INTERNATIONAL TELECOMMUNICATION UNION

# ITU-T

# I.325

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

(03/93)

## INTEGRATED SERVICES DIGITAL NETWORK (ISDN)

## OVERALL NETWORK ASPECTS AND FUNCTIONS

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# REFERENCE CONFIGURATIONS FOR ISDN CONNECTION TYPES

## ITU-T Recommendation I.325

(Previously “CCITT Recommendation”)

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## 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 I.325 was revised by the ITU-T Study Group XVIII (1988-1993) and was approved by the WTSC (Helsinki, March 1-12, 1993).

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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 Similarly, in this reform process, the CCIR and the IFRB have been replaced by the Radiocommunication Sector.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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# REFERENCE CONFIGURATIONS FOR ISDN CONNECTION TYPES

*(Melbourne, 1988; amended at Helsinki, 1993)*

## 1 Summary

In order to apply the network performance parameters to the ISDN, some form of hypothetical reference connections (HRXs) are necessary. These HRXs should be based on appropriate reference configurations for the connection types to which the network performance parameters refer. This Recommendation shows how reference configurations can be developed for the ISDN connection types and what form such reference configurations should take.

## 2 Introduction

### 2.1 Objective

The general architectural model of the ISDN (see Figure 1) is given in Recommendation I.324. The detailed network capabilities of the ISDN, as described by connection types in Recommendation I.340, are described topologically by this Recommendation giving reference configurations as appropriate for (an) ISDN connection type(s). These reference configurations do not give details on the number of switching nodes, length of connection, transmission facilities used, etc. However, they do give the details on the reference configuration (or topological configuration) of all matters described by the connection type to which they refer. Therefore they should include details on the signalling, existence of switching functions, channels, etc. Based on these reference configurations, appropriate HRXs should be developed which will be particular to network performance parameters or groups of network performance (NP) parameters. The details on these HRXs will be appropriate for the NP parameters in question.

In order to keep the task of developing reference configurations and the subsequent HRXs, and the allocation of performance values to these HRXs, to manageable proportions, it is necessary to have as limited a set as possible of specific reference configurations. Consequently the ISDN connection types in Recommendation I.340 need to be arranged in different classes which differ significantly from each other such that they require a separate reference configuration model.

