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CONSULTATIVE COMMITTEE

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SERIES E: OVERALL NETWORK OPERATION, TELEPHONE SERVICE, SERVICE OPERATION AND HUMAN FACTORS

Operation, numbering, routing and mobile service –
International operation –
Tones in national signalling systems

Technical characteristics of tones for the telephone service

Reedition of CCITT Recommendation E.180 published in the Blue Book, Fascicle II.2 (1988)

NOTES

1 CCITT Recommendation E.180 was published in Fascicle II.2 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.

Recommandation E.180 [1]

TECHNICAL CHARACTERISTICS OF TONES [2] FOR THE TELEPHONE SERVICE

1 General

Administrations are reminded of the advantages of standardizing audible tones as far as possible so that subscribers and operators may quickly recognize any tone transmitted of whatever origin [3].

Guidance on the application of tones and recorded announcements in various situations is given in Recommendation E.182.

In considering the degree of standardization, the CCITT took account of the nature of the various tones already in use. It was also considered that Administrations introducing new tones would find it helpful to know the preferred limits of cadence frequency and level.

Limits for tone cadences and frequencies are set forth below, all working tolerances being included in the limits.

Besides the limits applying to specifications, limits have been laid down for application to existing exchanges.

These latter limits are herein called *accepted* limits, while those for new equipment are called *recommended* limits.

The present Recommendation covers the case where audible tones are applied within the network. However, the same frequencies and cadences are to be applied if, in the ISDN, the audible tones are generated at the terminal equipment.

2 Electrical levels for tones

For international purposes, the levels of the ringing tone, the busy tone, the congestion tone, the special information tone and the warning tone have to be defined at a zero relative level point at the incoming (in the traffic direction) end of the international circuit.

The level of tones so defined must have a nominal value of –10 dBm0. The recommended limits should be not more than –5 dBm0 nor less than –15 dBm0 measured with continuous tone.

For the special information tone, a difference in level of 3 dB is tolerable between any two of the three frequencies which make up the tone.

For the power level of the dial tone the point of reference is the local exchange, where the subscriber line is connected. In the existing networks the absolute power at the 2-wire access in the direction towards the subscriber station is normally in the range of –10 dBm ± 5 dB. However, with respect to interference with multifrequency pushbutton (MFPB) receivers dial tone levels higher than –10 dBm should be avoided.

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1) This Recommendation is also included in the Series Q Recommendations under the number Q.35 (Fascicle VI.1).

2) See Supplement No. 2 at the end of this fascicle for particular values of tone cadences and frequencies in actual use.

3) Recommendation E.181 specifies the information which could be given to users to facilitate recognition of foreign tones.

Note – The relative level of local exchanges in an analogue network is not fixed. For digital local exchanges the relative levels are given in Recommendation Q.517. A preferred level range of digital tone generators is –8 dBm0 to –3 dBm0 corresponding with the above level range at the output of local exchanges.

3 Acoustical levels for tones

When tones are generated by a source within a network, e.g., by a telephone exchange, the power level as perceived by the user will be influenced by the characteristics of the subscriber's line and the equipment between the source and the user's ear.

Furthermore, tones can be generated within the user's equipment, triggered by signals from the exchange. In these circumstances it is necessary to define the tone level in terms of the preferred range of sound pressure levels as heard by the listener.

Research has shown that the preferred listening level for information tones is substantially independent of room noise, circuit noise and tone cadence, but does vary over a range of tone frequencies. Figure 1/E.180 shows the recommended sound pressure levels, with upper and lower limits of the recommended range, over a range of tone frequencies, based on these experiments.

