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Foreword

This European Telecommunication Standard (ETS) has been produced by the Network Aspects (NA) Technical Committee of the European Telecommunications Standards Institute (ETSI), in co-operation with the Signalling Protocols and Switching Sub-Committee, and with the T/SF Committee of the Conference of European Posts and Telecommunications.

This ETS is based on CCITT Recommendation E.172 [1] as given in the CCITT Blue Book, Volume II, Fascicle II.2, 1988. The requirements of this CCITT Recommendation shall apply together with the additional elements, and subject to the clarifications identified in this ETS.

CCITT Recommendation I.335 [2], as given in the CCITT Blue Book, Volume II, Fascicle III.8, 1988 describes the use of the ISUP Transmission Medium Requirement for routing.

This ETS has been prepared in support of the ISDN, as defined in ETSI Technical Report ETR 010 "The ETSI Basic Guide on the European Integrated Services Digital Network (ISDN)", which contains a complete list of services which the ISDN will provide. This ETS also supports services and capabilities as specified in ETS 300 121 [3].

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1 Scope

This standard gives guidance on call routing during the implementation of ISDN in Europe, as defined by the Memorandum of Understanding on the Implementation of the ISDN in Europe in 1992.

It is applicable to the functions required at ISDN international gateways and international transit exchanges for routing and network planning in order to achieve practical international interconnection of networks.

The relevant CCITT routing recommendations are identified and clarifications and additions to them are provided where necessary.

This standard is produced in connection with the implementation of ISDN services, using either ISUP version 1 or CEPT No. 7 TUP+ in the international network. This standard covers the services which are supported by ISUP version 1.

The following bearer and teleservices are not within the scope of this standard:

- 2 X 64 kbit/s circuit mode bearer service;

- videotex photographic mode;

- computerised communication;

- teleaction;

- audiographic teleconferencing;

- 7 kHz telephony;

- videotelephony.

2 Normative references

This standard incorporates, by dated or undated reference, provisions from other publications. Those normative references specific to this part are cited at the appropriate places in the text and listed below. For dated references, subsequent amendments to, or revisions of these publications will apply to this standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

[1]   CCITT Recommendation E.172 (1988): "Call Routing in the ISDN Era".

[2]   CCITT Recommendation I.335 (1988): "ISDN Routing Principles".

[3]   ETS 300 121: "Integrated Services Digital Network (ISDN); Application of the ISDN user part of CCITT Signalling System No.7 for international ISDN interconnections; CCITT Recommendation Q.767 draft edition 3: 1990 - modified".

[4]   CCITT Recommendation I.530 (1988): "Network Interworking between an ISDN and a PSTN".

3 Symbols and abbreviations

BC	Bearer Capability
CCITT	Comité Consultatif International Telegraphic et Telephonique
CEPT	Conférence des Administrations Européenes des Postes et Télécommunications
CLIP	Calling Line Identification Presentation
CLIR	Calling Line Identification Restriction
COLP	Connected Line Identification Presentation
COLR	Connected Line Identification Restriction
CUG	Closed User Group
DDI	Direct Dialling In
ETSI	European Telecommunications Standards Institute
IDN	Integrated Digital Network
IPI	ISUP Preference Indicator
ISDN	Integrated Services Digital Network
ISUP	ISDN User Part
ITC	Information Transfer Capability
MSN	Multiple Subscriber Number
PSPDN	Public Switched Packet Data Network
PSTN	Public Switched Telephone Network
R2	Signalling System R2
SC	Signalling Capability
SUB	Subaddressing
TMR	Transmission Medium Requirement
TP	Terminal Portability
TUP	Telephone User Part
TUP+	Enhanced Telephone User Part
UUS	User-to-User Signalling

4 Additions and/or clarifications to CCITT Recommendation E.172 [1]

4.1 Paragraph 6: Signalling Capability

Subclause 5.4 of this standard contains the application of the criteria for setting the IPI parameter for the implementation of the ISDN in Europe.