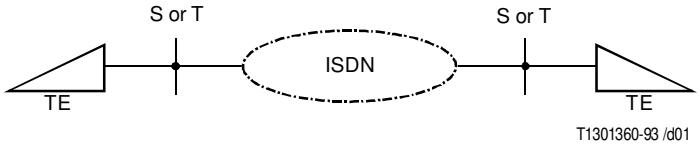



FIGURE 1/I.325

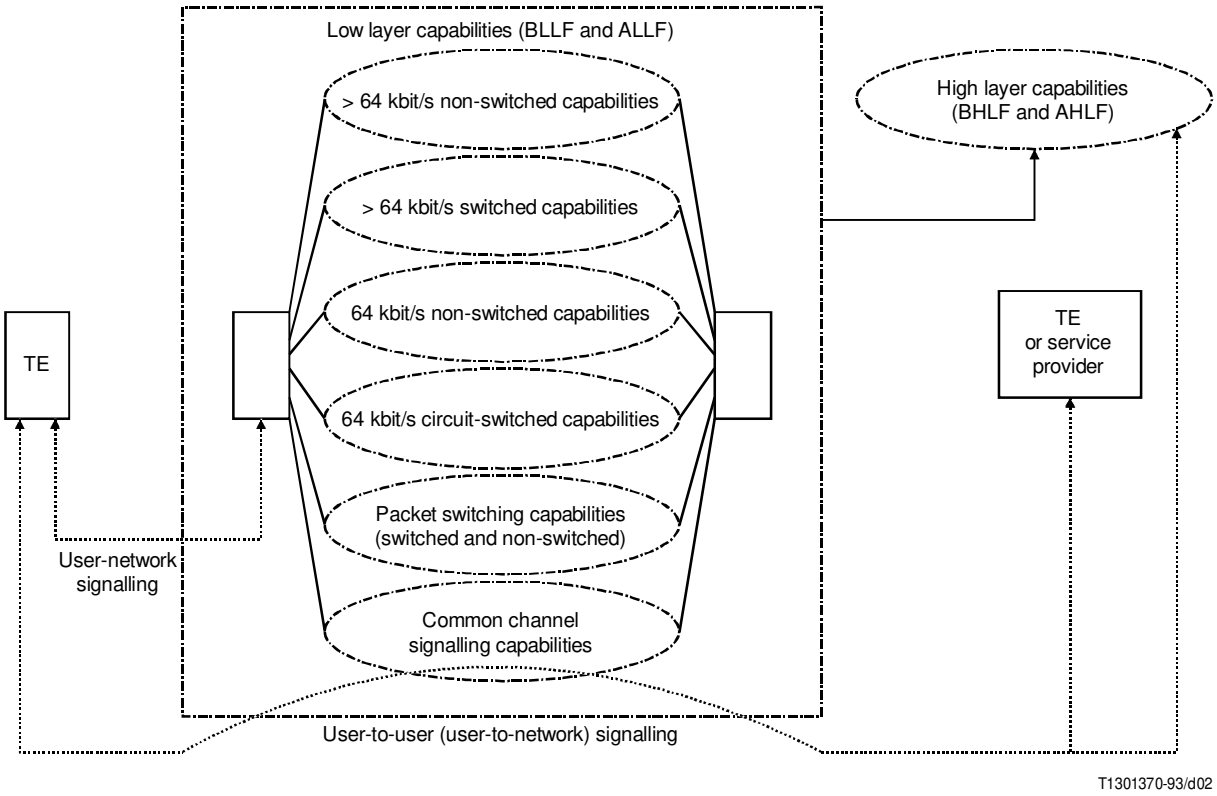
**Simple cloud model of the ISDN**

### 2.2 Relationship to other I-Series Recommendations

The concept of reference configurations has already been used in a number of areas of standardization of the ISDN. It is therefore necessary to consider the concept of connection type reference configurations in the context of these developments.

#### 2.2.1 ISDN architectural model

It should be noted that defining a set of reference configurations presupposes a particular architectural model of an ISDN (see Figure 2). The architectural model for the ISDN is contained in Recommendation I.324. In addition, Recommendation I.310 on the ISDN network functional principles, when considered together with Recommendation I.324, gives the general basis of the architecture of the ISDN from which it is possible to develop reference configurations for ISDN connection types.




BLLF Basic low layer functions
ALLF Additional low layer functions
BHLF Basic high layer functions
AHLF Additional high layer functions

FIGURE 2/I.325

**Basic architectural model of an ISDN**

### 2.2.2 ISDN user-network interfaces

The concept of reference configurations was first used in the ISDN work to describe the topological association of functional groupings at the user-to-network interface points. Recommendation I.411 (ISDN user-network interfaces – Reference configurations) is the complete description of these particular reference configurations. The key factors in the definition of reference configurations in Recommendation I.411 are the concepts of functional groupings and reference points.

### 2.2.3 Recommendations X.30 and X.31 (I.461 and I.462)

Recommendations X.30 and X.31 on the adaption of X.21 and X.25 based DTEs to the ISDN also use the concept of reference configurations to explain the topological configuration of functional groupings involved in these kinds of terminals accessing the ISDN.

# 3 Development of the concept of reference configurations

## 3.1 Definitions

As can be inferred from Recommendation I.411, a **reference configuration** is defined to be "a conceptual configuration based on association rules of functional groupings and reference points."

## 3.2 Generic reference configuration

The following definitions and Figure 3 describe a generic reference configuration which can be used, for example, for ISDN performance allocation.

NOTE – The definition of "International Portion" does not align with the definition of international transit connection element. This is because the location of the international boundary (IB) is for further study. Unless the definition of IB can be agreed the definition of international portion will be modified so that it aligns with the existing definition. All other definitions below will be modified accordingly.

An **access link** is the physical circuit or set of circuits connecting a TE (or NT2) at reference point T to a switching function. An access link transports user information and signalling information.

An **international transit link** is a physical circuit or a set of circuits connecting a switching function in an international gateway or a signalling node belonging to the international signalling network in one country with a switching function in an international gateway or a signalling node belonging to the international signalling network in another country. International transit links include domestic parts within the originating and terminating countries, and the international parts as needed, for example, transoceanic cables and satellite links. Transit links transport user information, signalling information, or both.

A **national network fabric** consists of the network components that route user information and signalling information between an access link and a switching function in an international gateway. National network fabrics always include switching functions. A national network fabric may include more than one network interconnected using standardized protocols. A national network fabric is completely contained within a single nation's borders.

An **international network fabric** consists of the network components that route user information and signalling information between two or three switching functions in international gateways. An international network fabric may include more than one network interconnected using standardized protocols. An international network fabric may cross national borders.

An **international boundary** (IB) reference point is the boundary between a national network fabric and an international transit link. An IB is physically adjacent to a switching function or a signalling node. The term IB may also be used to refer to the collection of individual IB reference points bounding a national network fabric from a set of international transit links.

A **national portion** is a national portion of an international ISDN connection begins at a T reference point and ends at an IB. A national portion carries the user information and signalling information between the T reference point and the IB. A national portion includes an access link and a national network fabric.

The **international portion** is the international portion of an international ISDN connection begins at an IB in one country and ends at an IB in a different country. The international portion carries the user information and signalling information between the two IBs. An international portion typically includes an international transit link and two switching functions in international gateways, or two international transit links and three switching functions in international gateways. In some instances, additional international transit links and switching functions may be present.

The **international ISDN reference configuration** is a model of a generic international ISDN connection (Figure 3) used in the performance Recommendations. The reference configuration connects two hypothetical T reference points in two different countries. The reference configuration includes the two national portions and the one international portion of that generic connection. Figure 4 shows an overall connection model including the customer network fabric of a mixed public/private ISDN.

