REPORT 799-2*

SUBJECTIVE ASSESSMENT OF QUALITY OF SOUND IN BROADCASTING USING DIGITAL TECHNIQUES

(Question 51/10, Study Programme 51A/10)

(1978-1982-1986)

1. Decision 18 co-ordinates the studies undertaken by the CCIR in the field of digital systems. It has allocated responsibility for the following studies to Study Group 10:

- study of encoding methods (including reduction of redundancy), transmission over various transmission media (including methods of monitoring), measurement of operational quality and test signals; these studies should apply in the field of sound studio equipment (including recording) and sound broadcasting from terrestrial transmitters and satellites;

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* This Report should be brought to the attention of Interim Working Party CMTT/1.

- study of methods for protection against impairments associated with digital transmission in the field of sound studio techniques;
- study of the subjective quality of encoded and digitally transmitted signals for sound broadcasting;
- study of the problems of switching, mixing and special effects in sound studios.

2. During the Final Meeting, Geneva, 1977, the following documents were considered: [CCIR, 1974-78a, b, c, d, e and f].

These documents were studied by the CMTT but they did not provide a sufficient basis to formulate solutions to the problems given to Study Group 10 and listed above and also in Study Programme 51A/10. They have been used for information only.

Study Programme 51A/10, the aim of which is subjective assessment of the quality in digital sound broadcasting systems, should, in particular, provide an answer to the question raised by the CMTT, with regard to whether a subjective impairment of grade 4.5 is appropriate for a reference circuit including digital sections (Decision 18, Annex I; Report 647; [CCIR, 1974-78e]). The lack of detailed studies concerning the addition of the specific impairments associated with the digital systems does not, at the present time, make it possible to define a precise limit for the subjective impairment acceptable to the reference circuit.

Further studies are therefore necessary. They would allow definition of quality characteristics for intermediate or short distance transmission circuits (such as between production centres).

3. [CCIR, 1978-82a and b] report listening tests which have been carried out to determine the upper cut-off frequency of the audio signal. To reduce the bit rate, this frequency should be as low as possible without deteriorating the quality of the audio signal.

The result of these tests shows that, for the listener, a bandwidth of 15 kHz is sufficient and an extension of the frequency range up to 20 kHz gives an insignificant improvement in quality even taking into account future developments in sound systems because the result is related to the hearing ability of the listener.

4. For digital audio signals transmitted via satellite, the EBU proposes to use either a 14/10 bits near-instantaneous compandor or a 14 bits system using linear quantizing. In connection with the compandor, the use of emphasis is believed to be essential and the CCITT Recommendation J.17 pre-emphasis is proposed. [CCIR, 1982-86a] reports on listening tests which have been carried out to examine the value of emphasis for linear coding, where slightly higher quality criteria apply.

Two different emphasis circuits were studied:

- CCITT Recommendation J.17 pre-emphasis (additional attenuation of 5 dB);
- pre-emphasis characterized by the two time constants 50 µs and 15µs.

The results of these subjective listening tests show that the 50/15 µs de-emphasis leads to a noise reduction of 1 to 2 dB. The CCITT de-emphasis leads to an increase of impairment by noise of about 1 to 1.5 dB.

Because of the need to avoid exceeding the clipping point of a digital audio system, it is necessary to expand the headroom when using pre-emphasis. This expansion of the headroom can only be obtained by attenuation of the maximum programme level. This attenuation is equivalent to a decrease of S/N ratio.

Compared with this loss, the gain in S/N ratio by the use of de-emphasis is very small (50/15 µs de-emphasis) or even can be an additional loss (CCITT de-emphasis).

Considering carefully the balance of evidence, it seems to the EBU that there is no advantage in introducing emphasis in a digital 14 bits (or more) system using linear quantizing for the purpose of reducing the audibility of quantizing noise. Nevertheless, the use of pre-emphasis in linear coding may be advantageous for other purposes (e.g. to reduce the impairment caused by errors or processes involving requantization).

5. A method to assess the perceptibility of group-delay distortion in low-pass filters is described in [CCIR, 1982-86b].

The group-delay distortion produced by a variable numer of 11th order Chebyshev filters are reproduced by means of a digital processor running a fast Fourier transform program. According to these studies, the distortions caused by at least three 15 kHz low-pass filters in tandem, without group-delay correction, are inaudible with a specially selected test signal.

6. A number of contributions [CCIR, 1982-86c, d, e, f, g] have been received on the relative merits of the CCITT Recommendation J.17 pre-emphasis and of the 50 and 15 μs pre-emphasis. Particular consideration is given in these contributions to the modification of peak programme levels resulting from their introduction as well as to their effect on the perceptibility of the modulation noise associated with companded systems.

REFERENCES

CCIR Documents

[1974-78]: **a.** 10/347 (Italy); **b.** 10/353 (EBU); **c.** 10/360 (France); **d.** 10/361 (France); **e.** CMTT/301 (Rev. 1); **f.** CMTT/349.

[1978-82]: **a.** 10/13 (EBU); **b.** 10/49 (Germany (Federal Republic of)).

[1982-86]: **a.** 10/21 (EBU); **b.** 10/212 (Japan); **c.** 10/269 (Germany (Federal Republic of)); **d.** 10/270 (France); **e.** 10-11S/139 (Japan); **f.** 10-11S/201 (EBU); **g.** 10-11S/205 (Japan).

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PLENGE, G., JAKUBOWSKI, H. and SCHÖNE, P. [1980] Which bandwidth is necessary for optimal sound transmission? *J. Audio Eng. Soc.*, Vol. 28, 3, 114-120.

REPORT 1200*

THE EFFECT OF DELAY IN SOUND-PROGRAMME OPERATIONS

(Study Programme 51B/10)

(1990)

1. Introduction

With the increasing use of digital sound transmission equipment, delay effects are becoming significant on the circuits linking sound programme originating points and studio - centres as well as on circuits linking studio - centres and sound broadcast transmitters; the use of satellite links introduces even more serious problems. It is clear that the subject requires particular study and the following text presents a few examples of how delay effects can arise and the problems that ensue.

2. The problem of time differences between commentary and cue-programme signals in sound broadcasting.

Where a person presenting a sound broadcast programme has to receive cue programme via headphones, it is often unavoidable that the presenter's own speech signal is present in the cue-programme feed. Where the circuits carrying the broadcast and/or cue programme introduce significant delay, the resulting time-difference between the presenter's own speech and what is heard in the headphones can cause serious psychological effects. The following examples of the phenomenon are drawn from current operational practice:

* This Report should be brought to the attention of the CMTT.