In table 3 of the CCITT Recommendation, the cases "64 kbit/s unrestricted" and "ISUP not required" are characterised by "Not applicable". The conjunction of these two values could nevertheless be used, according to bilateral agreements, in order to provide an international digital connectivity service (see also subclause 5.4 of this standard and Note 11 to table 4 of the CCITT Recommendation).

4.2 Annex A to E.172

The information contained in this annex is extended in subclauses 5.1 to 5.3 of this standard, to cover the implementation of the ISDN in Europe. The interworking situation from PSTN to ISDN is further detailed in Clause 6 of this standard.

4.3 Annex B to E.172

The application of the criteria defined in this annex to the implementation of the ISDN in Europe is specified in subclause 5.4 of this standard.

5 Additional information on parameters used for routing

5.1 Use of the Transmission Medium Requirement parameter

The use of the ISUP Transmission Medium Requirement (TMR) parameter for routing is described in:

- CCITT Recommendation E.172 [1], paragraph 5 (h); and

- CCITT Recommendation I.335 [2], paragraphs 4.2.1 (e) and 4.4.4.4.

In addition to the statements made in the above mentioned paragraphs, the following shall apply:

The TMR shall be used for routing in the international network;

The TMR parameter shall be conveyed unchanged in the international network.

For a specific service request, one TMR value shall be used in the international network and across internetwork boundaries. For its value see subclause 5.3.

It is recommended that national networks use the same TMR values as the international network. Conversion from the requested service to the TMR value can then be performed in the originating local exchange. If not done there, then the TMR information must be available from the outgoing international gateway onwards. It is then forwarded to following exchanges, if possible even up to the destination exchange.

At transit international exchanges as well as at incoming international gateway exchanges, the TMR shall be examined for routing purposes, irrespective of the service requested. This does not preclude that incoming gateway exchanges may need to examine additional information available to determine national routing.

5.2 Capability of signalling systems to support various TMRs

Table 1 indicates, for the different values of TMR, which international signalling systems have the capability of carrying implicitly or explicitly the TMR information (or request):