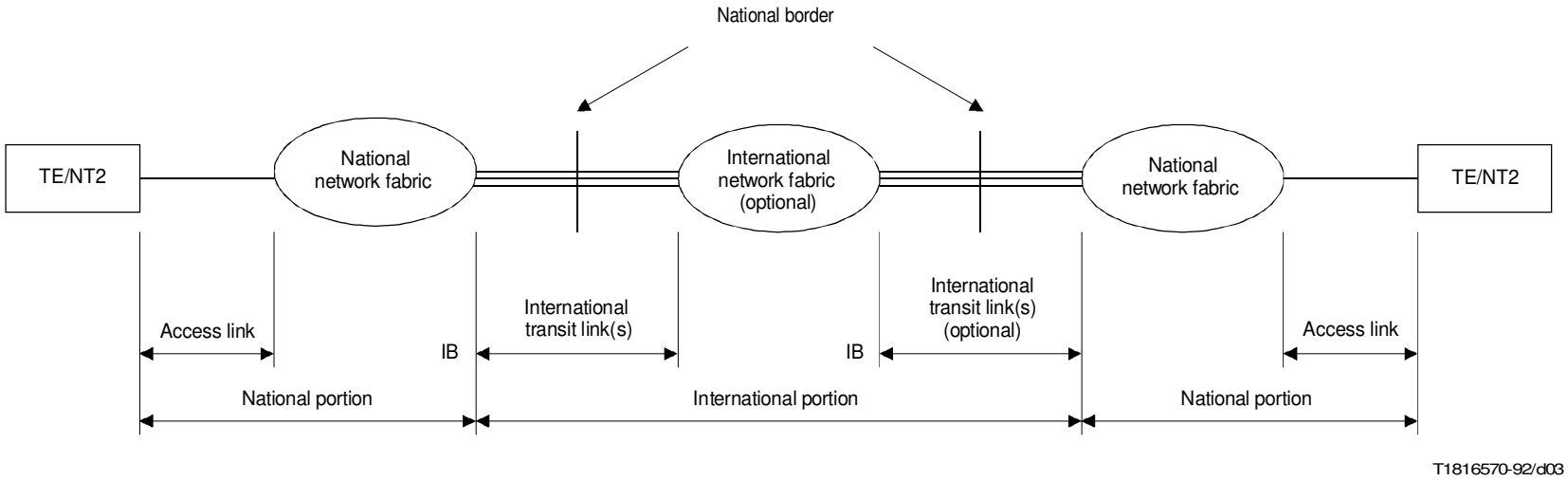



FIGURE 3/I.325

**Generic international ISDN reference configuration**

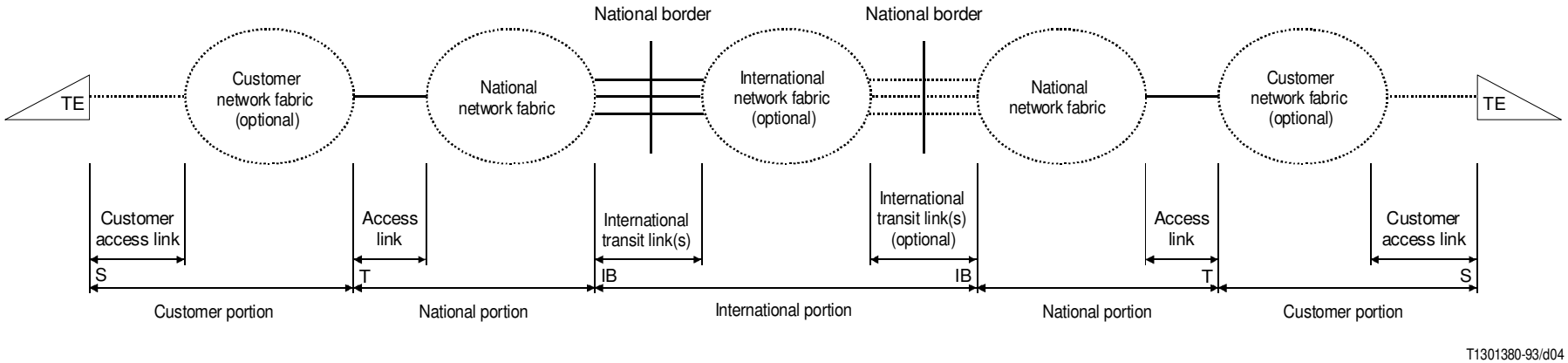



FIGURE 4/I.325

**Proposed reference configuration for mixed private/public ISDNs**

## 3.3 Principles for developing specific reference configurations for ISDN connection types

Overall, the concept of the ISDN connection elements, as introduced in Recommendations I.324 and I.340, can be effectively used to demarcate the different sections of the reference configuration. Because of the complicated nature and evolutionary potential of the ISDN, it may not be possible to internationallly specify a detailed end-to-end reference connection (such as Recommendation X.92 for data networks). Consequently, a functional approach is adopted to specify the structure of the ISDN connection types and the associated ISDN reference configurations. In order to keep the number of reference configurations manageable, only a restricted list of connection types and a limited number of models of frequently realized connection topologies are considered.

## 3.4 Connection elements

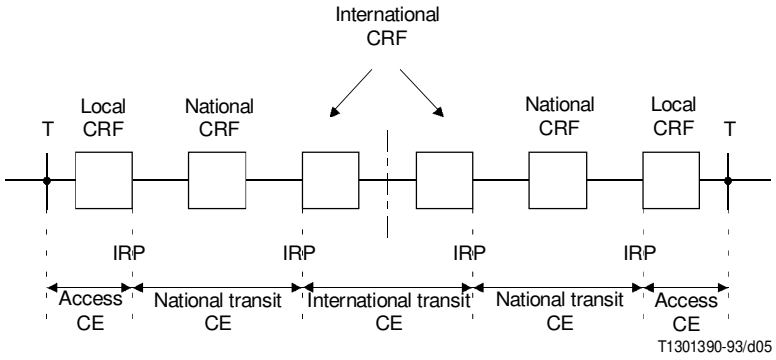
From the concepts of connection elements introduced in Recommendation I.324 a diagram, as shown in Figure 5 can be developed which can be considered as the general reference configuration of the ISDN. It is valid for all ISDN connection types. Particular ISDN connections may be local, national transit, international or international transit [i.e. transit switched through intermediate country(ies)]. In each case, the appropriate parts of the general reference configuration would be involved.

