INTERNATIONAL TELECOMMUNICATION UNION

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TRANSMISSION, SIGNALLING AND SWITCHING

FUNDAMENTAL PARAMETERS OF A MULTIPLEXING SCHEME FOR THE INTERNATIONAL INTERFACE BETWEEN SYNCHRONOUS DATA NETWORKS

ITU-T Recommendation X.50

(Extract from the *Blue Book*)

NOTES

1   ITU-T Recommendation X.50 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.50

FUNDAMENTAL PARAMETERS OF A MULTIPLEXING SCHEME
FOR THE INTERNATIONAL INTERFACE BETWEEN
SYNCHRONOUS DATA NETWORKS

(Geneva, 1972; amended at Geneva, 1976 and 1980)

The establishment in various countries of public synchronous data networks creates a need to standardize a preferred multiplexing scheme to be used on international links between these countries.

The CCITT,

considering

that the resolution of the fundamental parameters of a multiplexing scheme is urgently needed for the interworking of data networks using different envelope structures;

unanimously declares the following view:

1   Division 1

1.1   This Recommendation sets out the fundamental parameters of a multiplexing scheme for interworking of networks that make use of the following structures:

   a)   8-bit envelope (see Explanatory Note 1 below);

   b)   four 8-bit envelopes grouping (see Explanatory Note 2 below);

   c)   10-bit envelope (see Explanatory Note 3 below), in the case where at least one of the networks is structured according to a) or b).

1.2   For interworking between two networks both of which utilize the 10-bit envelope structure as identified in § 1.1 c) above, Recommendation X.51 will apply.

1.3   Paragraph 2 of this Recommendation deals with the basic multiplexing parameters which shall be used in any application of this Recommendation.

1.4   Paragraph 3 of this Recommendation, in addition to § 2, applies to the interworking between two networks both of which utilize the 8-bit envelope structure, as identified in § 1.1 a) above.

1.5   Paragraph 4 of this Recommendation, in addition to § 2, applies to the interworking of networks as identified in § 1.1 above in cases other than those described in §§ 1.2 and 1.4 above with due regard to the transit situations.

1.6   The use of the status bit, besides that indicated in this Recommendation, should comply with Recommendations X.21 and X.21 *bis,* together with Recommendation X.71 for connections using decentralized signalling and with Recommendation X.60 for connections using common channel signalling.

2   Division 2

2.1   The multiplex gross bit rate of 64 kbit/s should be standardized for international links and framing information for the channels should be contained within the 64 kbit/s capability.

2.2   For the basic multiplexing of information bearer channels, the following applies:

   i)   structures suitable both for handling homogeneous (with respect to bearer rates) mixes of bearer channels and structures suitable for handling heterogeneous mixes of bearer channels are required;

ii)   the signal elements of each individual channel should be assembled in 8-bit envelopes;

iii)   an 8-bit envelope interleaved structure should be used;

iv)   for the multiplex signal framing a distributed framing pattern should be used, employing the framing bits of consecutive 8-bit envelopes but taking into account the requirements for service digits (housekeeping digits);

v)   these interleaved 8-bit envelopes will appear on the 64 kbit/s bearer as follows:

-    12.8 kbit/s channels will repeat every 5th 8-bit envelope;

-    6.4 kbit/s channels will repeat every 10th 8-bit envelope;

-    3.2 kbit/s channels will repeat every 20th 8-bit envelope;

-    800 bit/s channels will repeat every 80th 8-bit envelope.

2.3   The following multiplexing structure is recommended:

i)   the multiplexing structure will comprise 80 8-bit envelopes;

ii)   this structure will allow the multiplexing of channels at the bearer rates indicated in § 2.2 v) above;

iii)   within each 12.8 kbit/s channel, only a homogeneous mixture of subrate channels will be allowed;

iv)   a 72-bit long framing pattern is recommended. This pattern is part of the 80-bit pattern which is generated according to the primitive polynomial:

$$1 + x^4 + x^7$$

of the 2^7 Galois field with the forcing configuration

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and which is reproduced in Table 1/X.50, showing 8 bits ("A" to "H") reserved for housekeeping;

v)   the first F bit, indicated as "A" in Table 1/X.50 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;

vi)   the "A" bit shall be assigned such that:
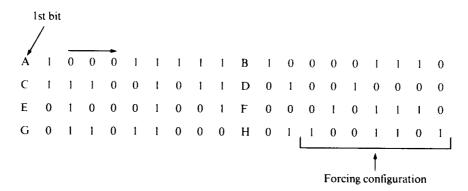
"A" equals 1 means no alarm;

"A" equals 0 means alarm;

vii)   the other F bits indicated as "B", "C", "D", "E", "F", "G", and "H" in Table 1/X.50 are reserved to convey further international housekeeping information. The exact use of the remaining housekeeping bits is under study. Pending the resolution of the housekeeping requirements, these bits are provisionally fixed to:

"B" equals 1, "C" equals 1, "D" equals 0,

"E" equals 0, "F" equals 1, "G" equals 1, "H" equals 0.