Table 1

Transmission medium required	Signalling systems					
	CCITT	CEPT	CCITT	CCITT No.6	R2	CCITT No.5
	ISUP	TUP+	TUP			
64 kbit/s unrestricted	V	V (NOTE 1)	V (NOTE 3)	(NOTE 2)	(NOTE 2)	(NOTE 4)
3,1 kHz audio	V	V (NOTE 1)	V	V	V	V (NOTE 4)
speech	V	V (NOTE 1)	V	(NOTE 2)	(NOTE 2)	(NOTE 4)

```
V:       The explicit or implicit transfer of the TMR information is
         possible. The signalling system definitely can be used.

NOTE 1:  The TUP+ uses the Information Transfer Capability (ITC) to
         indicate the requested TMR (see subclause 6.2).

NOTE 2:  The explicit transfer of the TMR information is not
         possible. This does not preclude the use of the
         signalling system, if:

         a) information is made available by other means
            (specialised trunk, particular numbering method); or

         b) the configuration of the network can guarantee the
            provision of the requested TMR; or

         c) there is further enhancement of the signalling systems
            in question.

NOTE 3:  The TUP provides for a possibility to indicate 64
         kbit/s connectivity.

NOTE 4:  CCITT Signalling system No. 5 links may not support 64 kbit/s
         unrestricted and 3,1 kHz audio bearer service
         because of the splitting function.

         CCITT Signalling system No. 5 does not support all kinds of
         modem operation e.g., V.22bis is not supported. Therefore,
         CCITT Signalling system No. 5 only supports the TMR speech.
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5.3 Relationship between requested service and TMR values

The following table gives TMR values for ISDN services to be used across international and internetwork boundaries:

Table 2

Requested service		TMR value		
		speech	3,1 kHz audio	64 kbit/s unrestricted
Bearer Service	64 kbit/s unrestricted			X
	3,1 kHz audio		X	
	speech	X		
	Packet Mode Case A: B-Channel			X (NOTE 1)
	Packet Mode Case B: B-Channel			X
	Packet Mode Case B: D-Channel			(NOTE 2)
Tele-services	Telephony 3,1 kHz	X		
	Telefax Group 4			X
	Teletex			X
	ISDN Syntax Based Videotex			X
PSTN/ IDN services	Telephony		X	
	Facsimile Group 3		X	
	Voice Band Data		X	
	Digital Connectivity			X

NOTE 1:	If implemented through the use of an on-demand or a semipermanent connection basis between the X.25 terminal and the packet handler.
NOTE 2:	The packet mode case B D-channel does not use TMR.

5.4 ISUP preference indicator values for ISDN services

5.4.1 General

CCITT Recommendation E.172 [1] describes the use of the ISUP Preference Indicator (IPI) and sets out criteria for setting the IPI to one of the three possible values. This section applies these criteria to the ISDN services and assigns IPI values to them.

Where more than one service is requested and one of the service requests is for a more restrictive IPI value, then the more restrictive IPI value shall be used.

Example: In the case of a joint request for services CUG (without outgoing access) - "ISUP required", and subaddress - "ISUP preferred", then the IPI value "ISUP required" shall be used.

5.4.2   Services requiring "ISUP Required"

Closed User Group (CUG) without outgoing access.

>   NOTE: TUP+ may be selected.

5.4.3   Services requiring "ISUP Preferred"

The value "ISUP preferred" is a minimum for all calls initiated by ISDN subscribers, in order to allow provision of supplementary services invoked after initial service request.

5.4.4   Services requiring "ISUP Not Required"

Calls originating in the PSTN.

6   Interworking requirements for the support of PSTN/IDN services in ISDN

The ISDN is evolving from PSTN/IDN. Existing PSTN/IDN services (refer to tables 2 and 9) therefore also have to be supported in the ISDN. This requires network interworking between the ISDN and PSTN (refer to CCITT Recommendation. I.530 [4]). In most countries there will be an integrated PSTN/ISDN network.

The following paragraphs only cover the interworking aspects of routing. They do not intend to cover all the signalling interworking aspects, which should be described in the signalling standards.

6.1   Interworking between TUP/channel associated signalling and ISUP

6.1.1   Interworking from TUP/channel associated signalling to ISUP

In the case of interworking between an incoming signalling system that does not have the capability of an explicit indication about the requested signalling capability and the ISUP, the implicit value given to the "ISUP preference indicator" shall be "ISUP not required", since it is not useful to request ISDN signalling capabilities.

In the case of interworking between an incoming TUP or a channel associated signalling system that does not have the capability of an explicit indication about the requested TMR and ISUP:

a)   the TMR parameter of ISUP shall be set to "3,1 kHz audio";

b)   in the case where an information is made available by any means indicating a digital connectivity request, the value given to the TMR parameter of ISUP shall be "64 kbit/s unrestricted".

