INTERNATIONAL TELECOMMUNICATION UNION

ITU-T X.51

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

PUBLIC DATA NETWORKS

TRANSMISSION, SIGNALLING AND SWITCHING

FUNDAMENTAL PARAMETERS OF A MULTIPLEXING SCHEME FOR THE INTERNATIONAL INTERFACE BETWEEN SYNCHRONOUS DATA NETWORKS USING 10-bit ENVELOPE STRUCTURE

ITU-T Recommendation X.51

(Extract from the *Blue Book*)

NOTES

1 ITU-T Recommendation X.51 was published in Fascicle VIII.3 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 X.51

FUNDAMENTAL PARAMETERS OF A MULTIPLEXING SCHEME FOR THE INTERNATIONAL INTERFACE BETWEEN SYNCHRONOUS DATA NETWORKS USING 10-bit ENVELOPE STRUCTURE

(Geneva, 1976; amended at Malaga-Torremolinos, 1984)

The CCITT,

considering

(a) that Recommendation X.50 sets out the fundamental parameters for a multiplexing scheme for the interworking of networks where at least one makes use of the 8-bit envelope structure or of the four 8-bit envelopes grouping,

(b) that there is a requirement for a multiplexing scheme for the interworking between two networks where both use 10-bit envelope structure,

unanimously declares the view

that the following fundamental parameters shall be used between networks using the 10-bit envelope structure.

1 Gross bit rate

For transmission on the international link the multiplexed bit stream shall have a gross bit rate of 64 kbit/s. The fundamental multiplex structure shall have a gross bit rate of 60 kbit/s and shall utilize padding techniques for transmission on the 64 kbit/s international bearer.

2 Fundamental multiplex

For the fundamental multiplexing of information bearer channels, the following applies:

2.1 The signal elements of each individual channel shall be assembled in 10-bit envelopes, in which bit 1 is a status bit (see Note), bit 2 is an envelope alignment bit, and bits 3-10 are information bits, as in Figure 1/X.51.

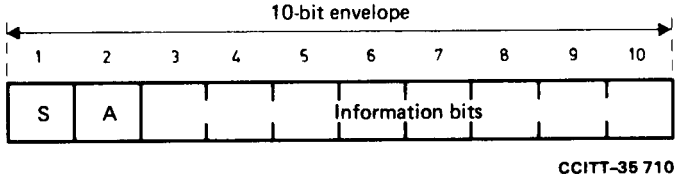

FIGURE 1/X.51

The addition of the status and the envelope alignment bits results in a 25% increase in bit rate, so that the bearer channel rates are:

12.0 kbit/s for the 9.6-kbit/s data signalling rate;

6.0 kbit/s for the 4.8-kbit/s data signalling rate;

3.0 kbit/s for the 2.4-kbit/s data signalling rate;

750 bit/s for the 600-bit/s data signalling rate.

Note - A status bit S bit is associated with each envelope and in conjunction with the associated 8-bit data byte conveys call control information (cf. Recommendations X.21, X.21 *bis*, X.60, X.71 and X.50).

2.2 A 10-bit envelope interleaved structure shall be used.

2.3 These interleaved envelopes will appear on the 60 kbit/s fundamental multiplex as follows:

- 12.0-kbit/s channels will repeat every 5th envelope;
- 6.0-kbit/s channels will repeat every 10th envelope;
- 3.0-kbit/s channels will repeat every 20th envelope;
- 750-bit/s channels will repeat every 80th envelope.

2.4 Both structures suitable for handling homogeneous (with respect to bearer rates) mixes of bearer channels and structures suitable for handling heterogeneous mixes of bearer channels are required, with the constraint that the division of any 12-kbit/s bearer channels of the multiplex shall be homogenous providing either two 6-kbit/s, four 3-kbit/s or sixteen 750-bit/s bearer channels.

3 Method of framing

3.1 *Overall structure*

The residual 4-kbit/s capacity obtained by carrying the fundamental 60-kbit/s multiplex on the 64-kbit/s bearer shall be distributed so that a padding bit is inserted after each group of 15 bits from the fundamental multiplex (see also Figure 2/X.51).

