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**INTEGRATED SERVICES DIGITAL
NETWORK (ISDN)**

INTERNETWORK INTERFACES

**GENERAL ARRANGEMENTS FOR
INTERWORKING BETWEEN B-ISDN
AND 64 kbit/s BASED ISDN**

ITU-T Recommendation I.580

(Previously "CCITT Recommendation")

FOREWORD

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The approval of Recommendations by the Members of the ITU-T is covered by the procedure laid down in WTSC Resolution No. 1 (Helsinki, March 1-12, 1993).

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NOTE

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

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SUMMARY

During the evolution to B-ISDN implementations, arrangements must be determined for interworking B-ISDN services and networks with existing services and networks. This Recommendation identifies the arrangements and principles for interworking between B-ISDN and 64 kbit/s based ISDN. Interworking with other than 64 kbit/s based ISDN is beyond the scope of this Recommendation.

GENERAL ARRANGEMENTS FOR INTERWORKING BETWEEN B-ISDN AND 64 kbit/s BASED ISDN

(Helsinki, 1993; revised in 1995)

1 Introduction

It is recognized that B-ISDN may be implemented in a variety of ways according to specific national situations. In these evolutionary phases, appropriate arrangements must be developed for the interworking of services on B-ISDN and services on other networks, and in particular, between B-ISDN and 64 kbit/s based ISDN services. The evolution to B-ISDN should ensure the continued support of existing terminals and services. That is, many terminals developed for 64 kbit/s based ISDN should be able to be connected to B-ISDN. Also, services currently provided by 64 kbit/s based ISDN should be provided through B-ISDN interworking configurations.

2 Scope

The purpose of this Recommendation is to identify the general arrangements and principles for the interworking between B-ISDN and 64 kbit/s based ISDN. The functions and other requirements for the interworking between B-ISDN and 64 kbit/s based ISDN for the provision of ISDN bearer services are also defined in this Recommendation. Interworking with other networks than 64 kbit/s based ISDN is beyond the scope of this Recommendation.

Teleservices and Supplementary services to be supported by B-ISDN interworking configurations require further study.

The case where broadband capabilities are available end-to-end is outside the scope of this Recommendation and should be described in other Recommendations.

3 Communication scenarios

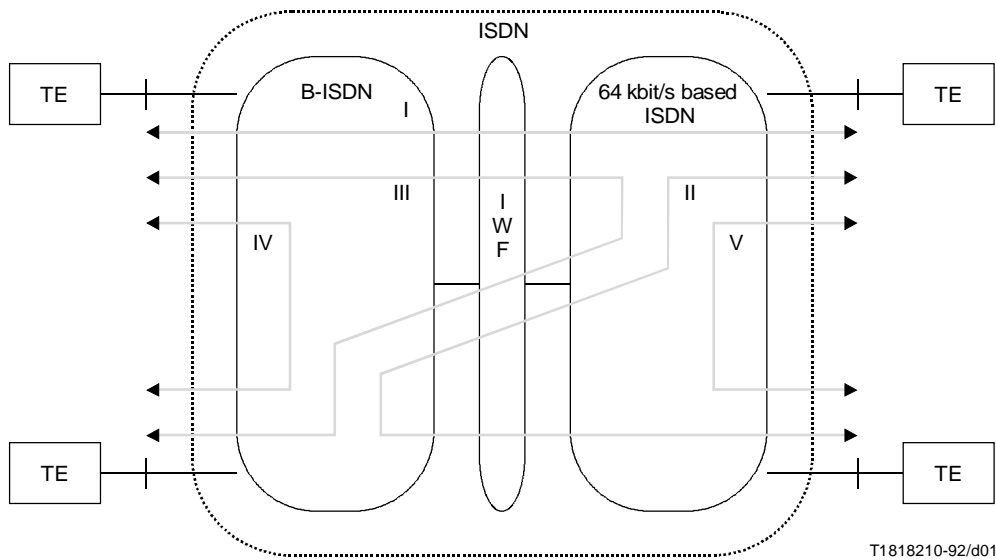
Considering the interworking configuration of ISDN having both 64 kbit/s based ISDN capabilities and broadband capabilities, the communication scenarios are identified as shown in Figure 1:

- Scenario I is an interconnection scenario between B-ISDN and 64 kbit/s based ISDN.
- Scenario II is a network concatenation interworking scenario, but the interfaces and services are the same as those which are currently provided by 64 kbit/s based ISDN.
- In Scenario III, the service capabilities provided between broadband user access points are restricted to 64 kbit/s based ISDN capabilities.
- In Scenario IV, broadband capabilities are available end-to-end and services currently provided by 64 kbit/s based ISDN are also supported. The 64 kbit/s based ISDN services provided by this scenario are similar to those provided by Scenarios I and III. The 64 kbit/s based services are provided on B-ISDN interfaces.
- In Scenario V, end-to-end communication is entirely within the 64 kbit/s based ISDN. The services available are the services provided by the 64 kbit/s based ISDN. The services provided by Scenario V will be similar to those provided by Scenarios I and II.

Scenarios IV and V are outside the scope of this Recommendation.

4 Interworking configurations

Reference configurations described in this clause are purely functional representations of possible interworking configurations.



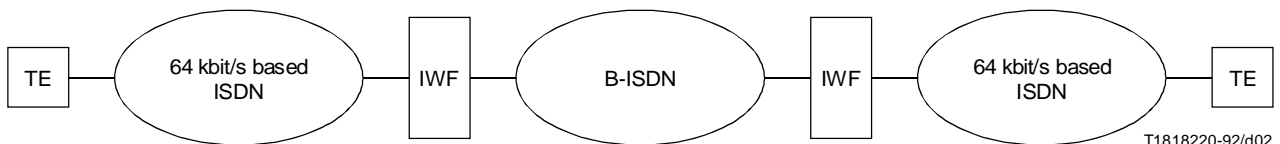
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IWF Interworking Function
TE Terminal Equipment

FIGURE 1/I.580
Communication scenarios applicable to B-ISDN and 64 kbit/s based ISDN

4.1 Concatenation of 64 kbit/s based ISDNs via B-ISDN

Figure 2 shows a reference configuration of concatenation of 64 kbit/s based ISDNs via B-ISDN. This configuration may appear in the evolutionary process towards B-ISDN. With this interworking configuration, the services provided by end-to-end telecommunication are those that are currently provided by 64 kbit/s based ISDN.



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FIGURE 2/I.580
Reference configuration of concatenation of 64 kbit/s based ISDNs via B-ISDN

For interworking between B-ISDN (the ATM part of the network) and 64 kbit/s based ISDN (the non-ATM part of the network), the Interworking Function (IWF) should be defined.

4.2 Concatenation of B-ISDNs via 64 kbit/s based ISDN

Figure 3 shows a reference configuration of concatenation of B-ISDNs via 64 kbit/s based ISDN. This configuration may be present in the initial phases of evolution towards B-ISDN wherein B-ISDN islands are interconnected via 64 kbit/s based ISDN. The end-to-end services available with this configuration will be limited to B-ISDN services which have a 64 kbit/s based ISDN equivalent.

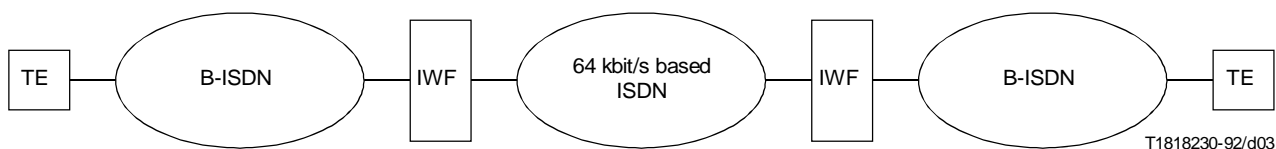


FIGURE 3/I.580

Reference configuration of concatenation of B-ISDNs via 64 kbit/s based ISDN

4.3 B-ISDN to 64 kbit/s based ISDN interconnection

Figure 4 shows a reference configuration of B-ISDN to 64 kbit/s based ISDN interconnection. This configuration where B-ISDN is interconnected to 64 kbit/s based ISDN will also provide the services that are currently provided by 64 kbit/s based ISDN. This is intended to provide connectivity between B-ISDN and 64 kbit/s based ISDN users.

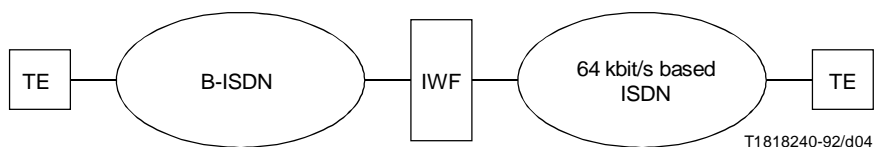


FIGURE 4/I.580

Reference configuration of B-ISDN to 64 kbit/s based ISDN interconnection

This configuration can be further classified to the following two cases:

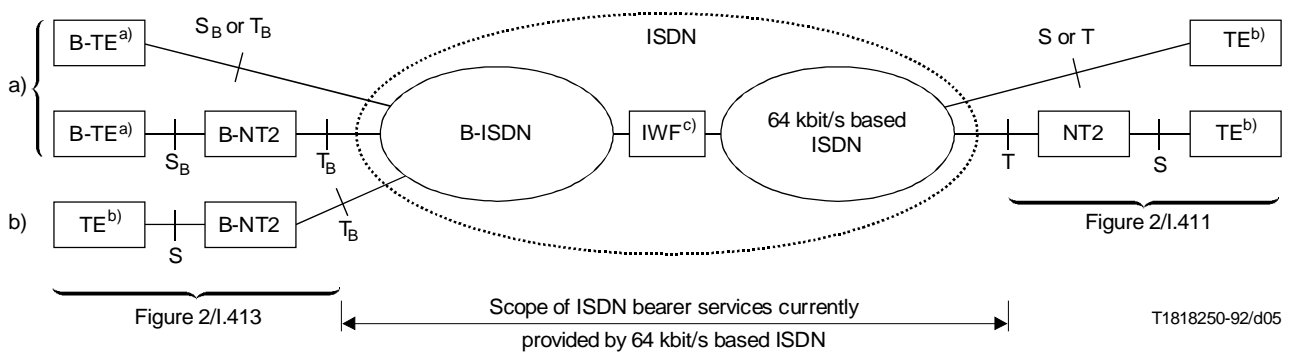
- a) where B-TEs support 64 kbit/s based ISDN services; and
- b) where 64 kbit/s based ISDN TEs are connected to B-ISDN.

Figure 5 shows these cases and the scope of ISDN bearer services currently provided by 64 kbit/s based ISDN:

- The physical configurations for 64 kbit/s based access are defined in Recommendation I.411, and those for broadband access are defined in Recommendation I.413.
- B-ISDN shall include functions of both broadband capabilities and 64 kbit/s based ISDN capabilities.
- Since the figures are purely functional representations, the IWF can be provided in an inter-exchange as well as in an intra-exchange environment.

4.4 Decomposition of 64 kbit/s based ISDN into component parts

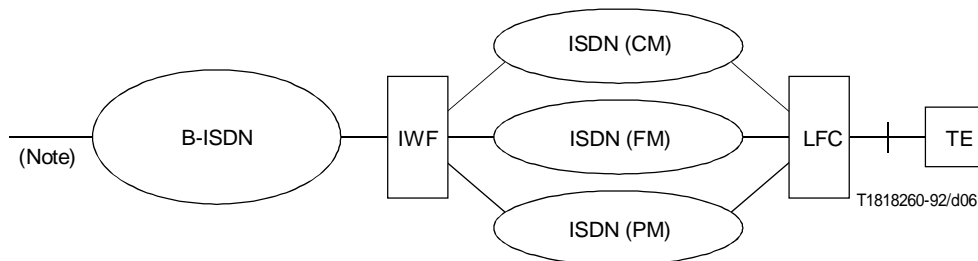
This describes decomposition of the 64 kbit/s based ISDN portion of the reference configuration model of 4.1, 4.2 and 4.3. The configuration model below is based on Recommendations X.300 and I.324 concepts. This model reflects a decomposition of 64 kbit/s based ISDN into ISDN (PM), ISDN (CM) and ISDN (FM) portions. A similar decomposition of the B-ISDN is not applicable. This model is used to assist in identification of interworking functions and requirements. See Figure 6.



