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G.745

**GENERAL ASPECTS OF DIGITAL TRANSMISSION
SYSTEMS**

TERMINAL EQUIPMENTS

**SECOND ORDER DIGITAL MULTIPLEX
EQUIPMENT OPERATING AT 8448 kbit/s
AND USING POSITIVE/ZERO/NEGATIVE
JUSTIFICATION**

ITU-T Recommendation G.745

(Extract from the *Blue Book*)

NOTES

1 ITU-T Recommendation G.745 was published in Fascicle III.4 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 G.745

SECOND ORDER DIGITAL MULTIPLEX EQUIPMENT OPERATING AT 8448 kbit/s AND USING POSITIVE/ZERO/NEGATIVE JUSTIFICATION

(Geneva, 1976; amended at Geneva, 1980 and at Melbourne, 1988)

1 General

The second order digital multiplex equipment using positive/zero/negative justification, considered below, is intended for use on digital paths between countries using 2048 kbit/s primary multiplex equipments, such as the PCM multiplex equipment described in Recommendation G.732 or any identical equipment.

2 Bit rate

The nominal bit rate should be 8448 kbit/s. The tolerance on that rate should be ± 30 parts per million (ppm).

3 Frame structure

Table 1/G.745 gives:

- the tributary bit rate and the number of tributaries;
- the number of bits per frame;
- the bit numbering scheme;
- the bit assignment;
- the bunched frame alignment signal.

4 Loss and recovery of frame alignment and consequent action

Loss of frame alignment should be assumed to have taken place when five consecutive frame alignment signals have been incorrectly received in their predicted positions.

Recovery of frame alignment should take place in the case of receiving without errors at least two consecutive frame signals in their predicted positions.

As soon as frame alignment has been lost and until it has been recovered, a definite pattern should be sent to all tributaries from the output of the demultiplexer. The equivalent binary content of this pattern, called the Alarm Indication Signal (AIS), at 2048 kbit/s is a continuous stream of binary 1s.

5 Multiplexing method

Cyclic bit interleaving in the tributary numbering order and positive/zero/negative justification with two-command control are recommended.

The justification control signal should be distributed and use the C_{jn} -bits ($n = 1, 2, 3$, see Table 1/G.745). Correction of one error in command is possible.

Positive justification should be indicated by the signal 111, transmitted in each of two consecutive frames; negative justification should be indicated by the signal 000 transmitted in each of two consecutive frames, and no justification by the signal 111 in one frame followed by 000 in the next frame. Bits 5, 6, 7 and 8 in Set IV (see Table 1/G.745) are used for negative justification of tributaries 1, 2, 3 and 4 respectively, and bits 9 to 12 for positive justification of the same tributaries.

Besides, when information from tributaries 1, 2, 3 and 4 is not transmitted, bits 5, 6, 7 and 8 in Set IV are available for transmitting information concerning the type of justification (positive or negative) in frames containing commands of positive justification control and intermediate amount of jitter in frames containing commands of negative justification.

Table 1/G.745 gives the maximum justification rate per tributary.

6 Jitter

The amount of jitter that should be tolerated at the input of the multiplexer and the demultiplexer should be according to Rec. G.823, § 3.1.1. The amount of jitter at the output of the multiplexer and the demultiplexer should be studied and specified.

7 Digital interface

The digital interfaces at 2048 kbit/s and 8448 kbit/s should be in accordance with Recommendation G.703.

8 Timing signal

It might be desirable to be able to derive the multiplexer timing signal from an external source as well as from an internal one.

9 Service digits

Some spare bits per frame are available for service functions (bits from 5 to 8 in Set II and bit 8 in Set III) for national and international use. Bits 5, 6, 7 and 8 in Set II are available for a digital service channel between two terminals (using 32 kbit/s Adaptive Delta Modulation) and bit 8 in Set III is available for ringing up a digital service channel. Utilization of other spare bits is under study.