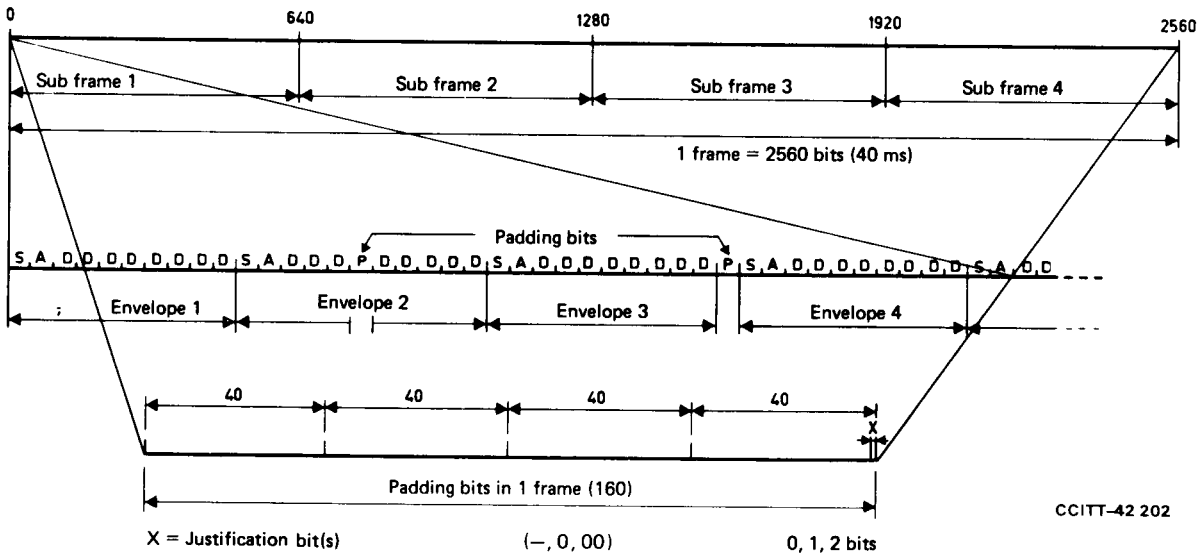

FIGURE 2/X.51

Multiplex frame structure

The frame length shall be 2560 bits in the case of a synchronized bearer, i.e. 2400 bits or 240 envelopes from the fundamental multiplex interleaved with 160 padding bits.

When justification is used (for national purposes) in the case of a non-synchronized bearer the last padding bit in the frame can be deleted or an extra padding bit added when needed, resulting in a variable frame length of 2560 ± 1 bit. (This can allow a maximum speed tolerance of approximately ± 4 parts in 10^4.)

The padding bits shall contain the framing pattern, justification service digits and housekeeping signalling (alarms, etc.).

3.2 *Framing*

3.2.1 *Frame alignment patterns*

The frame alignment method is based on the use of 4 equidistantly distributed frame alignment patterns

written into the padding bits, dividing the frame into 4 subframes. Each subframe alignment pattern starts with the 14-bit pattern:

11111001101010

followed by a 2-bit subframe identifier unique to the subframe, i.e.:

SF1 = 00,SF2 = 01, SF3 = 10, SF4 = 11.

3.2.2 *Framing strategy*

3.2.2.1 *Loss of frame alignment*

The criterion for loss of frame alignment shall be three consecutive frame alignment patterns including subframe identifier in error.

The frame alignment shall also be considered lost if the first received frame alignment pattern including subframe identifier after reframing is in error.

3.2.2.2 *Reframing*

The criterion for reframing shall be the detection of one valid frame alignment pattern.

3.2.2.3 *Reframing procedure*

After loss of frame alignment:

- the outgoing envelopes shall be set to all ones,
- the state shall be signalled to the distant end, and
- a parallel hunt for a valid frame alignment pattern shall be started.

After a valid frame alignment pattern is found:

- the two following padding bits shall be accepted as subframe identifiers and be used to set the frame and subframe counter(s) as applicable,
- the blocking of the outgoing data channels shall be removed, and
- the signalling of out of frame alarm to the distant end shall be terminated.

4 Justification

The 64-kbit/s bearer carrying the 10-bit envelope multiplex normally shall be locked to the data stream and therefore justification on international links is not required. However, justification could be required for national purposes. To achieve this, plus minus justification shall be used in which four repeated justification service signals occupy the 3 bits immediately following each subframe identifier. The last padding bit of the frame is used as a justification digit.

The repeated justification service signals are:

010 no justification (i.e. one padding bit at end of frame),

100 one justification bit has been added (i.e. two padding bits at end of frame),

001 the justification bit has been deleted (i.e. no padding bit at end of frame).

In evaluating the signals in one frame a majority decision of the four received signals is used. In case of no majority, no justification shall be assumed.

If framing is lost, no justification shall be assumed before reframing has occurred.

5 Housekeeping signals and functions

The padding bits not used for framing and justification shall be available for housekeeping information signals, for both international and national use. The definition and allocation of some of the available housekeeping bits is left for further study. The following allocation is recommended.