- a) B-TE B-TE1 or B-TA + B-TE2/TE2.
- b) TE TE1 or TA + TE2.
- c) IWF Interworking Function.

FIGURE 5/I.580

Scope of 64 kbit/s based ISDN bearer services through interworking B-ISDN



- LFC Local Functional Capabilities
- CM Circuit Mode
- FM Frame Mode
- PM Packet Mode

NOTE – This point could be connected to a TE, or to another IWF and a second 64 kbit/s based ISDN, consistent with 4.1, 4.2 and 4.3 interworking reference configurations.

FIGURE 6/I.580

Reference configuration decomposition

5 Relationship of connections between 64 kbit/s based ISDN and B-ISDN

64 kbit/s based ISDN connection types are defined in Recommendation I.340.

In the case of interworking between B-ISDN and 64 kbit/s based ISDN, 64 kbit/s based connections are related to broadband connections with appropriate AAL connections.

The relationship between 64 kbit/s based connections and broadband connections is categorized into the following two patterns:

- i) *One-to-one correspondence*

Each 64 kbit/s connection has a one-to-one correspondence to a broadband VP/VC connection with an appropriate AAL service class.

- Establishment of connections:

Switched, semi-permanent, permanent.

- Quality Of Service (QOS) classes:

64 kbit/s based ISDN connection types are related to appropriate broadband QOS classes. Specific QOS class assignment is for further study.

- Applied broadband bearer service classes:

Speech	Class A
3.1 kHz audio	Class A
Multi-use	Class A
64 kbit/s unrestricted	Class A
Multirate $n \times 64$ kbit/s ($n \leq 30$)	Class A
384, 1536, 1920 kbit/s unrestricted	Class A
Packet mode	Class C
Frame mode	Class C

ii) *N-to-one correspondence ($N \geq 1$)*

Multiple 64 kbit/s based ISDN connections are bundled without distinguishing constituent connections and the bundle corresponds to one broadband VP/VC connection with an appropriate AAL service class.

- 64 kbit/s based ISDN connection types:

64 kbit/s based ISDN connections have an N-to-one correspondence ($N \geq 1$) to broadband connections. The case might arise where different 64 kbit/s based ISDN connection types are mixed in the same bundle corresponding to one broadband connection.

- Establishment of connections:

Semi-permanent, permanent.

- QOS classes:

In general, each QOS of a 64 kbit/s based ISDN connection does not correspond to the QOS of the corresponding broadband connection. An appropriate broadband QOS is offered for the unit bundling multiple 64 kbit/s based ISDN connections.

- Applied AAL services classes:

One AAL service class is associated with one broadband connection. The following categories are identified.

In the case where a unique 64 kbit/s based ISDN connection type is bundled:

Speech	Class A
3.1 kHz audio	Class A
64 kbit/s unrestricted	Class A (Note)
384, 1536, 1920 kbit/s unrestricted	Class A (Note)
Packet mode	Class C
Frame mode	Class C

NOTE – This may be used for frame mode or packet mode bit streams multiplexed in a 64, 384, 1536 or 1920 kbit/s connection.

In the case where various 64 kbit/s based ISDN connection types are bundled:

- a typical example of this case is where a link is emulated by a broadband connection. This is for further study.

6 Interworking functional requirements

6.1 Interworking functional requirements for 64 kbit/s based ISDN services

ISDN bearer services supported by B-ISDN are classified into the following two categories:

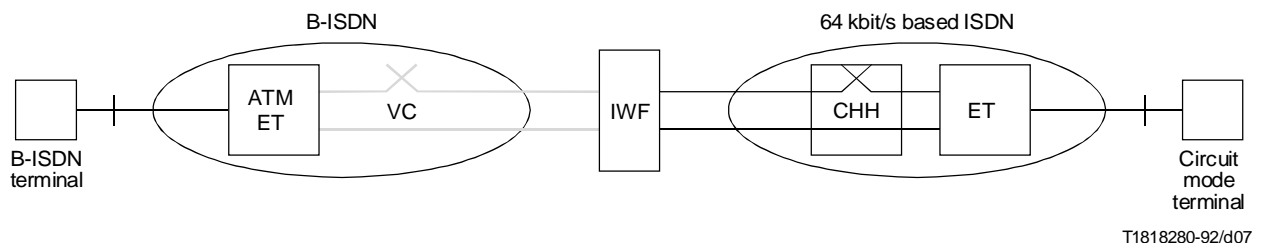
- 1) *Broadband specific ISDN bearer services*
 - The services which can only be provided by a network providing end-to-end broadband capabilities.
- 2) *64 kbit/s based ISDN bearer services*
 - The services which are equivalent to the bearer services currently provided by 64 kbit/s based ISDN, for example speech, 3.1 kHz audio and 64 kbit/s unrestricted bearer service.

Based on bearer services supported in the configuration of interworking between B-ISDN and 64 kbit/s based ISDN, services can be classified into three categories:

- i) circuit mode bearer service;
- ii) packet mode bearer service; and
- iii) frame mode bearer service.

6.1.1 Interworking functions for circuit mode bearer service

Figure 7 shows an example of a circuit mode bearer service interworking model in the configuration of B-ISDN to 64 kbit/s based ISDN interconnection.



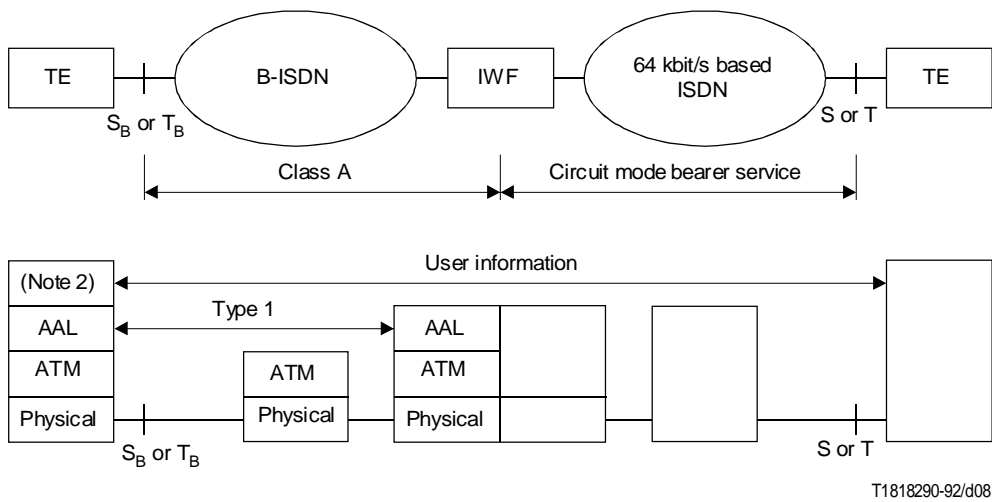
ET Exchange Termination
CHH Channel Handling functionality (e.g. switching)

FIGURE 7/I.580

Example of interworking model between circuit mode terminal and B-ISDN terminal

Figure 8 shows circuit mode bearer service interworking in the U-Plane for the reference configuration of B-ISDN to 64 kbit/s based ISDN interconnection. In this case, Broadband Connection Oriented Bearer Service-A (BCOBS-A defined in Recommendation F.811) for circuit emulation in B-ISDN and circuit mode bearer service in 64 kbit/s based ISDN are interworked. The values of each bearer service attribute are specified in Recommendations I.231 and F.811 (see Annex B).

Interworking functions are required to provide the mapping between BCOBS-A and circuit mode bearer services. More detailed study is needed.



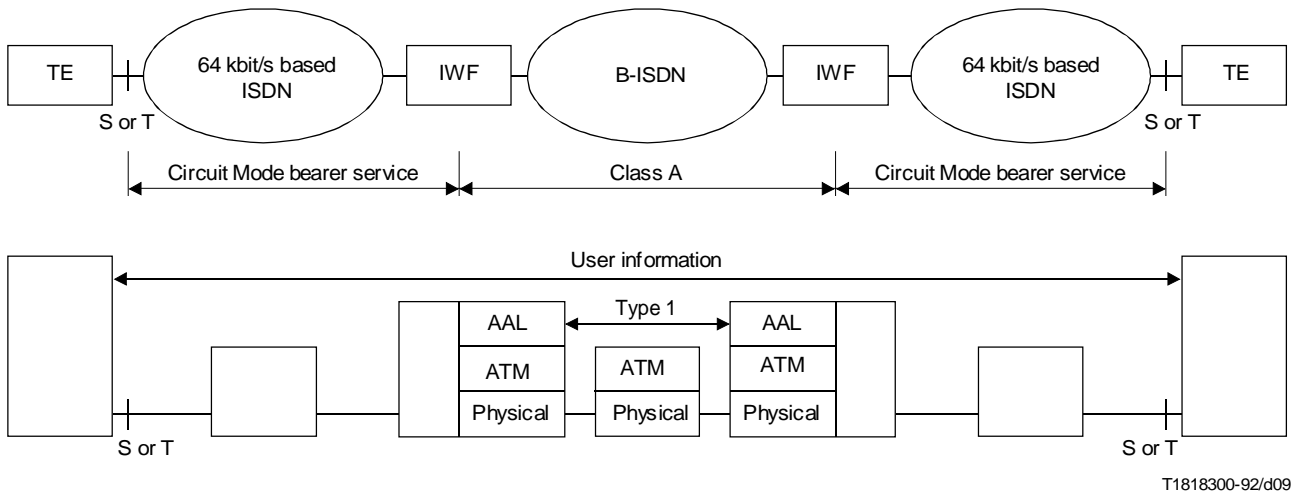
NOTES

- 1 In the U-plane, the 64 kbit/s based ISDN provides a circuit mode connection over which any user information protocols may be transferred. For this reason, the boxes relating to the 64 kbit/s ISDN side of the IWF, the 64 kbit/s ISDN connected to it are left unlabelled.
- 2 Application dependent.

FIGURE 8/I.580

Circuit mode interworking based on the reference configuration of B-ISDN to 64 kbit/s based ISDN interconnection

Figure 9 shows circuit mode bearer service interworking in the U-Plane for the reference configuration of concatenation of 64 kbit/s based ISDNs via B-ISDN. The 64 kbit/s circuit mode bearer service offered by the 64 kbit/s based ISDN is interworked via B-ISDN circuit emulation (BCOBS-A) to another 64 kbit/s based ISDN. The service perceived by the users in the 64 kbit/s based ISDNs is that of a 64 kbit/s based ISDN circuit mode bearer service.

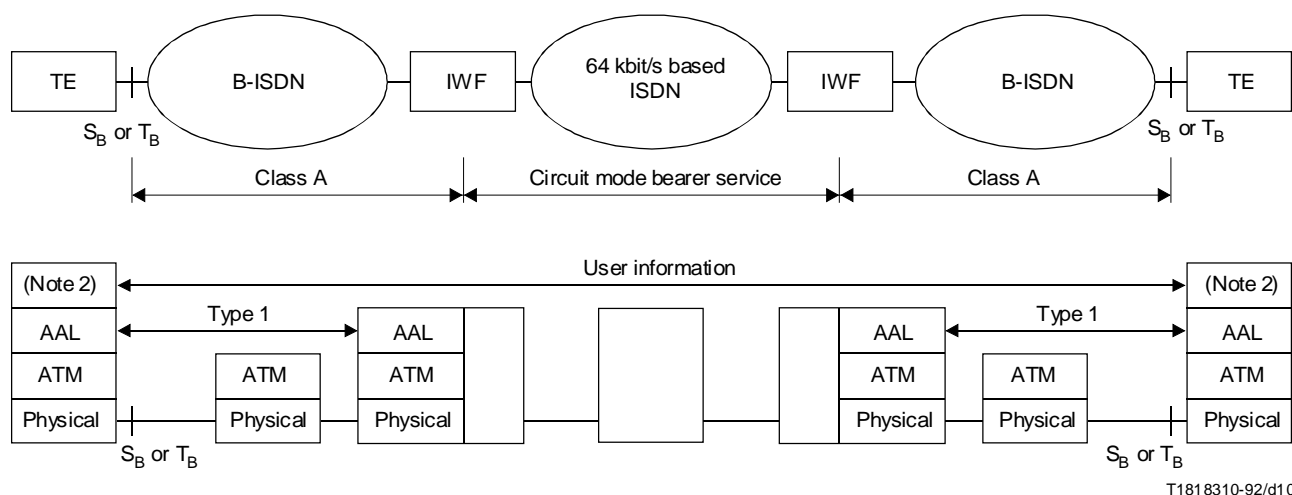


NOTE – In the U-Plane, the 64 kbit/s based ISDN provides a circuit mode connection over which any user information protocols may be transferred. For this reason, the boxes relating to the 64 kbit/s ISDN side of the IWF, the 64 kbit/s ISDN and the TE connected to it are left unlabelled.