TABLE 1/X.50

Forcing configuration

2.4   For frame synchronization, the following general requirements are recommended:

   i)   the frame synchronization method should be insensitive as far as possible to bit errors, error bursts and short bursts of the alarm indication signal (AIS) generated by transmission equipment;

   ii)   when a slip occurs in the transmission equipment, a fast frame alignment should be possible.

2.5   In addition to § 2.4 above, the frame synchronization method should offer the following performances:

   i)   the frame alignment recovery time, after a slip and in absence of bit errors should be less than 120 envelopes, with 95% probability;

   ii)   the time from the start of a disturbance as defined in § 2.4 i) to any action affecting the data channels shall be [including the transmission of alarm to the distant end defined in § 2.3 v) and vi)] greater than x (x in the range 1-20 ms);

   iii) a random error rate of 1 in 10^4 shall not cause any frame alignment recovery action.

3   Division 3

3.1   For interworking between two networks, both of which utilize the 8-bit envelope structure, as identified in § 1.1 a) above, each individual channel should be assembled into single 8-bit envelopes. As an alternative to the multiplexing structure recommended in § 2.3 above, other structures may be used by bilateral agreement. One of the preferred structures is described below:

   i)   the multiplexing structure will comprise 20 8-bit envelopes;

   ii)   the structure will allow the multiplexing of channels at the bearer rates 12.8 kbit/s, 6.4 kbit/s and 3.2 kbit/s indicated in § 2.2 v) above;

   iii) within each 12.8 kbit/s channel only a homogeneous mixture of subrate channels will be allowed;

   iv)   a 19-bit long framing pattern is recommended. The pattern is part of the 20-bit pattern which is generated to the primitive polynomial:
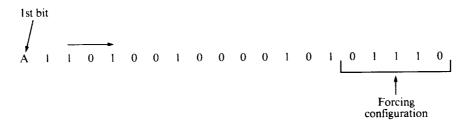
$$1 + x^2 + x^5$$

   of the Galois 2^5 field with the forcing configuration

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   and is reproduced in Table 2/X.50;

   v)   the first F bit indicated as "A" in Table 2/X.50, is used as stated in § 2.3 v) above,

   vi)   the sense of "A" will be in accordance with § 2.3 vi) above.

TABLE 2/X.50

3.2   For frame synchronization, the general requirements and the performances should be as recommended in §§ 2.4 and 2.5 above.

4   Division 4

For the interworking of networks as identified in § 1.1 above, in cases other than those described in §§ 1.2 and 1.4, the following shall apply.

4.1   A network using the 10-bit envelope structure shall interwork with other networks, as identified in § 1.1 a) and b) above, by offering the same characteristics as a network using the four 8-bit envelopes grouping. Therefore in the following, the term "network providing the four 8-bit envelopes grouping" will cover the case of a network using either four 8-bit envelopes grouping as identified in § 1.1 b) or the 10-bit envelope structure, as identified in § 1.1 c).

4.2   When either end of an international connection, carrying point-to-point or switched service, terminates in a network providing four 8-bit envelopes grouping, the use of the four 8-bit envelopes grouping may be required on the international connection carrying point-to-point or switched services. This is subject to further study.

4.3   The alignment of the four 8-bit envelopes grouping shall be subject to the following conditions:

   i)   the method of alignment shall allow switched and non-switched point-to-point data circuits to be conveyed;

   ii)   alignment shall be monitored and maintained at both ends of an international connection in the two networks providing the four 8-bit envelopes grouping by means of a pattern(s) on bit S_D of the four 8-bit envelopes grouping throughout the data phase of the call;

   iii) transit exchanges shall not overwrite the S_D bit once they have through connected;

   iv)   alignment shall be established at both ends of an international connection in the two networks providing the four 8-bit envelopes grouping prior to the through connection of the originating exchange.

   Note 1 - The interexchange signalling procedures are expected to allow iv) above without unacceptable delay in call set-up.

   Note 2 - Problems caused by imitation of the S_D pattern(s) should be studied further.