6.1.2   Interworking from ISUP to TUP/channel associated signalling systems

In the case of interworking from ISUP to TUP or channel associated signalling, the ISUP preference indicator (IPI) has to be examined:

a)   if the IPI is set to "ISUP required", an ISDN route shall be selected, if available. If it is not available, i.e. congested, failed or not provided, the call is failed (see CCITT Recommendation E.172 [1], paragraph 6.3);

b)   if the IPI is set to "ISUP preferred" (see CCITT Recommendation E.172 [1], paragraph 6.3);

c)   if TUP is selected and if the TMR in ISUP indicates 64 kbit/s unrestricted, the proper indication is set in TUP to perform a digital connectivity (all digital path required indicator = digital path required). Otherwise this connection with TUP is set up to perform the other PSTN services (TMR = speech or 3,1 kHz audio);

d)   The call is released if channel associated signalling is to be selected and

1)   if TMR in ISUP indicates 64 kbit/s unrestricted; and

2)   if no information is made available in the channel associated signalling to provide a digital connectivity or the configuration of the network cannot guarantee a digital connectivity.

6.2   Interworking between TUP+ and ISUP

For links controlled by TUP+, the signalling capability required on a connection is indicated by the "Signalling Capability (SC) Requested" information field, which has the same function as the ISUP preference indicator. There are three possible values for this information:

-    TUP+ mandatory;

-    TUP+ preferred;

-    any signalling.

For links controlled by TUP+, the "ITC requested" information has the same function as the TMR parameter in ISUP, and is used in the same way as described in subclause 5.3 to select appropriate transmission and switching capabilities.

This ITC information can be set to the following values:

-    64 kbit/s unrestricted;

-    speech;

-    3,1 kHz audio.

For a specific service request, one ITC value shall be used in the international network. This value is the same as the TMR given in subclause 5.3, for the services supported in TUP+.

6.2.1   Interworking from TUP+ to ISUP

In the case of interworking from TUP+ to ISUP, the following shall apply:

a)   The TMR parameter of ISUP shall be set to the same value as the received ITC parameter of TUP+; and

b)   the IPI parameter of ISUP shall be set depending on the value of the received "signalling capability requested" of TUP+, as indicated in table 3:

Table 3

TUP+ signalling capability requested	ISDN - UP preference indicator
TUP+ mandatory	ISUP required
TUP+ preferred	ISUP preferred
any signalling	ISUP not required

6.2.2 Interworking from ISUP to TUP+

In case of interworking from ISUP to TUP+, the following rules shall apply:

a) It is necessary to examine the ISUP preference indicator (IPI) and, in some cases, the supplementary service request;

b) When the IPI is set to either "ISUP preferred" or "ISUP required", an ISUP route shall be selected, if available. If it is not available (i.e. congested, failed or not provided), then the supplementary service request shall determine whether TUP+ can be selected (see table 4). For the impact on supplementary services, see subclause 6.3.

Table 4

Supplementary Service ISUP	Select TUP+ ?
CUG without outgoing access	yes
CUG with outgoing access	yes
SUB	yes
CLIP	yes
CLIR	yes
COLP	yes
COLR	yes
UUS 1 implicit	yes

c) When TUP+ is selected, the TMR in ISUP shall be mapped to the ITC in TUP+ as given in table 5:

Table 5

TMR	ITC
64 kbit/s unrestricted	64 kbit/s unrestricted
3,1 kHz audio	3,1 kHz audio
speech	speech

d) When TUP+ is selected, the IPI in ISUP shall be mapped to the SC in TUP+ as given in table 6:

Table 6

IPI	SC
ISUP required	TUP+ mandatory
ISUP preferred	TUP+ preferred
ISUP not required	any signalling

6.3 Interworking impact on supplementary services

For the support of supplementary services in ISDN by ISUP version 1, see normative Annex A. If ISUP is used end-to end, there is no impact on the supplementary services.

In order to perform supplementary services, an end-to-end ISUP connection may be "required" or "preferred" (see subclauses 6.1 and 6.2). In the latter case, and if no ISUP route is available for the destination, the call is routed either on a TUP or a channel associated signalling route (see subclause 6.1.2) or on a TUP+ route (see subclause 6.2.2), and then the supplementary services possibly invoked during the call may be affected as follows in tables 7 and 8:

Table 7: Call routed on TUP or Channel Associated Signalling

Supplementary Service ISUP	Select TUP+ ?
CLIP	supplementary service not supported
CLIR	supplementary service not supported
COLP	supplementary service not supported
COLR	supplementary service not supported
CUG	supplementary service not supported
DDI	no impact
MSN	no impact
SUB	subaddress discarded
TP	no notification