FIGURE 9/I.580

Circuit mode interworking based on the reference configuration of concatenation of 64 kbit/s based ISDNs via B-ISDN

Figure 10 shows circuit mode bearer service interworking in the U-Plane for the reference configuration of concatenation of B-ISDNs via 64 kbit/s based ISDN. The BCOBS-A bearer service offered by the B-ISDN is interworked via 64 kbit/s ISDN circuit mode bearer service to another B-ISDN. The service perceived by the users on the B-ISDNs is that of a 64 kbit/s ISDN circuit mode bearer service. An interworking indication may be provided to the B-ISDN users to indicate that interworking with the 64 kbit/s based ISDN has been encountered and that the service will be limited to that available from the 64 kbit/s based ISDN.



NOTES

- 1 In the U-plane, the 64 kbit/s based ISDN provides a circuit mode connection over which any user information protocols may be transferred. For this reason, the boxes relating to the 64 kbit/s ISDN side of the IWF and the 64 kbit/s ISDN are left unlabelled.
- 2 Application dependent.

FIGURE 10/I.580

Circuit mode interworking based on the reference configuration of concatenation of B-ISDNs via 64 kbit/s based ISDN

6.1.1.1 Requirements of interworking function

1) Support of 64 kbit/s based ISDN interface

The IWF may support the 64 kbit/s based ISDN interface. This includes the capability to verify the 64 kbit/s based ISDN signalling message, whether or not the requested service can be supported. It also includes translating the voice coding scheme, i.e. A-law and μ -law.

2) Support of B-ISDN interface

The IWF may support the B-ISDN interface. This includes the capability to verify the B-ISDN signalling message, whether or not the requested service can be supported. It also includes translating the voice coding scheme, i.e. A-law and μ -law. This requires further study.

3) Interworking functions

For more detailed descriptions than given below refer to clause 6 and Annex E in Recommendations Q.2931 and Q.2660.

- C-Plane

In cases where the IWF terminates the signalling message, the IWF shall translate both B-ISDN and 64 kbit/s based ISDN signalling messages. For instance, the IWF translates between Q.931 and Q.2931 messages or between B-ISUP and N-ISUP messages. This covers the generation, termination, and protocol conversion of signalling messages and the reordering of signalling

information elements, since Recommendation Q.2931 does not require any particular order to the information elements, whereas Recommendation Q.931 assumes some order. The specific procedures including error conditions are specified in Recommendation Q.2660.

- U-Plane

The IWF shall perform AAL type 1 procedures, as defined in Recommendation I.363, to provide circuit mode bearer service. Some optional functions may be provided for each service according to the network selected. The purpose of these functions may be to provide specific 64 kbit/s based ISDN services. One example is structured data transfer to provide 8 kHz integrity. Another example is source clock recovery. If a network supports SRTS as a default mode, an IWF may receive and send the SRTS information. Even in this case, if the IWF receives a clock from the 64 kbit/s based ISDN side, it ignores the SRTS information of the B-ISDN side to send user information to 64 kbit/s based ISDN.

4) *Others*

To provide some supplementary services such as Conference Calling and Call Waiting, further study is required, including the allocation of required functions.

6.1.2 Interworking functions for packet mode bearer service

Figure 11 a) and b) provides two examples of a packet mode bearer service interworking model in the configuration of B-ISDN to 64 kbit/s based ISDN interconnection based on Recommendation X.31 case A and case B respectively.

In case A, an ISDN transparent circuit connection (permanent, semi-permanent or switched) is used. The corresponding ISDN bearer service is 64 kbit/s, as described in Recommendation I.231.1. The service available to the user is that of the PSPDN described in Recommendations X.25 (permanent access) and X.32 (demand access), as well as in the other X-Series Recommendations (e.g. Recommendations X.2, X.121). In case B, an ISDN virtual circuit service is used, which is described in Recommendation I.232.1.

Figure 12 a) and b) shows packet mode bearer service interworking for the reference configuration of B-ISDN to 64 kbit/s based ISDN interconnection. In Figure 12 b) protocol stacks are categorized into two types. One (Type-I) is to encapsulate X.25 Layer 3 packets and carry them into PH. This method may be applied to the port access to PH via B-ISDN or the access similar to X.31 case B via B-ISDN.

Type-I: supporting existing X.31 terminal easily using terminal adaptor.

The other (Type-II) is protocol mapping, in which type X.25 Layer 3 packets are converted to the appropriate PDUs of I.365.2 (SSCS for CONS) protocol through IWF according to predetermined mapping by subscription or signalling.

Figure 13 shows packet mode bearer service interworking in the U-Plane for the reference configuration of 64 kbit/s based ISDNs via B-ISDN. Either ATM PVC or SVC can be used to connect IWFs in this figure. When SVC is used some signalling capabilities will also be required in IWF.

Interworking functions are required to provide the mapping between BCOBS-C for emulation of packet mode and packet mode bearer service.

There are two possible schemes of mapping X.25 Logical Channel (LC) into ATM connection.

- Type-I (N to 1 mapping): Multiple X.25 LCs are multiplexed into single ATM VC.
- Type-II (1 to 1 mapping): Each X.25 LC is mapped into single ATM VC.

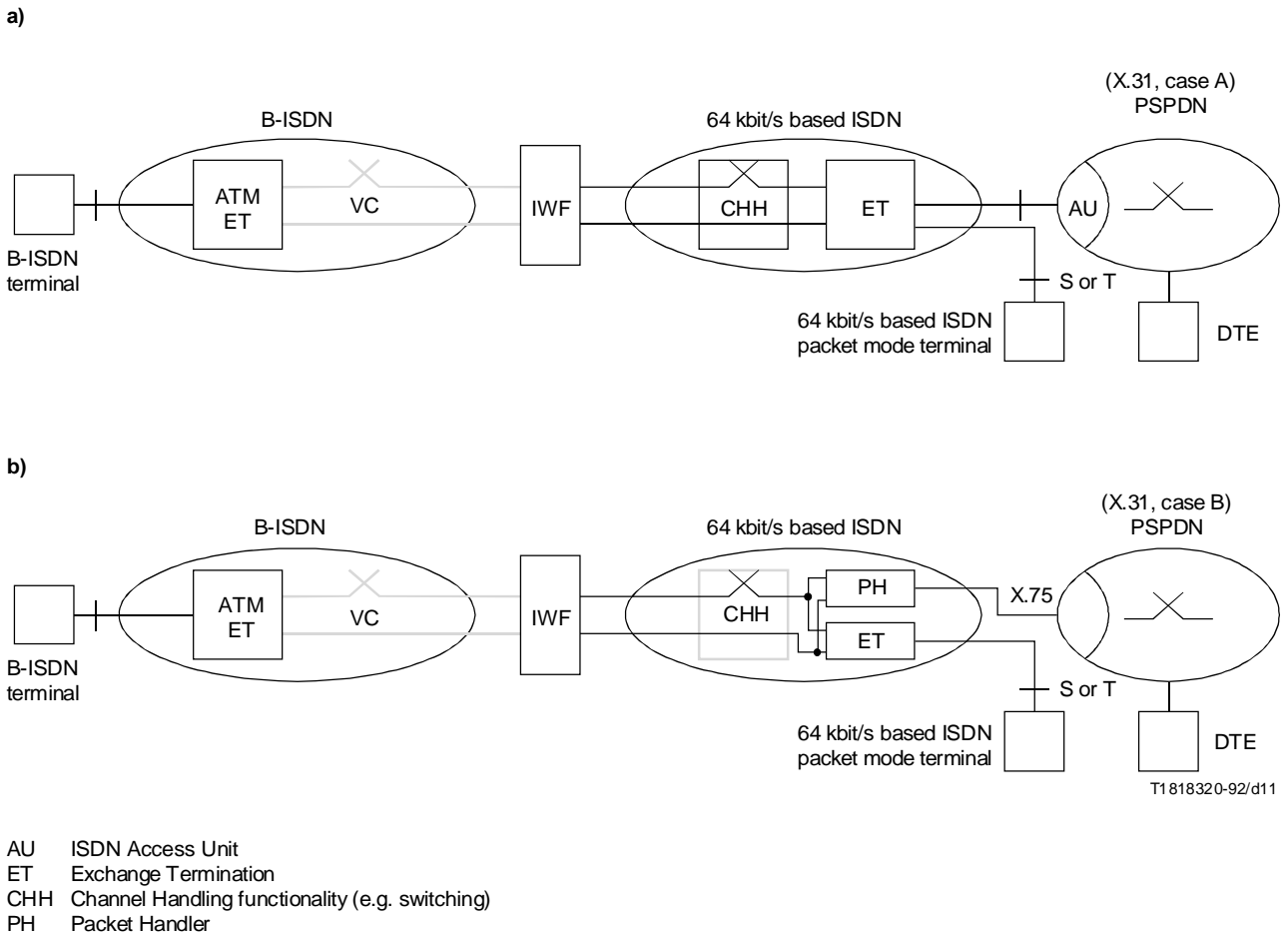


FIGURE 11/I.580

Examples of interworking model between X.31 terminal and B-ISDN terminal

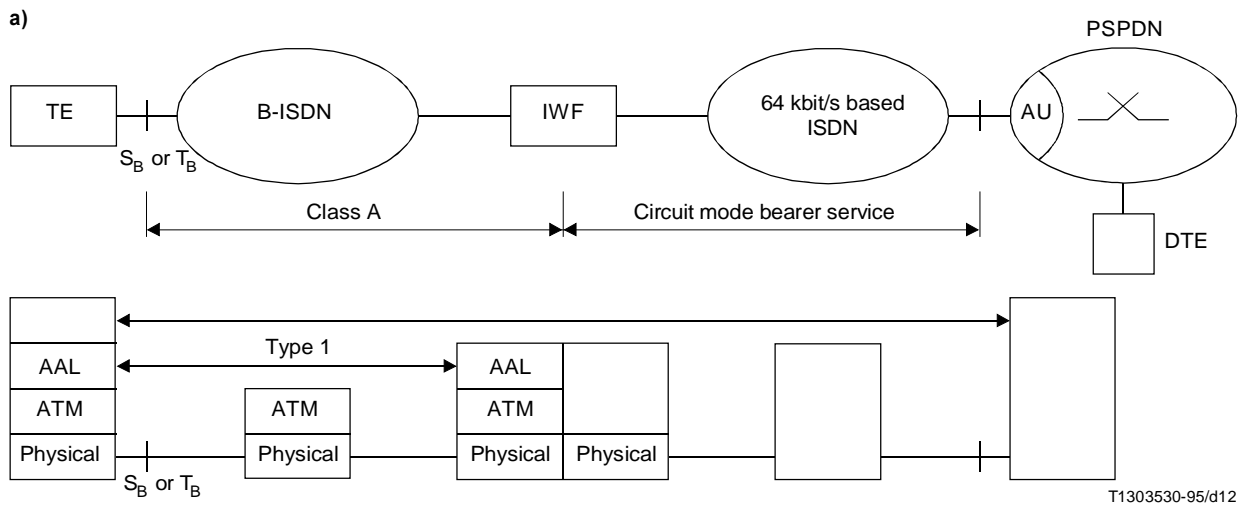
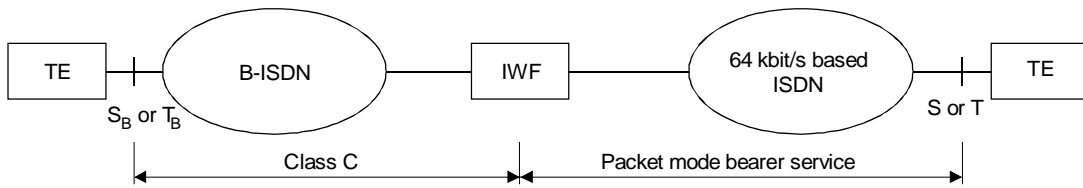