Recommendation I.324 shows that three types of connection element have been defined (so far):

– access connection element;

– national transit connection element;

– international transit connection element.

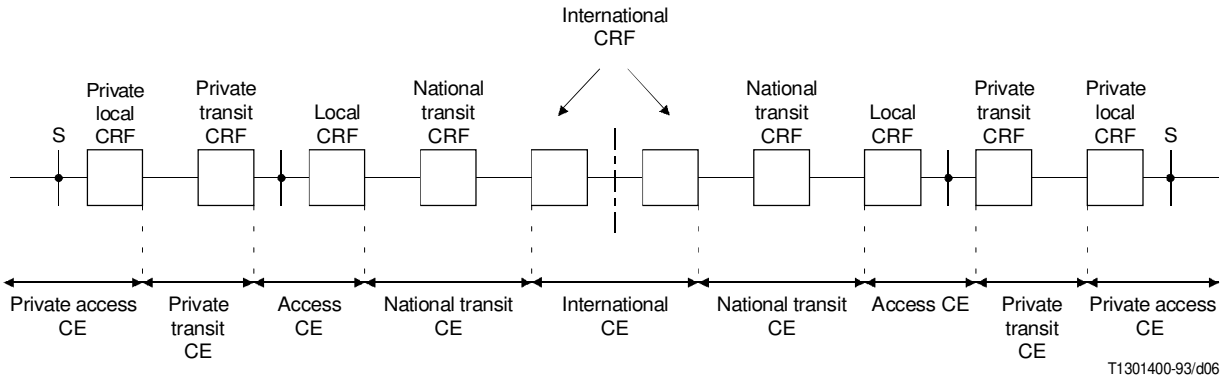



IRP Internal reference point
CRF Connection related functions
CE Connection element

FIGURE 5/I.325

**Reference configuration of public ISDN connection type**

In the case where the customer network consists of ISPBXs, two additional kinds of connection elements, a private access CE, and a private transit CE are identified as shown in Figure 6.




CRF Connection related functions

NOTE – The internal reference points (IRF) have been erased in this figure.

FIGURE 6/I.325

**Reference configuration of overall ISDN connection types for a mixed ISPBX/public scenario**

## 3.5 Functional groupings

As stated in the definition in 3.1, in order to define reference configurations, it is necessary to define certain functional groupings and also reference points which are the conceptual points dividing these functional groupings.

In the description of the connection type reference configuration, some of the major functional groupings involved can be considered under the concept of connection related functions (CRF) as described in 4.2.2.1/I.324. The concept of the CRF includes all the functional groupings involved in establishing and controlling the connections within the particular connection element. In the case of the international transit connection element, two CRFs are shown in Figure 6 in order to retain the symmetry of the diagram. The specific capabilities of each CRF are not specified in the general reference model. This is done in the reference configuration for each group of connection types. The boundary of the CRF should not be associated with the boundary of an exchange as these may not correspond to each other.

Other functional groupings which are necessary for the complete description of the connection type reference configuration include line termination (LT), digital link, packet handling (PH) function and various functions associated with the signalling network.

## 3.6 Reference points

The other element involved in the description of a reference configuration is the reference point concept. The I-series already identifies reference points S and T (in Recommendation I.411) and $K_X$, M, $N_X$ and P (in Recommendation I.324). As can be seen from Figure 6, some further internal reference points need to be identified. Further study is required to see whether these and any further reference points need to be defined.

In describing the reference configuration for the ISDN connection types, an important consideration vis-a-vis the reference points is the following. In Figure 6, and the following diagrams, the end points of the overall connection is shown as being at the T reference point. The reason for this is as follows. Reference point S is identical to reference point T when the NT2 function is null (Recommendation I.411). When the NT2 function is non-zero, then the performance of the overall connection will be made up of the performance of the ISDN network connection (i.e. between the two interfaces at reference point T) and the sum of the performance of the customer network connections (i.e. between the interfaces at reference points S and T at each end). Recommendation G.801 also uses this approach by defining the ends of the digital HRX as being at the T reference point.

# 4 Specific reference configurations

This general reference model needs now to be associated with specific connection types in order to develop specific reference configurations. However, Recommendation I.340 allows for so many variations in its different attributes, leading to a very large number of potential connection types, that is necessary to consider only certain dominant attributes in order to produce a shorter list of reference configurations. For an initial analysis, only the first two of the four dominant attributes listed in Recommendation I.340 need to be considered. Therefore the "information transfer mode" and "information transfer rate" will lead to three general classes of ISDN connection types, viz:

a) circuit:

   – 64 kbit/s,

   – greater than 64 kbit/s (broadband);

b) packet.