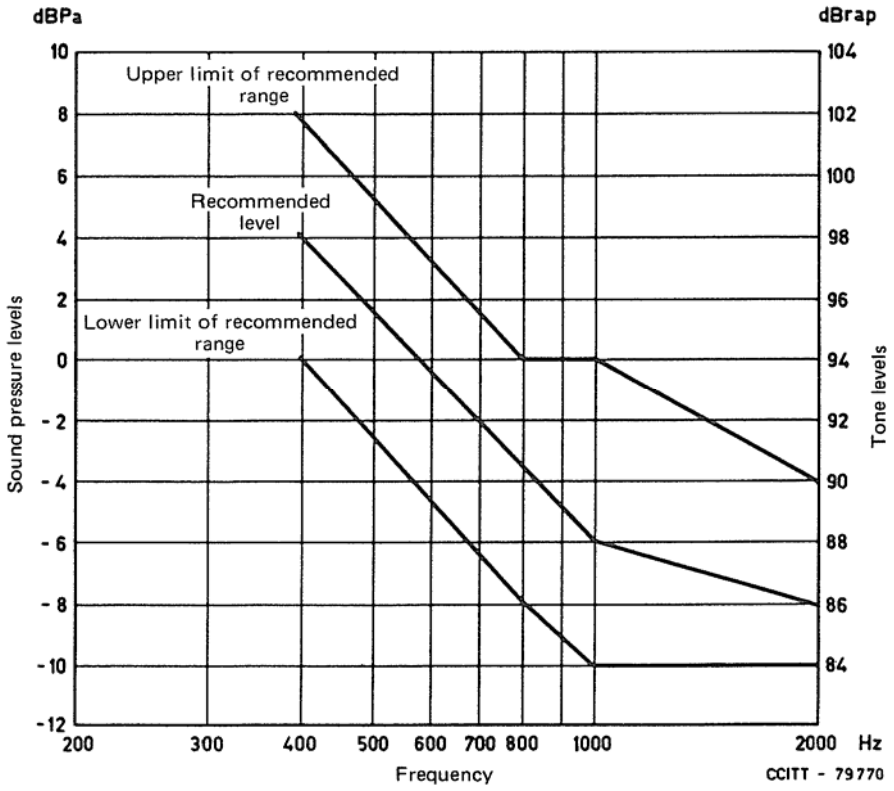

FIGURE 1/E.180

Recommended listening level limits for tones

It is emphasized that there is no one-to-one relationship between electrical and acoustical power levels. What acoustic level will result from a given electrical level is dependent on various parameters such as the characteristics of the user's equipment.

It should be noted that the recommended sound pressure levels apply only to the most common situation of a user listening via a telephone handset, held reasonably close to the ear so that normal “ear coupling loss” values apply.

When using a loudspeaking telephone or a headset, the preferred sound pressure level is generally lower than the recommended levels.

4 Dial tone

4.1 It is recommended that dial tone should be a continuous tone.

4.2 It is recommended that dial tone should be:

– *either* a single frequency tone in the range 400-450 Hz,

– *or* a combined tone composed of up to three frequencies, with at least one frequency in each of the ranges 340-425 Hz and 400-450 Hz. The difference between any two frequencies should be at least 25 Hz.

4.3 Recognizing the local nature of “normal” use of dial tone, as well as the technical and economic consequences and consequences on customer habits of changes in dial tone, the full range of existing dial tones, including non-continuous tones as in Supplement No. 2 at the end of this fascicle, are considered acceptable. However, when adopting a new single frequency dial tone, Administrations are recommended to use 425 Hz.

4.4 Where digital tone generation is applied, the frequencies for dial tone should be the same as those recommended for analogue generated tones (see Annex A).

4.5 In order to prevent interference of harmonics or spurious components of the dial tone with the frequencies recommended for pushbutton telephone sets in Recommendation Q.23 and the MFPB signal reception specified in Recommendation Q.24, the maximum permissible power level of harmonics or quantizing noise of the dial tone has to be limited in a suitable way, depending on the specific characteristics of the implementations of the dial tone generator and the MFPB receivers within the same exchange. Examples of such limitations for the dial tone generator are given in Annex B.

Note – In cases of digital generation of the dial tone, the quantizing noise is composed of a number of spectral lines which depend on the number of samples in the generating pattern. In order to reduce the amplitude of the quantizing components, the number of samples should be chosen sufficiently high, thus spreading the quantizing distortion power more evenly over the whole spectrum.