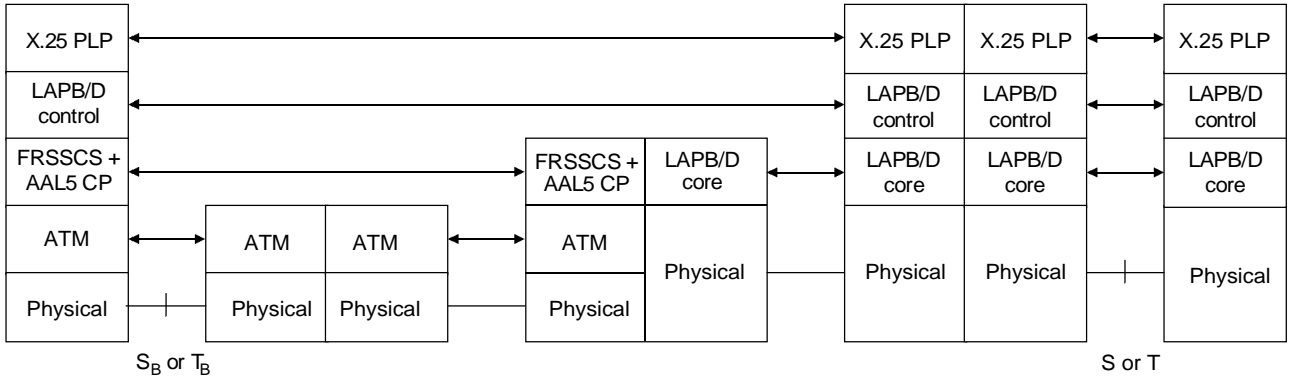
FIGURE 12a)/I.580

Packet mode interworking based on the reference configuration of B-ISDN to 64 kbit/s based ISDN interconnection

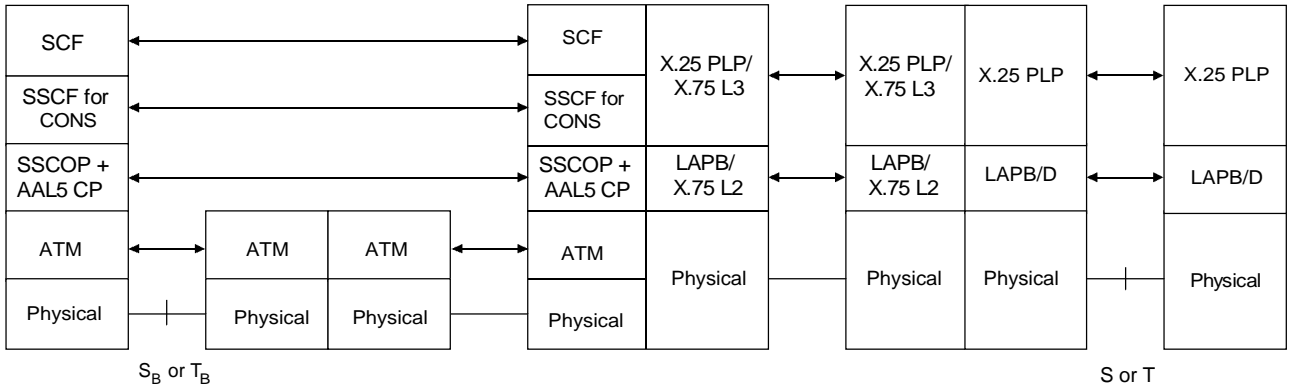
b)



(Type I)



(Type II)



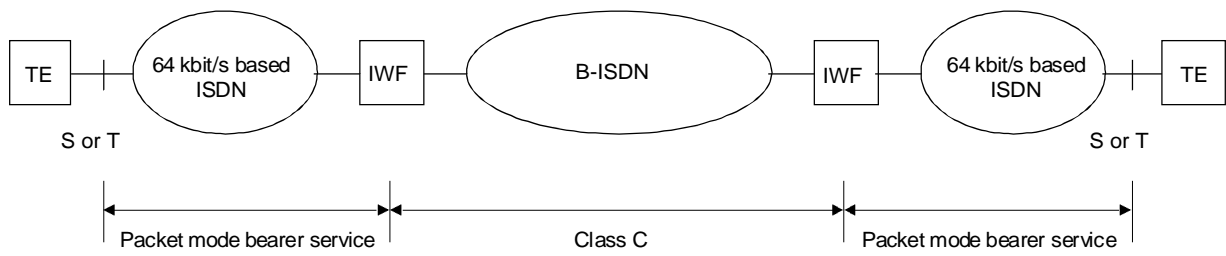
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- FRSSCS Frame Relaying Service Specific Convergence Sublayer
- CP Common Part
- SSCF Service Specific Coordination Function
- SSCOP Service Specific Connection-Oriented Protocol
- CONS Connection Oriented Network Service
- SCF Synchronization and Coordination Function

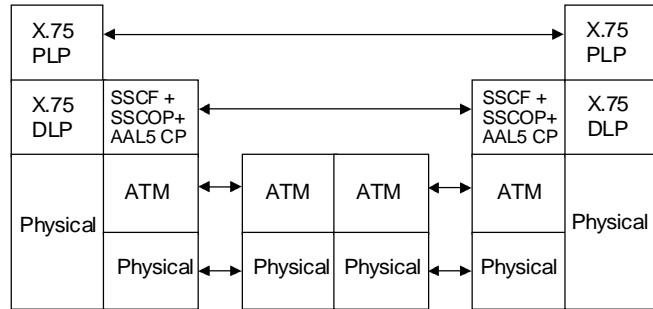
NOTE – Only U-Plane is depicted in B-ISDN side.

FIGURE 12b)/I.580

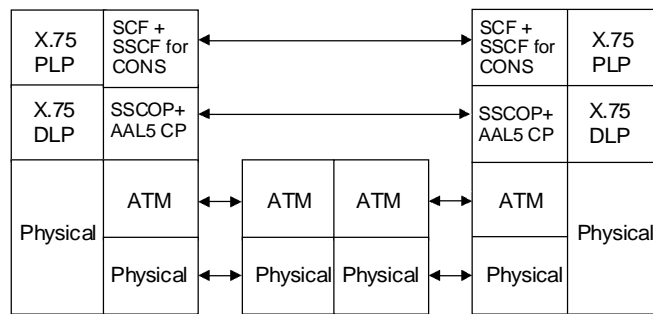
Packet mode interworking based on the reference configuration of B-ISDN to 64 kbit/s based ISDN interconnection



(Type I)



(Type II)



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NOTE – When packet LC multiplexing into one VC is required, Type-I is appropriate, as SSCF for CONS does not support multiplexing function.

FIGURE 13/I.580

Packet mode interworking based on reference configuration of concatenation of 64 kbit/s based ISDNs via B-ISDN

N to 1 mapping scheme includes 1 to 1 mapping scheme and has advantages in utilizing VCs effectively to accommodate low speed X.25 LCs.

More detailed study is needed, for example, on the mapping of virtual circuit throughput as defined by Recommendations X.25 and X.135 to appropriate B-ISDN traffic parameters (see e.g. Recommendation I.371).

6.1.2.1 Requirements of interworking function

For further study.

6.1.3 Interworking functions for frame mode bearer service

A brief description of interworking functions for Frame Mode Bearer Services (FMBS) is given here. Detailed description will be subject of future Recommendations.

The two interworking scenarios are illustrated in Figures 14 and 15.

Figure 14 shows B-ISDN to 64 kbit/s based ISDN interconnection, i.e. both services and network interworking. The access network is based on 64 kbit/s based ISDN and the core network is based on ATM. In this case, the FMBS interworking with B-ISDN class C services (message mode, unassured option without flow control).

Figure 15 shows concatenation of 64 kbit/s based ISDN via B-ISDN, i.e. network interworking. The access network is based on 64 kbit/s based ISDN and the core network is based on ATM. This is expected to be the first application of network interworking as applied to B-ISDN. The equivalent B-ISDN service for interworking with FMBS is class C (message mode, unassured option without flow control).

More detailed study is needed, for example, on the mapping of FMBS throughput parameters (CIR, Bc and Be) to appropriate B-ISDN traffic parameters (see e.g. Recommendation I.371).

6.1.3.1 Requirements of interworking function

Refer to Recommendation I.555.

7 Emulation of 64 kbit/s based ISDN network components

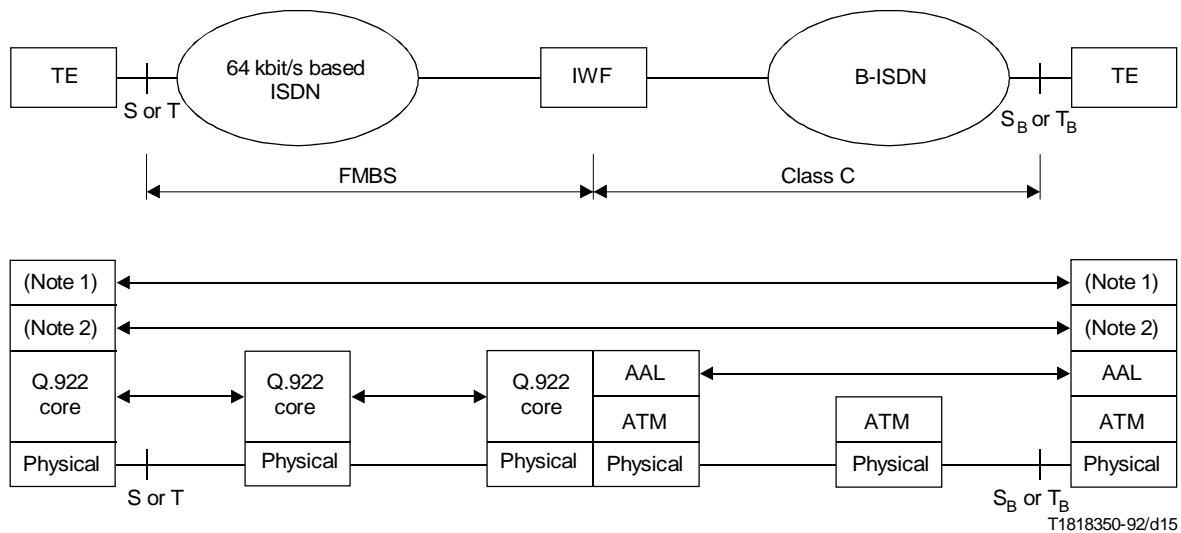
In the process of B-ISDN evolution, ISDN network components may be replaced by broadband techniques. In which case, the 64 kbit/s based ISDN connection elements or components are emulated in such a manner that the original services supported by 64 kbit/s based ISDN are unaffected.

– Emulation of connection elements

64 kbit/s based ISDN connection elements are emulated by broadband connection elements and IWF. Figure 16 illustrates one example of how this kind of emulation might work. Detailed methods of emulation are for further study.

– Emulation of links

Links are emulated by broadband connection elements and IWF. Detailed methods of emulation are for further study.

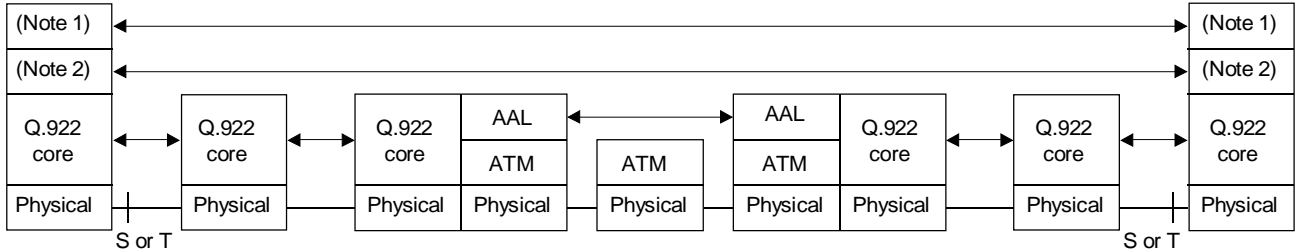
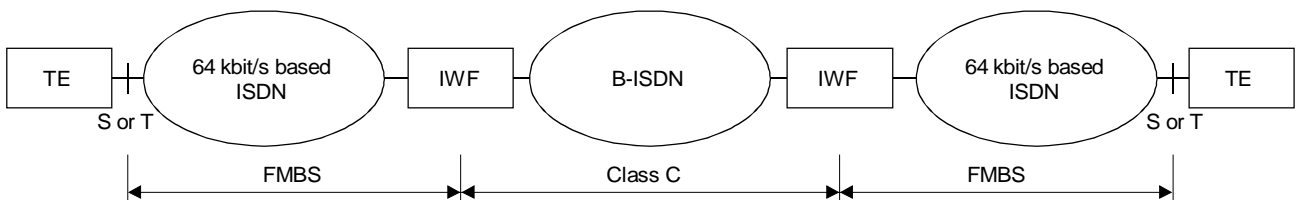


NOTES

- 1 User specified Upper Layers.
- 2 User specified additional Layer 2 protocols.