TABLE 1/G.745
8448-kbit/s digital multiplexing frame structure using positive/zero/negative justification

Tributary bit rate (kbit/s)	2048
Number of tributaries	4
Frame structure	Bit number
Frame alignment signal (11100110)	<i>Set I</i> 1 to 8
Bits from tributaries	9 to 264
Justification control bits (C_{j1}) (see Note)	<i>Set II</i> 1 to 4
Bits for service functions	5 to 8
Bits from tributaries	9 to 264
Justification control bits (C_{j2}) (see Note)	<i>Set III</i> 1 to 4
Spare bits	5 to 8
Bits from tributaries	9 to 264
Justification control bits (C_{j3}) (see Note)	<i>Set IV</i> 1 to 4
Bits from tributaries available for negative justification	5 to 8
Bits from tributaries available for positive justification	9 to 12
Bits from tributaries	12 to 264
Frame length	1056 bits
Frame duration	125 μ s
Bits per tributary	256 bits
Maximum justification rate per tributary	8 kbit/s

Note - C_{jn} indicates n th justification control bit of the j th tributary.

10 Fault conditions and consequent actions

10.1 The digital multiplex equipment should detect the following fault conditions:

10.1.1 Failure of power supply.

10.1.2 Loss of incoming signal at 2048 kbit/s at the input of the multiplexer.

Note - When using separate circuits for the digital signal and the timing signal, loss of either or both should constitute loss of the incoming signal.

10.1.3 Loss of the incoming signal at 8448 kbit/s at the input of the demultiplexer.

Note 1 - The detection of this fault condition is required only when it does not result in an indication of loss of frame alignment.

Note 2 - When using separate circuits for the digital signal and the timing signal, loss of either or both should constitute loss of the incoming signal.

10.1.4 Loss of frame alignment.

10.1.5 Alarm indication received from the remote multiplex equipment at the 8448 kbit/s input of the demultiplexer (see § 10.2.2).

10.2 Consequent actions

After detection of a fault condition appropriate actions should be taken as specified in Table 2/G.745. The consequent actions are as follows:

10.2.1 Prompt maintenance alarm indication generated to designate that the performance is below acceptable standards and maintenance attention is required locally. When detecting the AIS at the 8448 kbit/s input of the demultiplexer, the prompt maintenance alarm indication associated with loss of frame alignment should be prohibited (see Note 1 below).

Note - The location and provision of any visual and/or audible alarm activated by this prompt maintenance alarm indication is left to the discretion of each Administration.

10.2.2 Alarm indication to the remote multiplex equipment generated by changing from the state 0 to the state 1 bit 7 of set III at the 8448 kbit/s output of the multiplexer.

10.2.3 AIS (see Note 2 below) applied to all the four 2048 kbit/s tributary outputs from the demultiplexer.

10.2.4 AIS (see Note 2 below) applied to the 8448 kbit/s output of the multiplexer.

10.2.5 AIS (see Note 2 below) applied to the time slots of the 8448 kbit/s signal at the multiplexer output corresponding to the relevant 2048 kbit/s tributary.

Note 1 - The bit rate of the AIS at the output of the corresponding demultiplexer should be as specified for the tributaries. The method of achieving this is under study.

Note 2 - The equivalent binary content of the AIS at 2048 kbit/s and 8448 kbit/s is a continuous stream of binary 1s.

TABLE 2/G.745
Fault conditions and consequent actions

Equipment part	Fault condition (see § 10.1)	Consequent actions (see §10.2)				
		Prompt maintenance alarm indication generated	Alarm indication to the remote multiplexer generated	AIS applied		
				To all the tributaries	To the composite signal	To the relevant time slots of the composite signal
Multiplexer and demultiplexer	Failure of power supply	Yes	Yes, if practicable	Yes, if practicable	Yes, if practicable	
Multiplexer only	Loss of incoming signal on a tributary	Yes				Yes
Demultiplexer only	Loss of incoming signal at 8448 kbit/s	Yes	Yes	Yes		
	Loss of frame alignment	Yes	Yes	Yes		
	AIS received from the remote multiplexer					

Note - A *Yes* in the table signifies that a certain action should be taken as a consequence of the relevant fault condition. An *open space* in the table signifies that the relevant action should *not* be taken as a consequence of the relevant fault condition, if this condition is the only one present. If more than one fault condition is simultaneously present the relevant action should be taken if, for at least one of the conditions, a *Yes* is defined in relation to this action.