The other two dominant attributes ("information transfer" and "establishment of connection") do not require separate reference configurations but will manifest themselves by different performance values.

This limited set of connection types is subsequently modelled in the associated reference configurations taking into account a limited number of frequently realized connection topologies.

## 4.1 64 kbit/s class

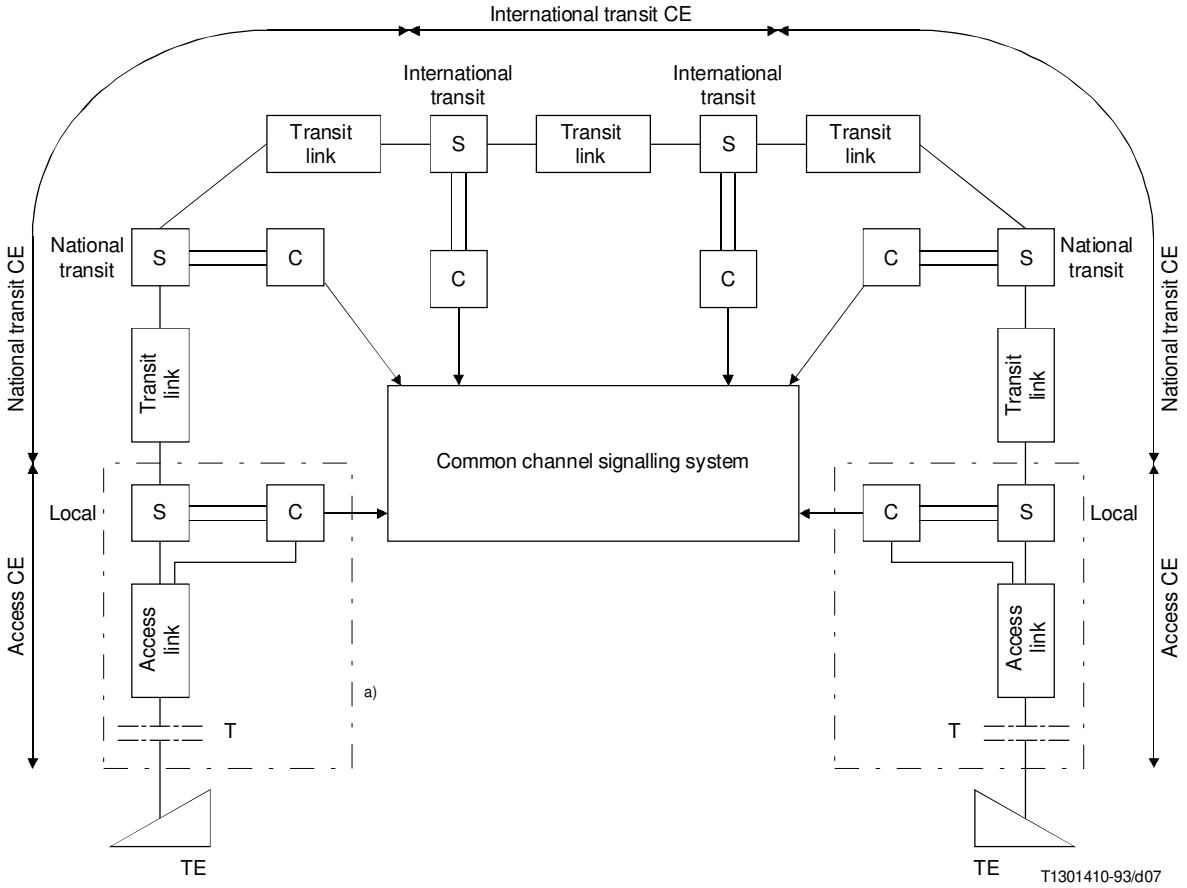
This class includes connection types A1 to A12 of Table 2/I.340, i.e. unrestricted digital, speech and 3.1 kHz audio information transfer susceptances and switched semi-permanent and permanent establishments.

The variation of the information transfer capability is determined by the network performance parameter values allocated to each portion of the connection. For example, use of digital speech interpolation in the international connection element would restrict the connection type to speech or 3.1 kHz audio. Likewise, the differences between permanent connection types and switched connection types would manifest themselves in differences in the value of parameters such as connection establishment time, etc.

This approach means that there is a small number of reference configurations, but that all of the different connection types listed in Recommendation I.340 would need to be tabulated for the allocation of performance values.

Figure 7 shows the reference configuration that is proposed for this class of ISDN connection types.

In the case where the customer network consists of ISPBXs, two additional kinds of connection elements, a private access CE and a private transit CE, are involved, as shown in Figure 8.




a) See Figure 1/Q.512.