UUS 1 implicit	supplementary service not supported

Table 8: Call routed on TUP+

Supplementary Service internationally supported by ISUP	Impact on the Supplementary Service	
CLIP	supplementary service supported	(NOTE 1)
CLIR	supplementary service supported	(NOTE 1)
COLP	supplementary service not supported	(NOTE 2)
COLR	supplementary service not supported	(NOTE 2)
CUG	supplementary service not supported	
DDI	no impact	
MSN	no impact	
SUB	supplementary service supported	(NOTE 3)
TP	no notification	
UUS 1 implicit	supplementary service supported	(NOTE 4)

NOTE 1: Supported to guidelines to CEPT Recommendation T/S 43-02 (1987, revised 1988).

NOTE 2: "Supplementary service not supported" means that this service, as it is described in the Stage 1 description, is not supported.

NOTE 3: Called Party Subaddress discarded, if subaddress information field > 4 octets.

NOTE 4: UUS information discarded, if user information field > 32 octets.

6.4 Service interworking/intercommunication and fall back

6.4.1 Impact on service interworking and intercommunication on routing

The interworking of services in the ISDN (such as telefax group 4) with services within the PSTN (telephony, telefax group 3) is a basic requirement for the ISDN services. The case of intercommunication (e.g. call is set up within the ISDN only) is not relevant for the routing.

If an incoming call is incompatible with the terminals connected to an access, the call will be released.

In order to allow calls between ISDN networks with full bearer and signalling capabilities and non-ISDN networks not providing the ISDN signalling capabilities but providing the bearer capabilities, and as the interworking point has no knowledge about the terminal connected to the destination access, the interworking point does not release the call, if the appropriate bearer capability can be provided on the selected route.

Considering the bearer and teleservices and assuming the selected route has the appropriate bearer capability, table 9 gives the possible network-initiated interworking cases (indicated by an "X" or a NOTE), where the routing on a route with lower capabilities is allowed. This table only shows cross-references without referring to a certain direction of interworking.

Table 9

	Outgoing provided service														
	Bearer Service Circuit Mode			Packet Mode Service			Tele-service				PSTN/IDN Service				PSPDN
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Bearer Service Circuit Mode															
1 Speech	X		X (6)								X				
2 64 kbit/s unres.		X		X	X	X								(2)	
3 3,1 kHz audio			X								(1)	(1)	(1)		
Bearer Service Packet Mode															
4 Case A: B-Channel		X		X (5)	X (5)									(2)	X
5 Case B: B-Channel		X			X (5)										X
6 Case B: D-Channel						X (5)									X
Teleservices															
7 Telephony(3,1 kHz)							X								
8 Teletex		(3)						X						(2)	
9 Telefax 4		(3)							X					(2)	
10 Videotex synt. based		(3)								X				(2)	
PSTN / IDN services															
11 Telephony			(1)								X				
12 Fax 2/3			(1)									X			
13 Voice band Data			(1)										X		
14 Digital connectivity		(4)												X	

 NOTE 1: PSTN network provides for 3,1 kHz audio bearer service.

 NOTE 2: Bearer capability supported, signalling capability lost.

 NOTE 3: If a teleservice is not supported by a signalling system, the call can be set up by using the appropriate bearer service. The service indication is lost.

 NOTE 4: No BC is delivered from the PSTN, only TMR is used for routing in the ISDN.

 NOTE 5: The bearer service is supported through the packet handler network.

7   Selection of path/traffic distribution

This section contains guidelines on the means of avoiding loss of calls, where carriers in the same destination offer different facilities, i.e. PSTN and ISDN. The means of implementing these guidelines, and use of the traffic distribution facility, is a matter for individual operators and administrations.

The bearer and signalling capabilities to support ISDN services will not be provided simultaneously by all carriers to a destination network, e.g. PSTN.

The different scenarios which may occur are as follows:

-       carriers providing ISDN services only;

-       carriers providing PSTN services only;

-       carriers providing ISDN and PSTN services on the same link;

-       carriers providing ISDN and PSTN services on separate links:

        -       one for ISDN (e.g. ISUP or TUP+);

        -       one for PSTN (e.g. TUP or channel associated signalling).

If a call routed to a specific carrier cannot be completed because the carrier does not provide the necessary signalling capability or because a particular supplementary service has not been agreed upon, the call should not fail. The possibility of failure will be reduced if PSTN and ISDN traffic is separated.

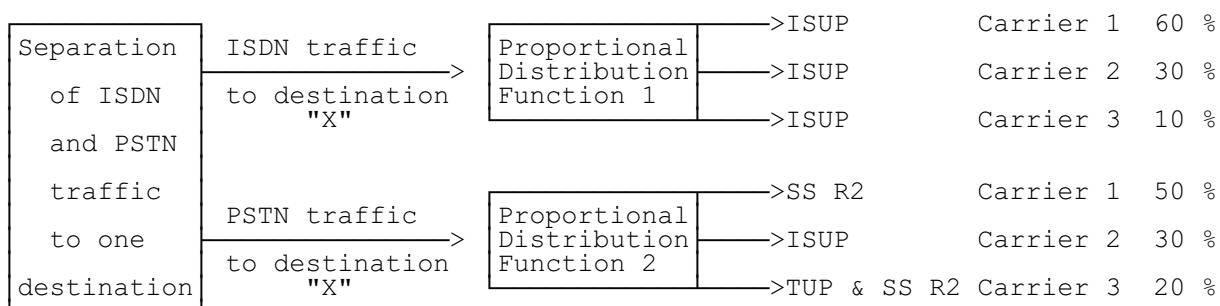A example of a functional model for such a separation is shown in figure 1 below.