5 Ringing tone

5.1 Ringing tone is a slow period tone, in which the tone period is shorter than the silent period.

The *recommended* limits for the tone period (including tolerances) are from 0.67 to 1.5 seconds. For existing exchanges, the *accepted* upper limit for the tone period is 2.5 seconds.

The *recommended* limits for the silent period separating two tone periods are 3 to 5 seconds. For existing exchanges, the *accepted* upper limit is 6 seconds.

The first tone period should start as soon as possible after the called subscriber's line has been found.

Figure 2/E.180 shows the recommended and accepted limits for the ringing tone periods.

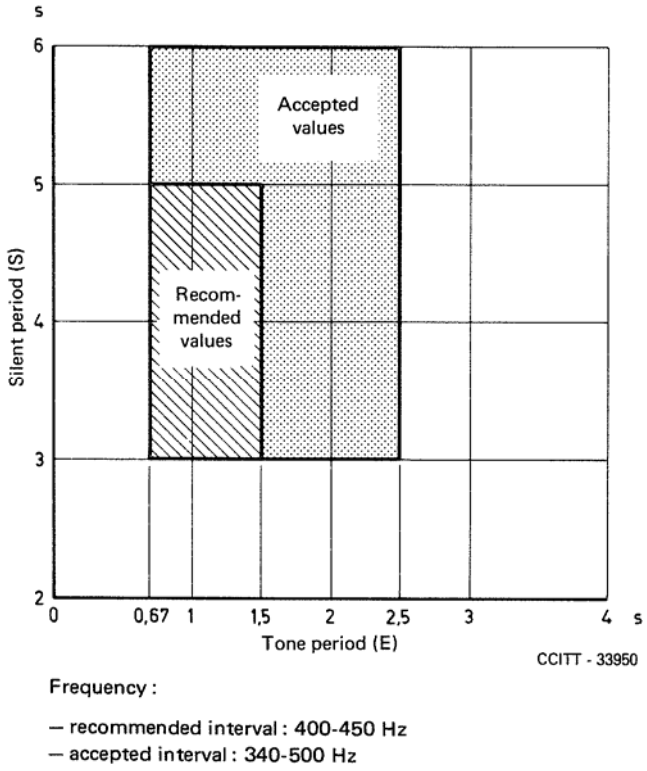

FIGURE 2/E.180

Ringing tone

5.2 The ringing tone cadence should be similar to the cadence used for applying ringing current to the called subscriber's telephone set, but these two cadences need not be synchronized. The electrical parameters of the ringing current must be evaluated by the Administration concerned to prevent shock hazard.

5.3 The recommended frequency for the ringing tone is between 400 and 450 Hz. The accepted frequency should be not less than 340 Hz, nor more than 500 Hz. Frequencies between 450 and 500 Hz in the accepted frequency range should, however, be avoided. Administrations adopting a new single frequency ringing tone are recommended to use 425 Hz.

The ringing tone frequency may be modulated by a frequency between 16 and 100 Hz, but such modulation is not recommended for new equipment. If the accepted frequency is more than 475 Hz, no modulation by a lower frequency is allowed.

5.4 Where digital tone generation is applied, the frequency for ringing tone should be the same as that recommended for analogue generated tones (see Annex A).

6 Busy tone and congestion tone

6.1 The (subscriber) busy tone and the (equipment or circuit group) congestion tone are *quick* period tones in which the tone period is theoretically equal to the silent period. The total duration of a complete cycle (tone period E + silent period S) should be between 300 and 1 100 milliseconds.

The ratio E/S of the tone period to the silent period should be between 0.67 and 1.5 (*recommended* values).

For existing exchanges, or for tones to be used in a special way, it is *accepted* that the tone period may be up to 500 milliseconds shorter than the silent period ($E \geq S - 500$ milliseconds). In no circumstances should the tone period be shorter than 100 milliseconds.

Figure 3/E.180 shows the recommended and the accepted areas for the busy tone and the congestion tone periods.