S 64 kbit/s circuit switch function
C Signalling handling and exchange control functions

FIGURE 7/I.325

**Reference configuration – 64 kbit/s circuit group**

## 4.2 Packet class

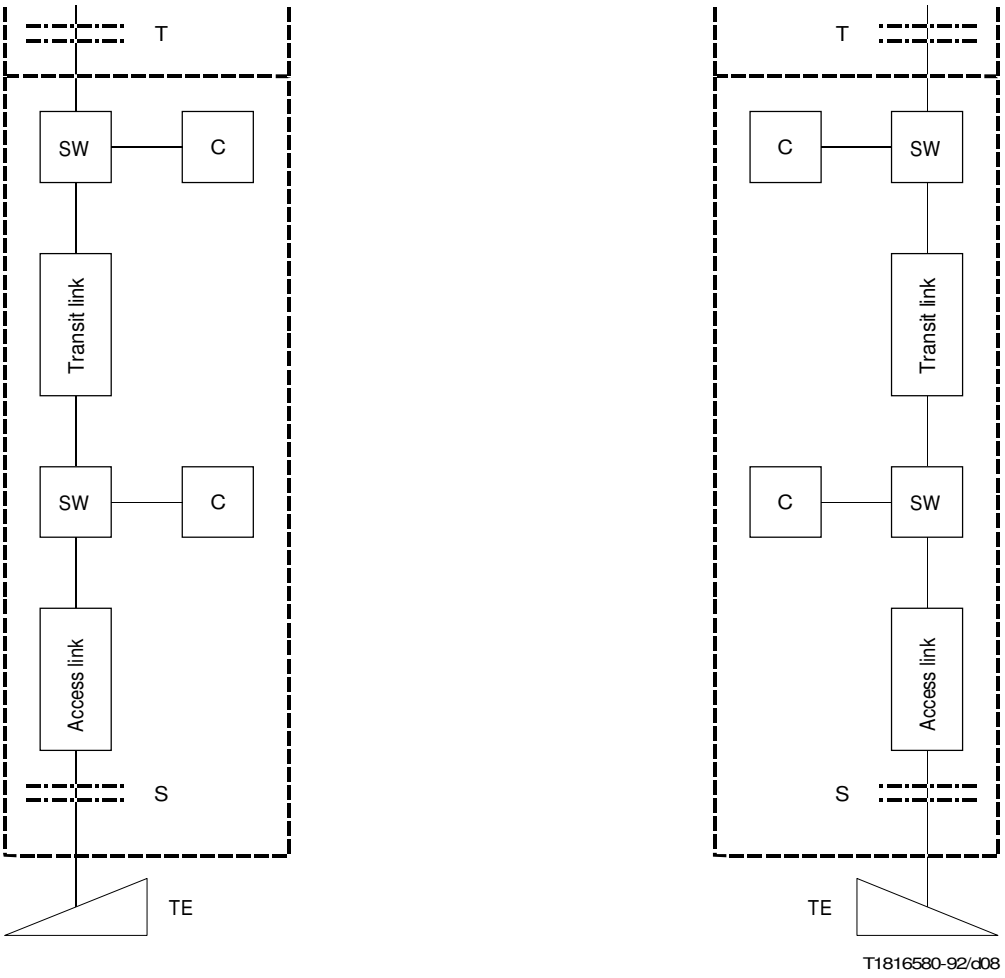
Recommendation X.31 illustrates the scenarios involved in providing packet switched capability in the ISDN. These are in fact reference configurations for the access connection element. The possible reference configurations for the B-channel access packet mode connection type class are shown in Figures 9 and 10.

It should be noted that the Recommendations in the X.130-Series also use the concepts of national and international portions of the connection for the purposes of the allocation of the division of network performance parameter values. In those cases the boundary between the national and the international portions is in the middle of the international data switching exchange (IDSE) [or international switching centre (ISC)]. Further study is required to see if this approach should be taken in the ISDN.

In the case where the customer network consists of ISPBXs, two additional kinds of connection elements, a private access CE and a private transit CE, are involved. In addition, private packet handler functions are involved, as shown in Figure 11.

