confirmation Phase			a)	a)(=)		
User Data conveyed in the Call Clearing Phase					a)	a)(=)
Fast Select						
– Restriction on Response	B	B(=)				
– No Restriction on Response	B	B(=)				

TABLE I.8/X.301

Other arrangements and optional user facilities

Arrangement/Optional User Facility	Call Request Phase		Call Confirmation Phase		Call Clearing Phase	
	Calling DTE	Called DTE	Called DTE	Calling DTE	Clearing DTE	Cleared DTE
Receipt Confirmation Selection	B	B(≤)	B	B(=)		