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CHARACTERISTICS OF EQUIPMENT FOR THE CODING OF ANALOGUE HIGH QUALITY SOUND PROGRAMME SIGNALS FOR TRANSMISSION ON 384 kbit/s CHANNELS

ITU-T Recommendation J.41

(Extract from the *Blue Book*)

NOTES

1 ITU-T Recommendation J.41 was published in Fascicle III.6 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.

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Recommendation J.41

CHARACTERISTICS OF EQUIPMENT FOR THE CODING OF ANALOGUE HIGH QUALITY SOUND PROGRAMME SIGNALS FOR TRANSMISSION ON 384 kbit/s CHANNELS

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

1 General

1.1 This Recommendation gives the characteristics of equipment for the coding of 15 kHz monophonic analogue sound-programme signals into a digital signal of 384 kbit/s. For stereophonic operation, two monophonic digital codecs can be utilized. Two monophonic digital signals that form a stereophonic signal should be routed together over the same transmission systems (path) to avoid any difference in transmission delay.

1.2 Equipment for coding of analogue sound-programme signals, as specified in this Recommendation, can be:

- a) A stand-alone encoder/decoder with a digital interface at 384 kbit/s. The encoder operation and the decoder operation may be performed in two separate equipments or in the same equipment.
- b) A combined encoder-multiplex/decoder-demultiplex with a digital interface at 1544 or 2048 kbit/s. The encoder-multiplex operation and the decoder-demultiplex operation may be performed in two separate equipments or in the same equipment.

In case b), it is not mandatory to provide an external digital sound programme access port at 384 kbit/s.

1.3 Two methods of encoding have been specified by the CMTT [1] and these form the basis for this Recommendation.

2 Transmission performance

The transmission performance per encoder/decoder pair shall be such that the limits specified in Recommendation J.21 (CCIR Recommendation 505) are not exceeded by three encoder/decoder pairs connected in tandem at audio frequencies.

Note – When transmitting stereophonic sound programme signals, it is necessary that the encoder and decoder are designed such that they will meet the specified requirements for phase difference.

In order to avoid any unnecessary complexity, the sampling of channels A and B should be performed simultaneously.

3 Method of encoding

3.1 The recommended encoding laws are as specified in [1].

3.2 These encoding laws are based on a uniformly quantized 14-bit per sample PCM technique with companding and employ either:

- a) eleven-segment 14- to 11-bit instantaneous A-law companding, or
- b) five-range 14- to 10-bit near instantaneous companding.

For provisional rules for through connection between the two companding methods, see Note 4 in [1].

3.3 Other coding techniques which may be used by bilateral agreement of the Administrations concerned are also listed in Annex A. However, these techniques do not form part of this Recommendation.

3.4 Equipment characteristics common to both methods of encoding are:

Nominal audio bandwidth:	0.04 to 15 kHz.
Audio interface:	see Recommendation J.21, § 2.
Sampling frequency (CCIR Recommendation 606):	$32 (1 \pm 5 \times 10^{-5})$ kHz.
Pre/de-emphasis:	Recommendation J.17 with 6.5 dB attenuation at 800 Hz.

Note – Pre-emphasis and de-emphasis are not used by the Administrations of Canada, Japan and the United States on their national circuits and on international circuits between each other, but are used on international circuits to other countries.

4 Equipment using instantaneous companding

4.1 Coding table

4.1.1 The coding law is specified in Table 1/J.41.

4.1.2 The allocation of character signals (PCM code words) is also given in Table 1/J.41. Two variants (A and B) of character signals are allowed.

Note – In the case of digital interconnection between variants A and B, the conversion from one set of character signals to the other in Table 1/J.41 can be implemented without any performance degradation. In the case of analogue interconnection, a small reduction in the S/N ratio, in the order of 3 dB, is expected.

4.2 Bit rates

Nominal source coding bit rate ($32 \text{ kHz} \times 11 \text{ bits/sample}$)	352 kbit/s
Error protection	32 kbit/s
Transmission bit rate	384 kbit/s

4.3 Overload level

The overload level for a sine-wave signal at zero dB insertion loss frequency (2.1 kHz) of the pre-emphasis is + 15 dBm₀.

4.4 Digital signal format

The character signal bit sequences for variants A and B are shown in Figure 1/J.41.

4.5 Bit error protection

One parity bit is added to each 11-bit character signal.

TABLE 1/J.41

11 segment, 14 to 11 bit instantaneous companding A-law PCM for sound-programme signals (positive half only)^{a)}

11 bit coding														
Normalized analogue input	Normalized analogue output	Compressed digital code	Segment No.	Effective resolution (bits)	1	Allocation of character signals								
						Variant A ^{b)}				S	X Y Z	Variant B ^{c)}		
						2 3 4	5 6 7 8 9 10	11	A B C D E F G					
8160 to 8192	8176	895	1	9	0		1 1 1 1 1 1	1	0	1 1 0	1 1 1 1 1 1 1			
4096 to 4128	4112	768				1 1 1	0 0 0 0 0 0	0			0 0 0 0 0 0 0			
4080 to 4096	4088	767	2	10	0		1 1 1 1 1 1	1	0	1 0 1	1 1 1 1 1 1 1			
2048 to 2064	2056	640				1 1 0	0 0 0 0 0 0	0			0 0 0 0 0 0 0			
2040 to 2048	2044	639	3	11	0		1 1 1 1 1 1	1	0	1 0 0	1 1 1 1 1 1 1			
1024 to 1032	1028	512				1 0 1	0 0 0 0 0 0	0			0 0 0 0 0 0 0			
1020 to 1024	1022	511	4	12	0		1 1 1 1 1 1	1	0	0 1 1	1 1 1 1 1 1 1			
512 to 516	514	384				1 0 0	0 0 0 0 0 0	0			0 0 0 0 0 0 0			
510 to 512	511	383	5	13	0		1 1 1 1 1 1	1	0	0 1 0	1 1 1 1 1 1 1			
256 to 258	257	256				0 1 1	0 0 0 0 0 0	0			0 0 0 0 0 0 0			
255 to 256	255.5	255	6	14	0		1 1 1 1 1 1	1	0	0 0 1	1 1 1 1 1 1 1			
128 to 129	128.5	128				0 1 0	0 0 0 0 0 0	0			0 0 0 0 0 0 0			
127 to 128	127.5	127			0	1	1 1 1 1 1 1	X	0	0 0 0	1 1 1 1 1 1 1			
0 to 1	0.5	0				0 0 0	0 0 0 0 0 0	0			0 0 0 0 0 0 0			

11th bit freely available in variant A.

Character signals for the negative half are the same as those for the positive half except that the sign bits (bit 1 and S for variants A and B respectively) are inverted.

Variant A is presently used with digital equipment based on a 2048 kbit/s hierarchy. After coding and before the parity bit is inserted, bits 1 to 5 are inverted.

Variant B is presently used with digital equipment based on a 1544 kbit/s digital hierarchy. All bits, including the parity bit, are inverted and reformatted before transmission (see Figure 1/J.41).