```
                                                  ------>ISUP        Carrier 1  60 %
 ------------    ---------------    ------------  |
| Separation |  | ISDN traffic  |  |Proportional|-|----->ISUP        Carrier 2  30 %
|            |  |               ->|Distribution|-|
|  of ISDN   |  | to destination|  |Function 1  |-|
|            |  |     "X"       |  ------------   ------>ISUP        Carrier 3  10 %
|  and PSTN  |
|            |
|  traffic   |                                    ------>SS R2       Carrier 1  50 %
|            |  ---------------    ------------   |
|  to one    |  | PSTN traffic  |  |Proportional|-|----->ISUP        Carrier 2  30 %
|            |  |               ->|Distribution|-|
|destination |  | to destination|  |Function 2  |-|
 ------------   |     "X"       |  ------------   ------->TUP & SS R2 Carrier 3  20 %
                ---------------
```

Figure 1

If, for a given destination, all carriers can provide ISDN and PSTN services on the same link, then the separation between ISDN and PSTN traffic is not needed. Furthermore, to route PSTN traffic with ISDN signalling allows the PSTN traffic to get some benefits of the advanced signalling system: performance, maintenance, testing.

Where carriers do provide both ISDN and PSTN services, traffic distribution should be agreed upon separately for ISDN and PSTN traffic. The traffic separation function could also be used to separate traffic based on other criteria, e.g. bearer capability.

The functions for destination dependent routing and the separation of ISDN and PSTN traffic on one side and the distribution function on the other side, should be logically separated.

Annex A (normative): Support of supplementary services in ISDN by ISUP version 1

Table A.1

Supplementary Service	Support by ISUP Version 1
CLIP	yes
CLIR	yes
COLP	yes
COLR	yes
CUG	yes
DDI	no impact
MSN	no impact
SUB	yes
TP	yes
UUS 1 implicit	yes

Annex B (informative): Bibliography

CCITT Recommendation Q.761 (1988): "Functional description of the ISDN user part of Signalling System No. 7".

CCITT Recommendation Q.762 (1988): "General function of messages and signals".

CCITT Recommendation Q.763 (1988): "Formats and codes".

CCITT Recommendation 764: "Signalling procedures".

CCITT Recommendation Q.767 (1990): "Application of the ISDN user part of CCITT Signalling System No. 7 for international ISDN interconnections".

CCITT Recommendation E.172 (1988): "Call Routing in the ISDN Era".

CEPT Recommendation T/N 23-02 (1988): "Routing in the ISDN, for GAP Phase 1 Services".

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