4.4   The specific strategy of the four S-bit envelopes grouping alignment would be the subject of further study.

4.5   In the case where one of the networks is not providing the four 8-bit envelopes grouping, there is no relationship between any four 8-bit envelopes grouping and any character structure outgoing from that network. Moreover this network will not originate any alignment information for the outgoing four 8-bit envelopes grouping.

4.6   When links containing a four 8-bit envelopes grouping are connected in tandem to provide a trunk, the four 8-bit envelopes grouping alignment information shall be maintained across the connection.

4.7   In transit switching, the four 8-bit envelopes grouping alignment information shall be maintained once the transit exchange has through connected.

4.8   When links containing single 8-bit envelopes are connected in tandem to provide a trunk, the information and status bits of the 8-bit envelopes shall be transparently conveyed across the connection.

5   Division 5

To regulate transmission of 64-kbit/s streams, the following will apply:

   i)   In networks where the 64-kbit/s transmission paths have an octet structure throughout (i.e. 8-bit time slots are generally available), the 8-bit envelopes of the data multiplex signal should be aligned with the octet structure. This relationship will be established across 64-kbit/s interfaces by means of the 8-kHz timing signal.

   ii)   In networks where an octet structure is not utilized throughout (i.e. 8-bit time slots are not generally available on 64-kbit/s transmission paths), the 8-bit envelopes need not necessarily be aligned with the octet structure. On 64-kbit/s interfaces the 8-kHz timing signal may not be used; in that case the framing information is conveyed across this interface fully within the multiplex.

   iii) Whether on an international link the 8-bit envelopes have to be aligned with the octet structure is provisionally subject to bilateral agreement but further study is required.

Note 1 - 8-bit envelope

In an 8-bit envelope, bit 1 is reserved for framing purposes, bits 2-7 are information bits of the channel, and bit 8 is a status bit (see Figure 1/X.50).
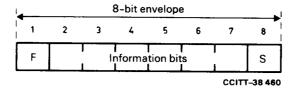

FIGURE 1/X.50

The addition of the framing and the status bits results in a 33% increase in bit rate, so that bearer channel rates are:

12.8 kbit/s for the 9.6 kbit/s data signalling rate;

6.4 kbit/s for the 4.8 kbit/s data signalling rate;

3.2 kbit/s for the 2.4 kbit/s data signalling rate;

800 bit/s for the 600 bit/s data signalling rate.

The status bit is associated with each envelope and, in conjunction with the information bits, conveys call control information.

Note 2 - Four 8-bit envelopes grouping

A group of four 8-bit envelopes is assembled on a single channel as a 32-bit group providing 24 information bits. This gives the possibility of accommodating three 8-bit characters, e.g. P, Q, R, as in Table 3/X.50.

TABLE 3/X.50

F	P1	P2	P3	P4	P5	P6	S_A	8-bit envelope A
F	P7	P8	Q1	Q2	Q3	Q4	S_B	8-bit envelope B
F	Q5	Q6	Q7	Q8	R1	R2	S_C	8-bit envelope C
F	R3	R4	R5	R6	R7	R8	S_D	8-bit envelope D

Status bit S_D is used to provide the alignment information of the four 8-bit envelopes grouping.

Status bits S_A, S_B and S_C in conjunction with the 24 information bits convey call control information.

When the three 8-bit characters P, Q and R are accommodated as above described, status bits S_A, S_B and S_C are respectively associated with those characters.

The four 8-bit envelopes grouping is applied on a per channel basis. For example, for the 12.8-kbit/s bearer rate, the four 8-bit envelopes group recurs after twenty 8-bit envelopes of the multiplexed stream, as in Figure 2/X.50.
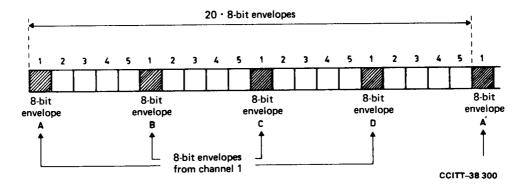
FIGURE 2/X.50

Note 3 - 10-bit envelope

In a 10-bit envelope, bit 1 is a status bit, bit 2 is reserved for envelope alignment purposes and bits 3-10 are information bits of the channel (see Figure 3/X.50).
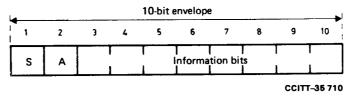

FIGURE 3/X.50

The addition of the envelope alignment and the status bits results in a 25% increase in bit rate, so that 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.

The status bit is associated with each envelope and, in conjunction with the associated 8-bit byte information bits, conveys call control information.