## 4.3 Broadband class

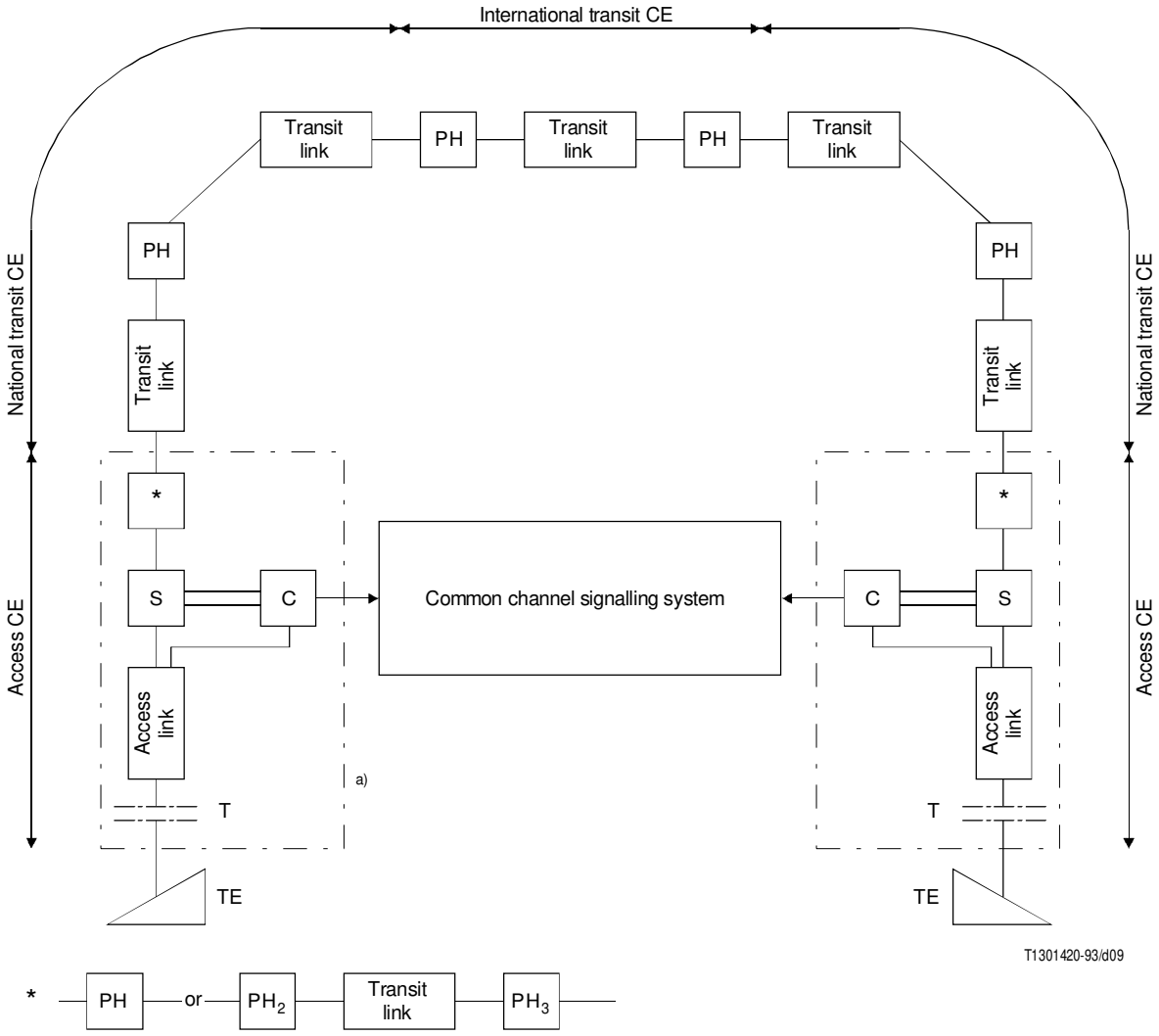
Further study is required to determine what the salient features of this class of ISDN connection types are. According to Recommendation I.340, it would include permanent and semi-permanent connections at 384, 1536 or 1920 kbit/s.




SW 64 kbit/s circuit switch function
C Signalling handling and exchange control functions