FIGURE 14/I.580

Frame mode interworking based on the reference configuration of B-ISDN to 64 kbit/s based ISDN interconnection

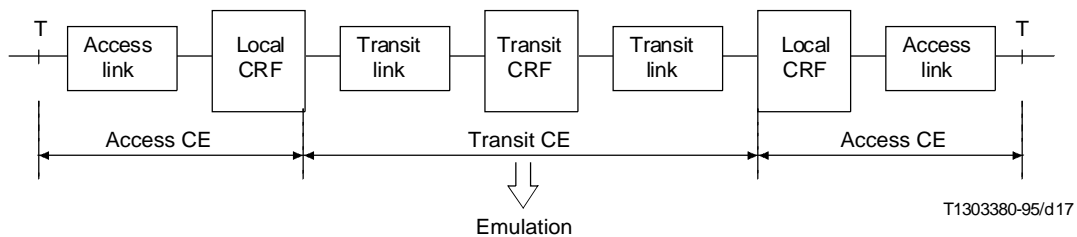


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NOTES

- 1 User specified Upper Layers.
- 2 User specified additional Layer 2 protocols.

FIGURE 15/I.580
**Frame mode interworking based on the reference configuration
of concatenation 64 kbit/s based ISDNs via B-ISDN**



T1303380-95/d17

CE Connection Element
CRF Connection Related Function

FIGURE 16/I.580
Example of emulation of 64 kbit/s based ISDN network components

Annex A

Interworking scenarios to provide 64 kbit/s based ISDN services to a B-ISDN user

(This annex forms an integral part of this Recommendation)

This annex describes two possible interworking scenarios to provide 64 kbit/s based ISDN services to a B-ISDN user. Further study is required.

From the B-ISDN user point of view, 64 kbit/s based ISDN services are accessible to them without any restriction. In order to fulfil this requirement, two possible interworking scenarios may be considered:

- Scenario A: To provide access to 64 kbit/s based ISDN through a B-ISDN; or
- Scenario B: To integrate all 64 kbit/s based ISDN services in B-ISDN with a broadband signalling protocol.

1) Scenario A

In this scenario a transparent ATM connection, either permanent, semi-permanent or switched is used. The corresponding bearer service is Broadband Connection Oriented Bearer Service-A as described in Recommendation F.811. This scenario may be employed for a B-ISDN which does not fully support 64 kbit/s based ISDN services yet.

2) Scenario B

In this scenario network interworking takes place using broadband signalling protocol.

The first scenario may operate in the interim period in which the broadband overlay network will coexist with 64 kbit/s based network. On the other, hand the second scenario is considered as a long-term solution.

A.1 Scenario A

The scenario may have three possible cases and it is depicted in Figure A.1:

- Case 1 – Emulation of the H-, B- and D-channels.
- Case 2 – Emulation of the basic and primary rate accesses.
- Case 3 – Emulation of the digital transmission system.

1) Case 1 – Emulating the H-/B-/D-channels of basic and primary rate access

A B-NT2 is used to connect the TEs (64 kbit/s TEs) to the B-ISDN. At the physical layer activation of the TEs, one permanent connection (semi-permanent or switched ATM connection) will link the TEs to the IWF. The B-NT2 will packetize/depacketize information from/to the D-channel in ATM cell flow. The Data Link Connection will be established between the TEs and the IWF and the Q.921 TEI procedures may then take place under the control of the IWF. The IWF may then play the role of the NT2 or the ET. Following that step the circuit connection control protocol of Recommendation Q.931 may take place. During the circuit connection establishment phase, the allocation of the H-/B-channels will result in dynamic establishment and allocation of ATM connections between the B-NT2 and the IWF.

2) Case 2 – Emulating the basic and primary rate access

In this scheme the B-NT2 will have a generic function which is reduced to the circuit emulation function foreseen in AAL Type 1. The interface at the S reference point will be extended from the B-NT2 to the IWF. In this scenario the B-ISDN is transparent to the 64 kbit/s based ISDN circuit switched call control.

The IWF is seen from the B-ISDN as a specialized service provider (Server for 64 kbit/s based ISDN services access). It is viewed as the NT2 or the ET from the 64 kbit/s based ISDN network.

Two cases may be distinguished:

- a) I.431 emulation: In this case the whole physical layer I.431 is emulated by the AAL Type 1 connection;
 - b) I.430 emulation: In this case only the 2B + D (144 kbit/s) is emulated by the AAL Type 1 connection. The echo channel handling will be taken over by the B-NT2 device.
- 3) *The case that the IWF has no NT2 function*

As an option of above Case 1 and Case 2, IWF has no NT2 function, but has only AAL procedure to emulate H-/B-/D-channels or basic and primary rate accesses.

- 4) *Case 3 – Emulating the digital transmission system*

For further study.

Emulation of the B- and D-channel or the basic and primary rate accesses through a B-ISDN to 64 kbit/s based ISDN requires consideration of a number of management, timing and synchronization issues as follows:

For the I.430 basic rate interface the following functions, conveyed over Layer 1 at the S or T reference points, should be considered.

- activation/deactivation;
- optional loop tests provided by use of Layer 1;
- monitoring of the transmission quality according to the requirements of the line system used (Recommendation G.961).

Conveyance of this information across the B-ISDN will typically require a bit rate higher than the corresponding data rate of 2B + D (144 kbit/s) through the B-ISDN. The functional requirements may also require a more stringent quality of service from the B-ISDN than required for the transfer of data information in the B- and D-channels only.

For the I.431 primary rate interface, the following maintenance functions should be considered:

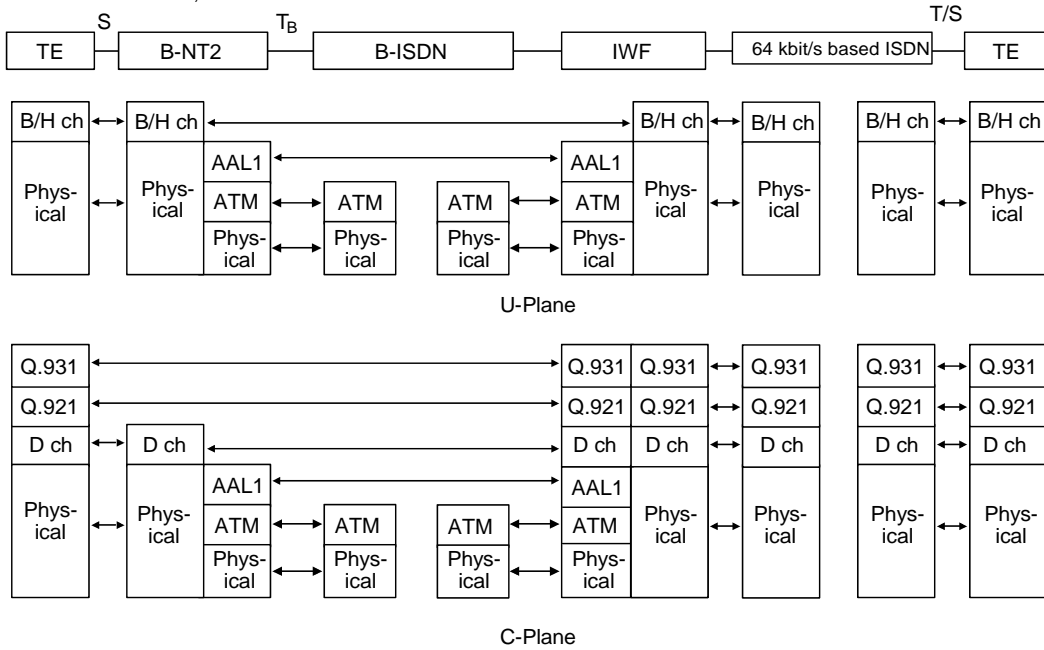
- supervision of Layer 1 capability and reporting across the interface, which includes, on the user side, reporting loss of incoming signal or loss of frame alignment from the user side;
- on the network side, reporting loss of Layer 1 capability and loss of incoming signal or frame alignment from the user side;
- CRC performance monitoring and reporting across the interface.

A.2 Scenario B

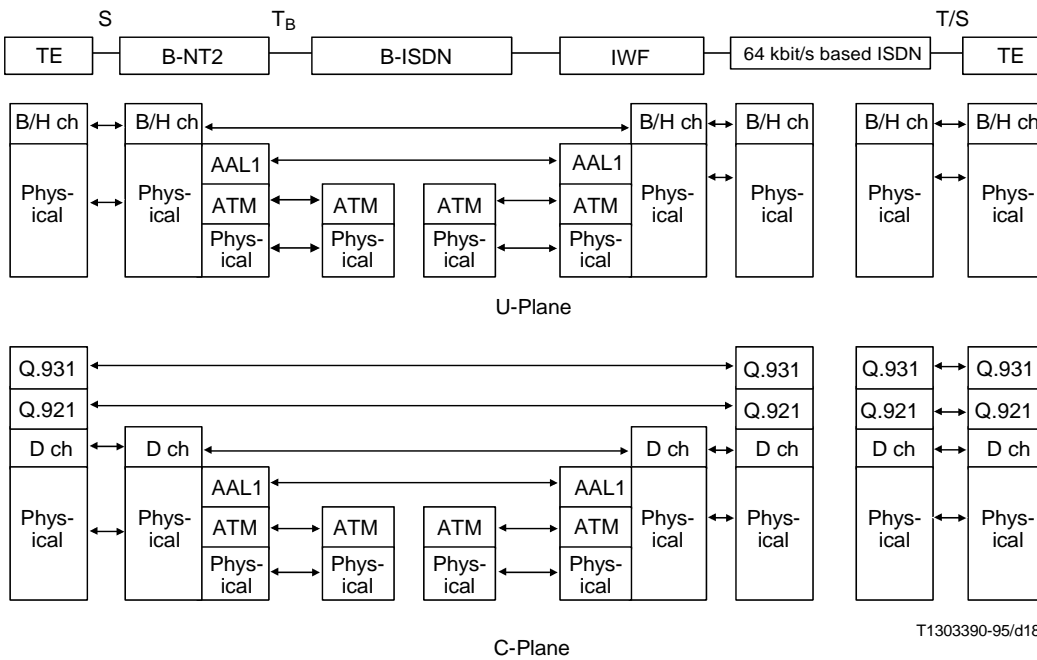
This scenario is depicted in Figure A.2. In this scenario, B-ISDN shall support not only broadband capabilities but also 64 kbit/s based ISDN capabilities.

Interworking functions must take into account the interworking both C-Plane and U-Plane. Interworking between broadband service and 64 kbit/s based ISDN services is performed by call control mapping. Two kinds of signalling interworking are considered (UNI signalling or NNI signalling). C-Plane procedures must provide for the negotiation of U-Plane parameters. These mapping functions require further study.