5.1 *International housekeeping bits*

Eight bits A, B, C, D, E, F, G, and H (cf. Recommendation X.50) are allocated for international housekeeping signals.

The bit A is used to convey to the distant end alarm indications detected at the local end corresponding to:

- absence of incoming pulses,
- loss of frame alignment,

and the bit A shall be assigned such that:

- A equals 1 means no alarm,
- A equals 0 means alarm.

The other bits B, C, D, E, F, G and H are reserved to convey further international housekeeping signals. The exact use is under study. Pending the result of the study these bits shall be set to binary 1.

5.2 *Cyclic error-control*

A cyclic error-control (cf. Recommendation V.41) to be used end-to-end on the international 64-kbit/s link is recommended but not mandatory. The multiplex frame (2560 bits) is divided modulo 2 by the polynomial $x^{16} + x^{12} + x^5 + 1$ and the resulting reminder (16 bits), the check bits, are sent in the next frame, 4 bits in each subframe. An error is detected at the receiving end by comparing the check bits generated locally, by dividing the received multiplex frame with the same polynomial, and the check bits received in the following frame. The error detection shall be blocked in the out-of-frame state.

5.3 *National housekeeping signals*

A total of 48 housekeeping bits, 12 in each subframe, remains for national housekeeping signals, of which the following are foreseen:

Network status	1-4 bits
Multiplex channel allocation (depending on number of speed classes and coding)	5-10 bits
Internal and external alarms	1-4 bits

These signals could possibly be extended for international use. Housekeeping bits not used in one network shall be set to binary 1.

6 Allocation and use of padding bits (40 bits) in one subframe (640 bits) for framing, justification and housekeeping

The allocation of padding bits in one subframe numbered P1 to P40 is described below and shown in Figure 3/X.51.

P1-P4	International housekeeping bits A, B, C, and D (cf. Recommendation X.50)	
P5-P8	Error check bits	4 bits
P9-P20	National housekeeping bits	12 bits
P21-P34	Framing pattern. Code 11111001101010	14 bits

P35-P36 Subframe identifier 2 bits
Code 00, 01, 10 or 11

For P37-P40 two alternatives exist:

I - Synchronous transmission bearer

P37-P40 International housekeeping bits E, F, G and H
(cf. Recommendation X.50)

II - Asynchronous transmission bearer

P37-P39 Justification service signals 3 bits
Code 001, 010, 100

P40(P41) Justification bit(s) 0, 1, 2 bit(s)
Code –, 0, 00

Only the justification bit(s) in the last subframe (SF4) is used for justification.

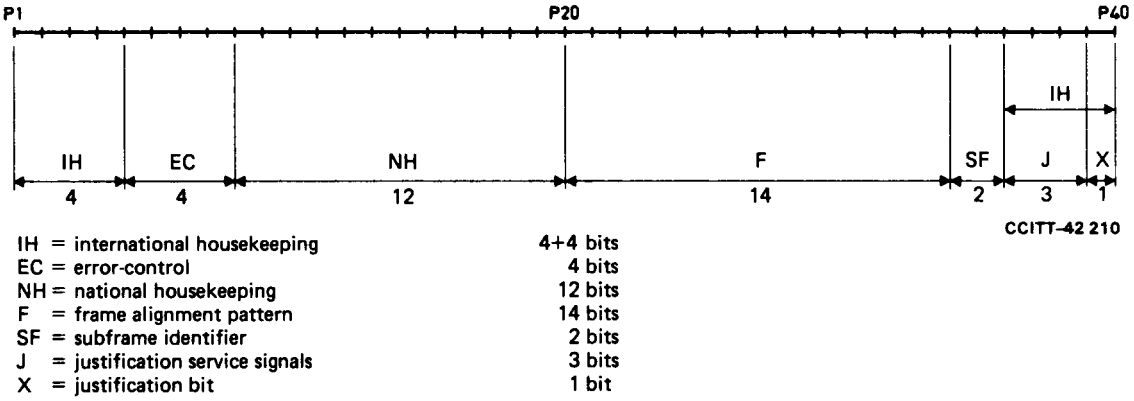

FIGURE 3/X.51

Allocation of padding bits in one subframe (40 bits)

7 Transmission of the 48 kbit/s user data signalling rate

Generally, Recommendation X.51 *bis* applies.

Optionally, on bilateral agreement, the scheme described in this Recommendation may be applied also to transmit the 48 kbit/s user data signalling rate. Using this option, the bearer channel rate of the fundamental multiplex described in § 2 becomes 60 kbit/s, permitting only one single channel to be conveyed.