FIGURE 8/I.325

**Overall ISDN reference configuration – 64 kbit/s circuit group**

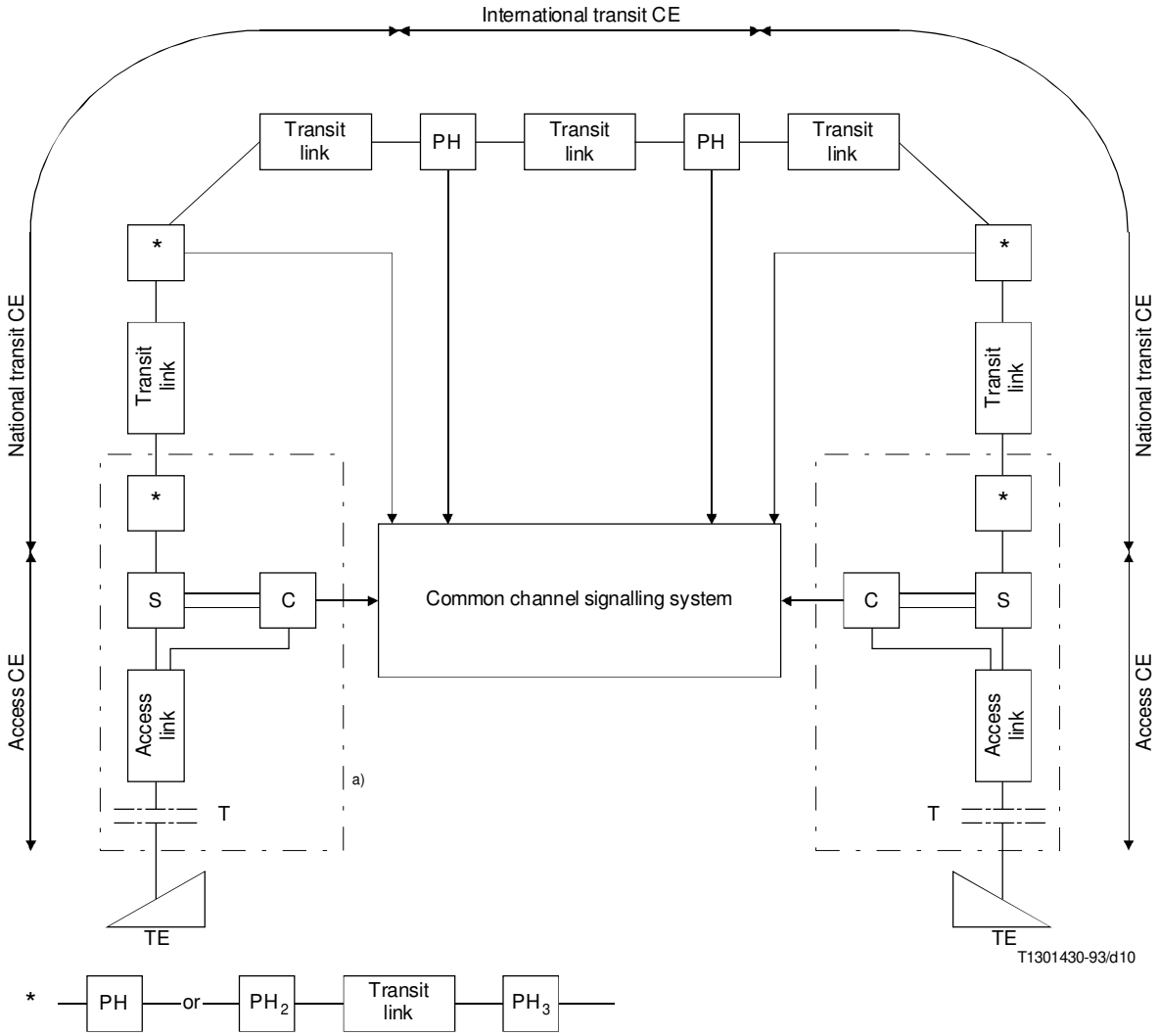



a) See Figure 2/X.31.

$PH_2$ Level 2 packet handler
$PH_3$ Level 3 packet handler
S 64 kbit/s circuit switch function

FIGURE 9/I.325

**Reference configuration – packet group**

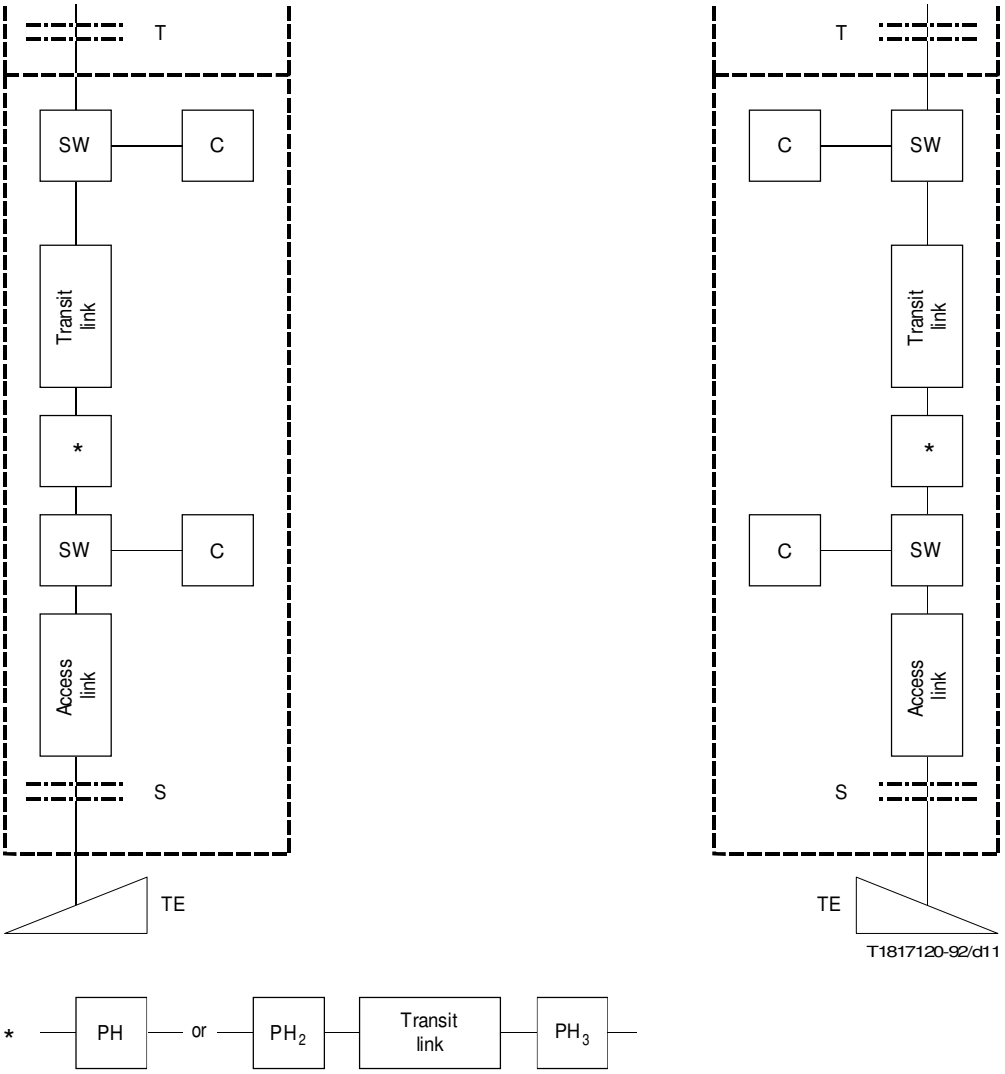



a) See Figure 2/X.31.

$PH_2$ Level 2 packet handler
$PH_3$ Level 3 packet handler
S 64 kbit/s circuit switch function

FIGURE 10/I.325

**Reference configuration – packet group**




$PH_2$ Level 2 packet handler
$PH_3$ Level 3 packet handler
SW 64 kbit/s circuit switch function

FIGURE 11/I.325

**Overall ISDN reference configuration – packet group**