Scenario A Case 1, 2



Scenario A Case 1, 2 (no NT2 function in IWF)

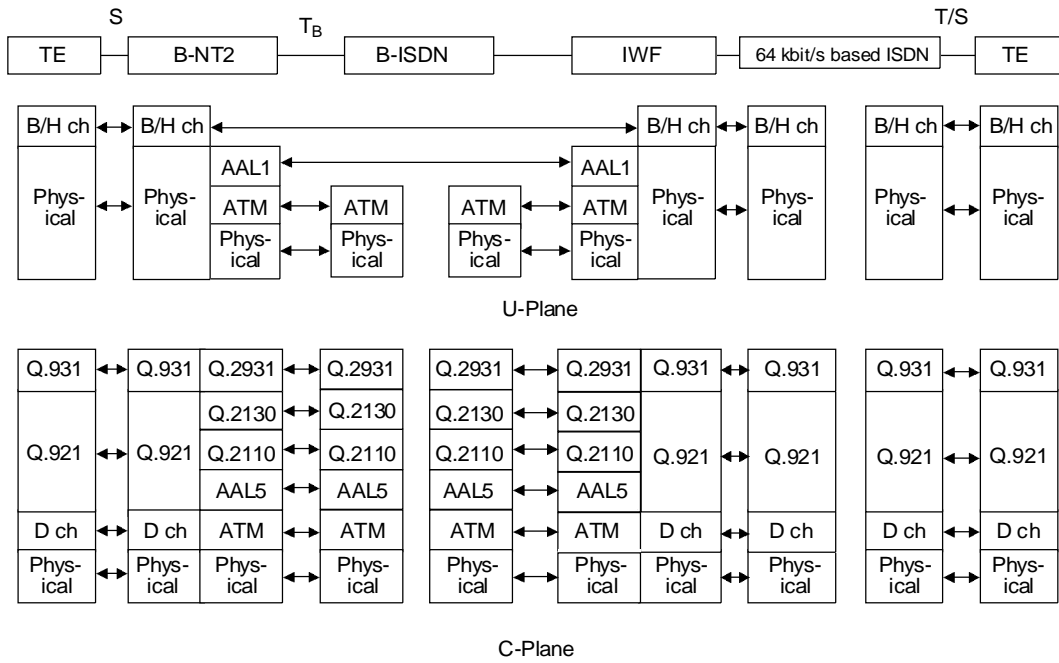


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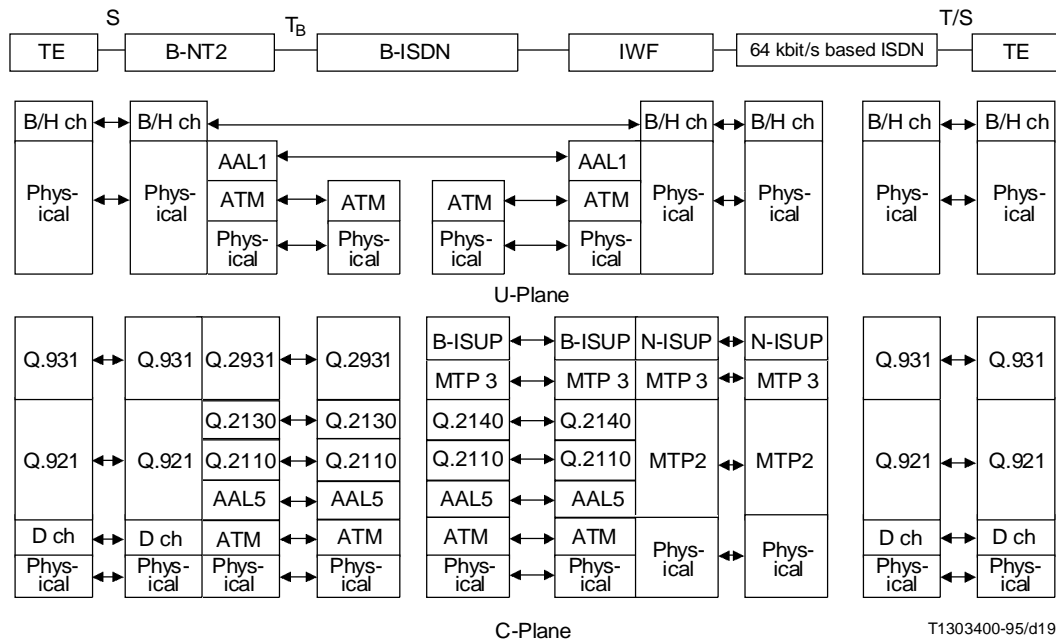
FIGURE A.1/I.580

Example of interworking Scenario A, Case 1 and Case 2

Scenario B Case 1 (UNI signalling)



Scenario B Case 2 (NNI signalling)



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FIGURE A-2/I.580
Example of interworking Scenario B

Annex B

Comparison of Broadband Connection Oriented and 64 kbit/s based ISDN bearer services

(This annex forms an integral part of this Recommendation)

This annex gives the tables comparing Broadband Connection Oriented Bearer Service as defined in Recommendation F.811 and 64 kbit/s based ISDN bearer services as defined in Recommendations I.231 and I.232 for further consideration of the interworking functions. For FMBS, refer to Recommendation I.555. See Tables B.1, B.1-1 and B.2.

TABLE B.1/I.580

Comparison with circuit mode bearer service

Category	Broadband Connection Oriented Bearer Service	Circuit Mode Bearer Service
Subcategories	A	
Bearer service attributes	Value of attributes	
Information transfer attribute		
1 Information transfer mode	ATM	Circuit
1.1 Connection mode	Connection Oriented (CO)	
1.2 Traffic type	Constant Bit Rate (CBR)	
1.3 Timing end-to-end	Required	
1.4 VCI transparency	Transparent for Virtual Path	
2 Information transfer rate	Peak cell rate (Note)	Bit rate: 16 kbit/s (Dch) 64 kbit/s $n \times 64$ kbit/s ($n \leq 30$) 384 kbit/s 1536 kbit/s 1920 kbit/s
2.1 Others for further study		
3 Information transfer capability	Unrestricted/speech/3.1 kHz audio/others for further study	Unrestricted/speech/3.1 kHz audio/unrestricted with tones and announcements
4 Structure	8 kHz integrity/unstructured/others for further study	8 kHz integrity/unstructured/others for further study
5 Establishment of communication	Switched/semi-permanent/permanent	Switched/semi-permanent/permanent
6 Symmetry	Bidirectional symmetric/bidirectional asymmetric/unidirectional	Bidirectional symmetric/unidirectional
7 Communication configuration	point-to-point/point-to-multipoint/multipoint-to-point/multipoint-to-multipoint/multicast/broadcast	point-to-point/point-to-multipoint/multipoint-to-point/multipoint-to-multipoint/ multicast/broadcast
Access attributes		
8 Access channel and rate (kbit/s)		B(64), H0 (384), H11 (1536), H12(1920) for user information
8.1 User information	Virtual channel connection or virtual path connection via the interface (I.432). The maximum service bit rate is for further study	

TABLE B.1/I.580 (concluded)

Comparison with circuit mode bearer service

Category	Broadband Connection Oriented Bearer Service	Circuit Mode Bearer Service
Subcategories	A	
Bearer service attributes	Value of attributes	
9 Access protocols		I-Series for D-channel
9.1 Signalling access protocol physical layer	I.432	I.430, I.431
9.2 Signalling access protocol ATM layer	I.150, I.361	
9.3 Signalling access protocol ATM adaptation layer (AAL)	I.362, I.363, Q.2110, Q.2130	
9.4 Signalling access protocol Layer 3 (above AAL)	Q.2931	Q.930, Q.931
9.5 Information access protocol physical layer	I.432	I.431, I.430
9.6 Information access protocol ATM layer	I.150, I.361	
9.7 Information access protocol ATM adaptation layer (AAL)	I.362, I.363 (Type 1, others for further study)	
9.8 Information access protocol layers above AAL	User defined	User defined
General attributes		
10 Supplementary services provided	Existing supplementary services when supporting 64 kbit/s ISDN services Supplementary services for other services are for further study	Refer to I.250
11 Quality Of Service	For further study	For further study
12 Interworking possibilities	Interworking with other connection oriented services in ISDN and other networks	For further study
13 Operational and commercial aspects	For further study	For further study
<p>NOTE – Traffic description of Peak Cell Rate for UDI and RDI are classified into three cases:</p> <ol style="list-style-type: none"> 1) PCR if no OAM cells are used; 2) PCR if 1 OAM cell/s is used; 3) PCR with maximum OAM support. <p>PCR if no OAM cells are used is: $S / \{ 8 \times (47 \times 8 - 1) / 8 \}$ [cell/s] PCR if 1 OAM cell/sec is used is: $S / \{ 8 \times (47 \times 8 - 1) / 8 \} + 1$ [cell/s] PCR with maximum OAM support is: $S / \{ 8 \times (47 \times 8 - 1) / 8 \} \times 130 / 128 + 1$ [cell/s]</p> <p>where S [bit/s] is the information transfer rate and is not 64 kbit/s and 16 kbit/s.</p> <p>In case of 64 kbit/s and D:</p> <p>PCR if no OAM cells are used is: $S / \{ 8 \times (47 \times 8) / 8 \}$ [cell/s] PCR if 1 OAM cell/sec is used is: $S / \{ 8 \times (47 \times 8) / 8 \} + 1$ [cell/s] PCR with maximum OAM support is: $S / \{ 8 \times (47 \times 8) / 8 \} \times 130 / 128 + 1$ [cell/s]</p>		

TABLE B.1-1/I.580

Default values for ATM traffic descriptor

Information transfer rate (kbit/s)	Peak cell rate for user information (cell/s)	PCR if no OAM cells are used	PCR if 1 OAM cell/sec is used	PCR with maximum OAM support
D: 16	42.55	43	44	45
B: 64	170.21	171	172	174
$n \times 64$ ($n \leq 30$)	–	–	–	–
H0: 384	1024.00	1024	1025	1041
H11: 1536	4096.00	4096	4097	4161
H12: 1920	5120.00	5120	5121	5201

TABLE B.2/I.580

Comparison with packet mode bearer service

Category	Broadband Connection Oriented Bearer Service	Packet Mode Bearer Service
Subcategories	C	
Bearer service attributes	Value of attributes	
Information transfer attribute		
1 Information transfer mode	ATM	Packet
1.1 Connection mode	Connection Oriented (CO)	
1.2 Traffic type	Variable Bit Rate (VBR)	
1.3 Timing end-to-end	Not required	
1.4 VCI transparency	Transparent for Virtual Path	
2 Information transfer rate	I.371	Maximum throughput of a given virtual circuit is less than or equal to the maximum bit rate of the user information access channel and the throughput class of the virtual circuit (Note)
2.1 Others for further study		
3 Information transfer capability	Unrestricted	Unrestricted
4 Structure	AAL-SDU integrity	Service data integrity
5 Establishment of communication	Switched/semi-permanent/ permanent	Demand (virtual call)/ permanent (permanent virtual call)
6 Symmetry	Bidirectional symmetric/ bidirectional asymmetric/ unidirectional	Bidirectional symmetric/ unidirectional

TABLE B.2/I.580 (concluded)

Comparison with packet mode bearer service

Category	Broadband Connection Oriented Bearer Service	Packet Mode Bearer Service
Subcategories	C	
Bearer service attributes	Value of attributes	
7 Communication configuration	Point-to-point/point-to-multipoint/ multipoint-to-point/ multipoint-to- multipoint/ multicast/broadcast	Point-to-point/point-to-multipoint/ multipoint-to-point/ multipoint-to- multipoint/ multicast/broadcast
Access attributes		
8 Access channel and rate (kbit/s)		User information over virtual circuit within B- or D-channel
8.1 User information	Virtual channel connection or virtual path connection via the interface (I.432). The maximum service bit rate is for further study	
8.2 Signalling	Signalling virtual channel for signalling	
9 Access protocols		As specified in I.440, I.450, I.451, I.462 and X.25 (Layers 2 and 3)
9.1 Signalling access protocol physical layer	I.432	
9.2 Signalling access protocol ATM layer	I.150, I.361	
9.3 Signalling access protocol ATM adaptation layer (AAL)	I.362, I.363, Q.2110, Q.2130	
9.4 Signalling access protocol Layer 3 (above AAL)	Q.2931	Q.930, Q.931
9.5 Information access protocol physical layer	I.432	I.431, I.430
9.6 Information access protocol ATM layer	I.150, I.361	
9.7 Information access protocol ATM adaptation layer (AAL)	I.362, I.363, Q.2110, I.365.2	X.25 (Layers 2 and 3)
9.8 Information access protocol layers above AAL	User defined	User defined
General attributes		
10 Supplementary services provided	Existing supplementary services when supporting 64 kbit/s ISDN services Supplementary services for other services are for further study	As listed in X.2. Others are for further study
11 Quality Of Service	For further study	For further study
12 Interworking possibilities	Interworking with other connection oriented services in ISDN and other networks	For further study
13 Operational and commercial aspects	For further study	For further study
NOTE – The exact value of information transfer rate for the switched virtual circuit and permanent virtual circuit are for further study.		

