



INTERNATIONAL TELECOMMUNICATION UNION

CCITT

THE INTERNATIONAL
TELEGRAPH AND TELEPHONE
CONSULTATIVE COMMITTEE

I.460

(11/1988)

SERIES I: INTEGRATED SERVICES
DIGITAL NETWORK (ISDN)

Overall network aspects and functions,
ISDN user-network interfaces

**MULTIPLEXING, RATE ADAPTION AND
SUPPORT OF EXISTING INTERFACES**

Reedition of CCITT Recommendation I.460 published in
the Blue Book, Fascicle III.8 (1988)

NOTES

1 CCITT Recommendation I.460 was published in Fascicle III.8 of the *Blue Book*. This file is an extract from the *Blue Book*. While the presentation and layout of the text might be slightly different from the *Blue Book* version, the contents of the file are identical to the *Blue Book* version and copyright conditions remain unchanged (see below).

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

Recommendation I.460

MULTIPLEXING, RATE ADAPTION AND SUPPORT OF EXISTING INTERFACES

(Malaga-Torremolinos, 1984; amended at Melbourne, 1988)

This Recommendation describes procedures to be used to:

- a) adapt the rate of one stream, of rate lower than 64 kbit/s, into a 64 kbit/s B-channel;
- b) multiplex several streams, of rates lower than 64 kbit/s, into a 64 kbit/s B-channel.

The rates lower than 64 kbit/s are of two types:

- 1) binary rates of 8, 16 and 32 kbit/s; and
- 2) other rates including those associated with DTEs conforming to the X and V series Recommendations.

The detailed procedures for support of X-Series circuit mode DTEs, X-Series packet mode DTEs, and V-Series DTEs are given in Recommendations 1.461 (X.30), I.462 (X.31), I.463 (V.110) and I.465 (V.120), respectively.

Rate adaption, multiplexing and support of existing interfaces for restricted 64 kbit/s transfer capability is covered in Recommendation I.464.

1 Rate adaption to a 64 kbit/s channel

1.1 Rate adaption of 8, 16 and 32 kbit/s streams

The procedure in this section will be used to adapt the rate of a *single* stream at 8, 16 or 32 kbit/s into a 64 kbit/s B-channel. In this Recommendation, bit positions in the B-channel octet are assumed to be numbered from 1 to 8 with bit position 1 being the first transmitted.

The procedure requires that:

- i) the 8 kbit/s stream occupies bit position 1;
the 16 kbit/s stream occupies bit positions (1, 2);
the 32 kbit/s stream occupies bit positions (1, 2, 3, 4);
- ii) the order of transmission of the bits of the subrate stream is identical before and after rate adaption; and
- iii) all unused bit positions be set to binary "1".

1.2 Rate adaption of streams other than 8, 16 and 32 kbit/s

Information streams at bit rates less than 64 kbit/s need to be rate adapted to be carried on the B-channel. The approaches in this section are for adapting *single* information streams.

1.2.1 The rate adaption of bit rates up to 32 kbit/s uses a multi-stage approach. One stage is described in Recommendations I.461 (X.30), I.462 (X.31), I.463 (V.110). For example, user rates of 4.8 kbit/s and below are mapped to 8 kbit/s, 9.6 kbit/s is mapped to 16 kbit/s, and 19.2 kbit/s is mapped to 32 kbit/s.

Another stage of rate adaption is from 8 kbit/s, 16 kbit/s, or 32 kbit/s to 64 kbit/s and is described in § 1.1.

A third stage for asynchronous data is described in Recommendation I.463 (V.110).

1.2.2 Rate adaption of bit rates higher than 32 kbit/s uses a single stage approach as described in Recommendations I.461 (X.30) and I.463 (V.110). That is, 48 kbit/s and 56 kbit/s rates are adapted to 64 kbit/s in one stage.

1.2.3 Rate adaption for packet mode operation may be performed in two ways as described in Recommendation I.462 (X.31):

- a) the preferred method: in using HDLC flag stuffing between HDLC frames; or
- b) using the two stage approach.

1.2.4 Rate adaption of bit rates up to 48 kbit/s on a B-channel may be performed by insertion of HDLC frames as described in Recommendation I.465 (V.120).

2 Multiplexing into a 64 kbit/s channel

2.1 *Time division multiplexing of 8, 16 and 32 kbit/s*

Multiplexing of 8, 16 and 32 kbit/s streams is done by interleaving the subrate streams within each B-channel octet.

Using the procedures described in § 2.1.2, any number of 8, 16 and 32 kbit/s streams may be combined up to the limit of 64 kbit/s aggregate bit-rate in one B-channel.

Using the procedure described in § 2.1.1 can lead to situations where the full 64 kbit/s capacity cannot be utilized; however, this will not occur if the mixture of substreams is known in advance. The procedures in § 2.1.2 are recommended when the mixture will change during the duration of the 64 kbit/s connection.

2.1.1 *Fixed format multiplexing*

This procedure will multiplex any combination of 8, 16 and 32 kbit/s streams by allocating bit positions in each B channel octet to each subrate stream. The fixed format procedure requires that:

- i) an 8 kbit/s stream be allowed to occupy any bit position; a 16 kbit/s stream occupies bit positions (1, 2) or (3, 4) or (5, 6) or (7, 8); a 32 kbit/s stream occupies bit positions (1, 2, 3, 4) or (5, 6, 7, 8);
- ii) a subrate stream occupies the same bit position(s) in each successive B-channel octet;
- iii) the order of transmission of the bits at each subrate stream is identical before and after multiplexing; and
- iv) all unused bit positions be set to binary "1".

2.1.2 *Flexible format multiplexing*

This procedure will multiplex any combination of 8, 16 and 32 kbit/s streams by allocating bits in each B-channel octet to each subrate stream. This procedure always allows subrate streams to be multiplexed up to the 64 kbit/s limit of the B-channel. This procedure first attempts to accommodate the subrate streams by using the fixed format procedure of § 2.1.1. Although there may be a sufficient number of available bits in the B-channel octet, the attempt may fail because rule i) of § 2.1.1 cannot be satisfied. If this attempt does fail, then flexible format procedure requires that:

- i) a subrate stream occupy the same bit position(s) in each successive B-channel octet;
- ii) the new subrate stream be added to the existing multiplex by inserting each successive bit of the new subrate stream into the earliest (lowest numbered) available bit position in the B-channel octet; and
- iii) all unused bit positions be set to binary "1".

2.2 *Multiplexing of rates other than 8, 16 and 32 kbit/s*

Two technical approaches for multiplexing lower bit rate information streams (e.g. Recommendation X.1 rates) can be used:

i) *Time division multiplexing*

In this case, the two stage approach (rate adaption up to 8, 16 or 32 kbit/s followed by multiplexing to 64 kbit/s) as defined in §§ 1.2 and 2.1 should be used.

Note – Multiplexing schemes according to X-Series Recommendations (e.g. X.50) may be used only in the context of 64 kbit/s access through the ISDN to existing dedicated networks.

ii) *Statistical multiplexing*

- a) for supporting packet mode terminals using either the D-channel or Recommendation X.25 protocols;
- b) for circuit mode terminals or terminal adaptors on the B-channel, see Recommendation V.120.

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