Annex C

OAM information mapping for interworking B-ISDN and 64 kbit/s based ISDN

(This annex forms an integral part of this Recommendation)

This annex gives the principle of OAM information mapping required when interworking B-ISDN and 64 kbit/s based ISDN is performed.

C.1 Interworking scenarios

In order to clarify OAM information mapping, several interworking scenarios are identified in this subclause.

According to Annex A, interworking scenarios are described as follows.

C.1.1 Scenario A

This scenario provides access to 64 kbit/s based ISDN through B-ISDN. The interworking configuration is illustrated in Figure C.1. Scenario A may have three possible cases.

- 1) Case 1: Emulation of the B- and D-channel (Figure C.2);
- 2) Case 2: Emulation of the basic and primary rate accesses (Figure C.5);
- 3) Case 3: Emulation of the digital transmission systems.

C.1.2 Scenario B

This scenario integrates all 64 kbit/s based ISDN services in B-ISDN with a broadband signalling protocol. The interworking via NNI configuration is illustrated in Figure C.8 and U-Plane interworking model is illustrated in Figure C.9.

C.2 Possible OAM information mapping

C.2.1 Scenario A – Case 1

Since TA and IWF in case 1 has channel level emulation function, lower level OAM flow than channel level or VC level should be terminated at TA and IWF. Figures C.3 and Figure C.4 illustrate OAM flow relationship at IWF and TA for basic rate and primary rate, respectively.

At the B-ISDN side, F1 to F4 flow are terminated and appropriate maintenance signal interaction (e.g. AIS, RDI) should be performed according to Recommendation G.782 and I.610 at IWF and TA.

At the 64 kbit/s based ISDN side, physical layer related OAM information are terminated at TA and IWF. This information may include INFO-n signal according to Recommendation I.430 or maintenance signal (e.g. RAI, AIS) according to Recommendation I.431.

Interaction between B-ISDN and 64 kbit/s based ISDN occurs only at channel level. Since OAM information which is associated with channel level for 64 kbit/s based ISDN does not exist, specialized channels are required to transfer INFO-n or (AIS, RAI) information transparently between TA and IWF and appropriate interactions to layer management entity should be performed.

C.2.2 Scenario A – Case 2

Since the I.430/I.431 frame of 64 kbit/s based ISDN is transported by VP, INFO-n signal according to Recommendation I.430 or maintenance signal (e.g. RAI, AIS) according to Recommendation I.431 are transferred transparently to remote end. Figures C.6 and C.7 illustrate OAM flow relationship at IWF and TA for BRI and PRI, respectively. Failures of VP level may be indicated to 64 kbit/s based ISDN.

C.2.3 Scenario A – Case 3

For further study.

C.2.4 Scenario B

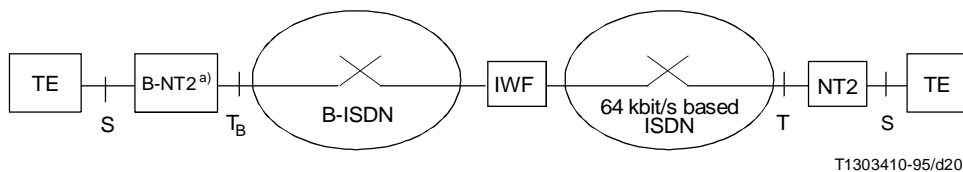
Since TA and IWF in Scenario B has channel level emulation function, lower level OAM flow than channel level or VC level should be terminated at IWF.

Figure C.10 illustrates OAM flow relationship at IWF.

At the B-ISDN side, F1 to F4 flow are terminated and appropriate maintenance signal interaction (e.g. AIS, RDI) should be performed according to Recommendations G.782 and I.610 at IWF and TA.

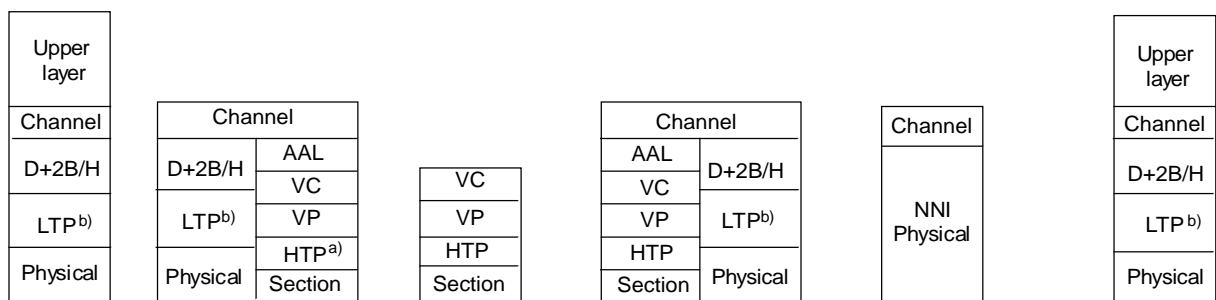
At the 64 kbit/s based ISDN side, F1 to F4 flow are terminated and appropriate maintenance signal interaction (e.g. AIS, RDI) should be performed according to Recommendation G.782 (SDH) or G.700-Series Recommendation (PDH).

Interaction between B-ISDN and 64 kbit/s based ISDN occurs only at channel level. Since OAM information which is associated with channel level for 64 kbit/s based ISDN does not exist, interaction with F5 level may be performed.



a) Including TA functions.

FIGURE C.1/I.580
Interworking configuration in Scenario A



Channel Corresponding D, B, H rate

- a) HTP Higher order Transmission Path based on SDH (e.g. VC-4, VC-4-4c)
- b) LTP Lower order Transmission Path Based on Primary Rate Interface in the case of Basic Rate Interface, this layer may be null.

FIGURE C.2/I.580
U-plane interworking model in Type Scenario A Case 1

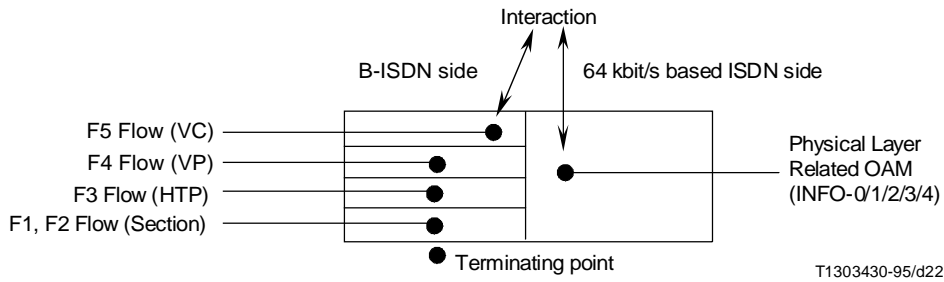
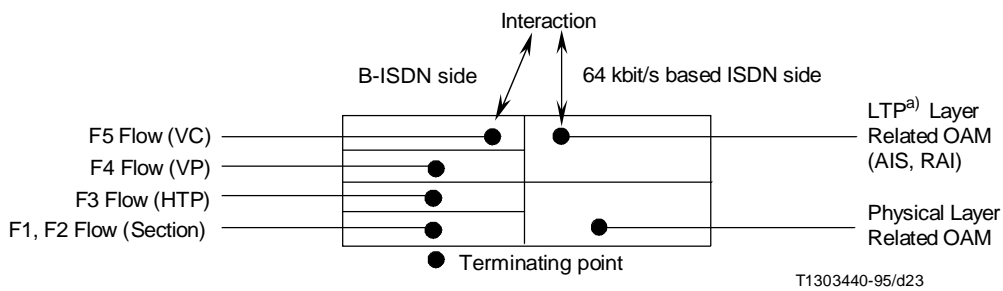
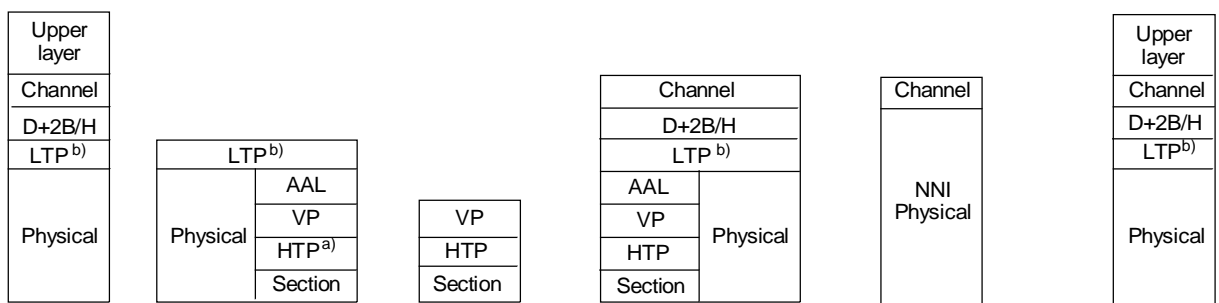


FIGURE C.3/I.580
OAM flow relationship between B-ISDN and 64 kbit/s ISDN at IWF and TA in Scenario A Case 1-1 (BRI)



^{a)} Lower Order Transmission Path based on Primary Rate Interface. In the case of Basic Rate Interface, this layer may be null.

FIGURE C.4/I.580
OAM flow relationship between B-ISDN and 64 kbit/s ISDN at IWF and TA in Scenario A Case 1-2 (PRI)



Channel Corresponding D, B, H rate

^{a)} HTP Higher order Transmission Path based on SDH (e.g. VC-4, VC-4-4c).

^{b)} LTP Lower order Transmission Path Based on Primary Rate Interface. In the case of Basic Rate Interface, this layer may be null.

FIGURE C.5/I.580
U-plane interworking model in Type Scenario A Case 2

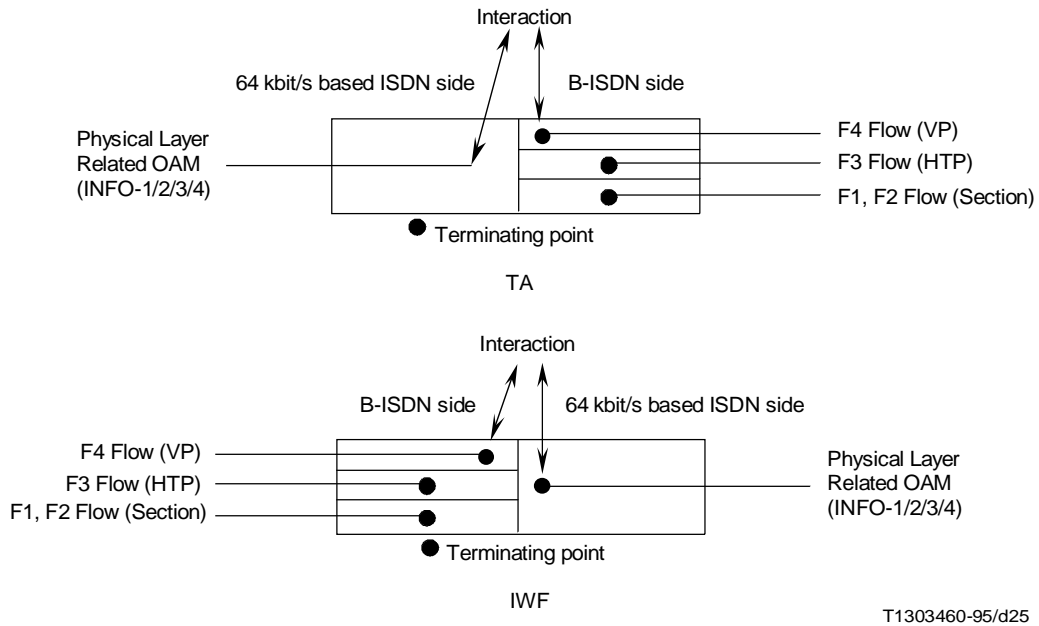


FIGURE C.6/I.580
**OAM flow relationship between B-ISDN
and 64 kbit/s ISDN at IWF and TA in Scenario A Case 2-1 (BRI)**

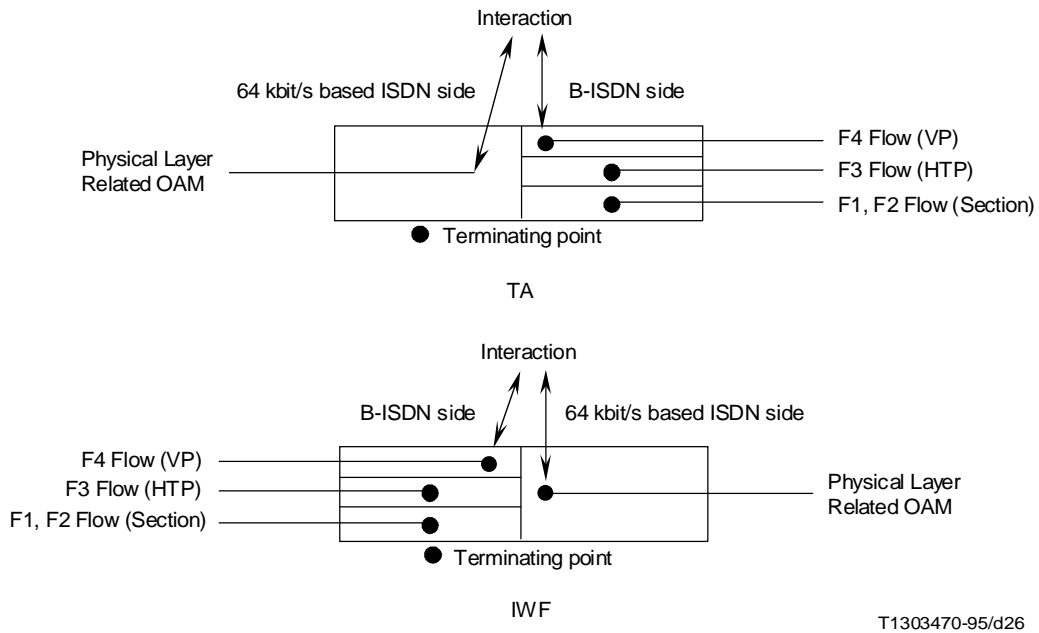


FIGURE C.7/I.580
**OAM flow relationship between B-ISDN
and 64 kbit/s ISDN at IWF and TA in Scenario A Case 2-2 (PRI)**

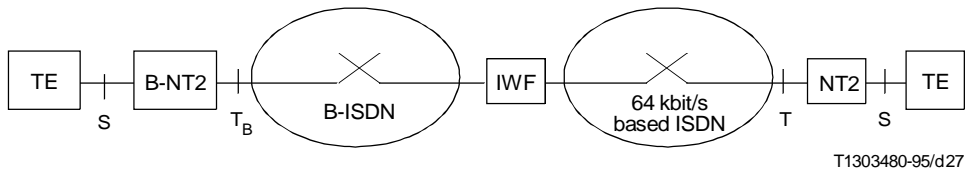
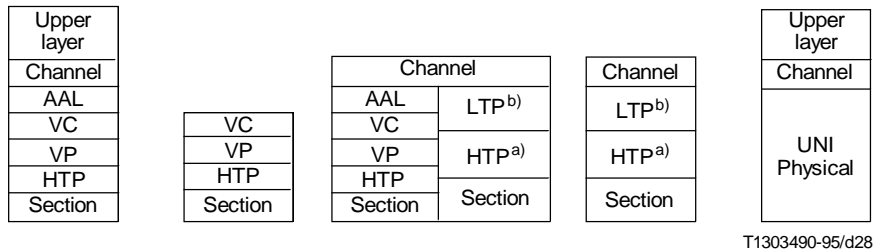


FIGURE C.8/I.580
Interworking configuration in Scenario B



HTP Higher order Transmission Path based on SDH (e.g. VC-4, VC-4-4c)
 LTP Lower order Transmission Path based on SDH (e.g. VC-1, VC-2)
 Channel Including B, H rate

- a) In the case of PDH is applied to NNI, LTP may correspond to lower order digital path.
- b) In the case of PDH is applied to NNI, HTP may correspond to higher order digital path.

FIGURE C.9/I.580
U-plane interworking model in Scenario B

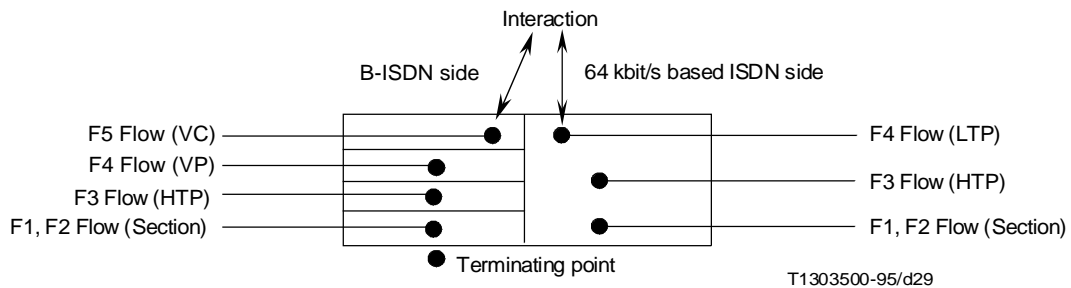


FIGURE C.10/I.580
OAM flow relationship between B-ISDN and 64 kbit/s ISDN at IWF in Scenario B

Appendix I

Access to specific B-ISDN services from a 64 kbit/s based ISDN

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

This appendix describes an interworking scenario by which 64 kbit/s based ISDN users have access to specific B-ISDN services. Characteristic for these services is the absence of a compatible service in 64 kbit/s based ISDN.

An example of such B-ISDN service is:

- the Broadband Connectionless Data Bearer Service (BCDBS).

In principle there are two ways to provide access to specific B-ISDN services for 64 kbit/s based ISDN users (with of course limited QOS).

- 1) To provide a similar service within the framework of the 64 kbit/s based ISDN in conjunction with an interworking function to its B-ISDN counterpart.
- 2) To realize an access to the B-ISDN service available on the B-ISDN (in this case, 64 kbit/s based ISDN is used as a transparent access network).

In this appendix only solution 2) is considered.

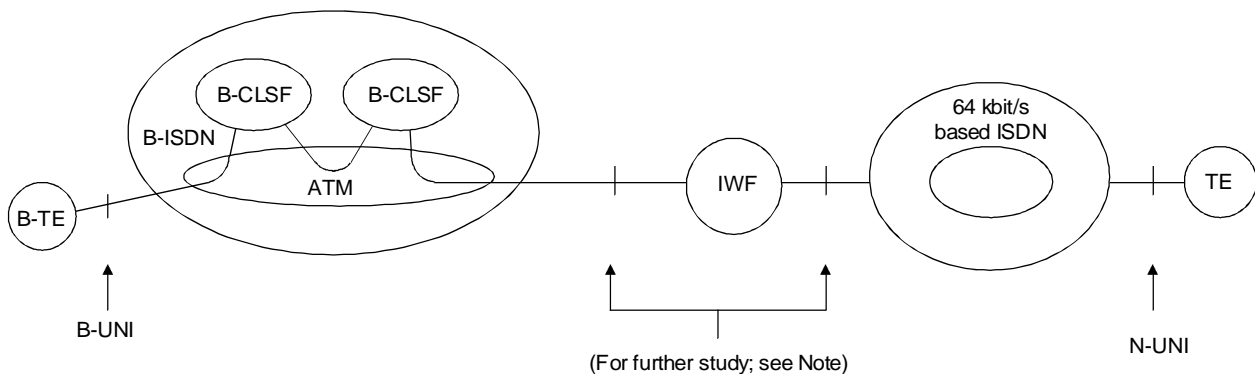
It should be noted that the QOS experienced from the 64 kbit/s based ISDN is limited compared to direct access from B-ISDN.

I.1 Access to BCDBS from 64 kbit/s based ISDNs

The Broadband Connectionless Data Bearer service in B-ISDN as defined in recommendation F.812 is realized by means of so called ConnectionLess Server Functions (CLSFs). Users are required to have a connection to a CLSF in order to use the service.

In this scenario 64 kbit/s based ISDN users will have access to a CLSF on the B-ISDN through a transparent access connection in the 64 kbit/s based ISDN.

The BCDBS B-ISDN/64 kbit/s based ISDN interworking architecture is given in Figure I.1.



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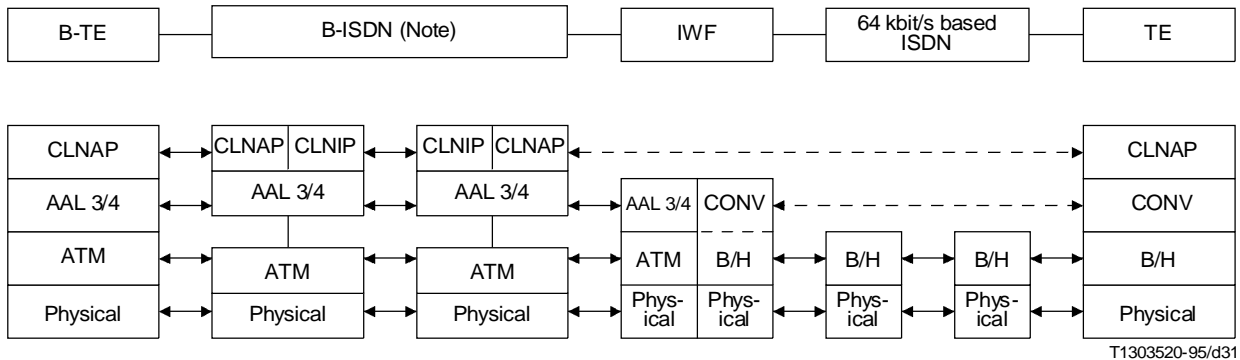
NOTE – The exact definition of the interfaces between IWF and B-ISDN/64 kbit/s based ISDN in Figure I.1 is for further study.

FIGURE I.1/I.580

BCDBS B-ISDN/64 kbit/s based ISDN interworking architecture

This scenario allows 64 kbit/s based ISDN to be used transparently. No existing 64 kbit/s based ISDN (signalling) protocols or network equipment is envisaged to be modified or replaced. (This point is for further study.)

The protocol architecture for BCDBS provision in 64 kbit/s based ISDN using IWFs is given in Figure I.2.



NOTE – Include CLSFs.

FIGURE I.2/I.580

Protocol architecture for BCDBS provision in 64 kbit/s based ISDN using IWF

In Figure I.2, it is assumed that BCDBS is provided via circuit switched bearer connections in 64 kbit/s based ISDN. For the use of other bearer service connections (e.g. frame relay), only minor changes in this figure are needed.

Two new layers are introduced in the 64 kbit/s based ISDN terminal equipment and in the IWF:

CLNAP layer

This layer provides the same interface to the narrow-band user as the CLNAP provides to a broadband user. It should be identical to the CLNAP used in the B-ISDN environment.

CONV(Convergence layer)

This layer adapts the connectionless packets such that they can be transported via an existing 64 kbit/s based ISDN bearer service. This layer can be compared to the AAL in B-ISDN; the AAL adapts connectionless packets so they fit in ATM cells.

The exact functions to be performed by this layer are for further study, and depend on the exact bearer service chosen (examples of 64 kbit/s based ISDN bearer services to be used are circuit mode, frame relaying and frame switching).

As an option, this convergence layer may include error detection, segmentation and reassembling, multiplexing, etc.

I.2 Access to other specific B-ISDN services from 64 kbit/s based ISDN

For further study.

I.3 QOS experienced by the 64 kbit/s based ISDN user

The resulting QOS experienced by the 64 kbit/s based ISDN user will be limited compared to B-ISDN access, further study is required.

Transmission speed

A Packet's transmission speed in a 64 kbit/s based ISDN necessarily is lower than in B-ISDN due to bandwidth limitations. As a result, a packet experiences a relatively large delay in the 64 kbit/s based ISDN environment.

Bit-error probability

The bit-error probability in a 64 kbit/s based ISDN is much larger than in B-ISDN. As a result, the probability that a BCDBS-packet is lost is higher in 64 kbit/s based ISDN than in B-ISDN.