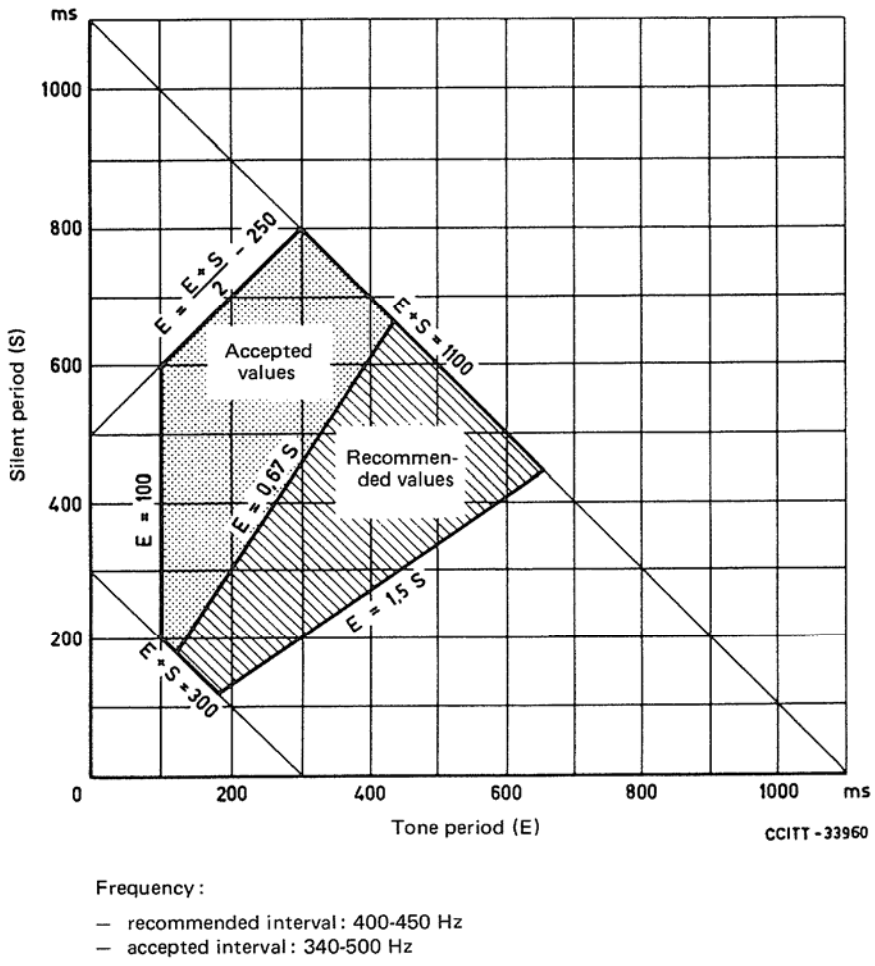

FIGURE 3/E.180

(Subscriber) busy tone and (equipment or circuit group) congestion tone

6.2 The busy tone (of the called subscriber) and the congestion tone (of switching equipment or circuit groups) can be identical or almost identical, providing that this does not create any serious problems for the network and does not cause the subscriber to become confused. However, a distinction between these two tones is desirable:

– to allow Administrations to assess the quality of service,

– for the convenience of experienced subscribers.

6.3 Where a distinct congestion tone is used, it is recommended that:

a) the same *frequency* should be used for the busy tone and the congestion tone;

b) the busy tone should have a slower cadence than the congestion tone, but both cadences should be within the limits mentioned in § 5.1 above.

6.4 The *recommended* frequency for the busy tone and for the congestion tone must be between 400 and 450 Hz. The *accepted* frequency must not be less than 340 nor more than 500 Hz. Frequencies between 450 and 500 Hz in the accepted frequency range should, however, be avoided. Administrations adopting a new single frequency for busy and congestion tones are recommended to use 425 Hz.

6.5 Where digital tone generation is applied, the frequency for busy and congestion tones should be the same as that recommended for analogue generated tones (see Annex A).

7 Special information tone

7.1 The special information tone is provided for all cases in which neither the busy nor the congestion tone can give the required information to the calling subscriber in the case of call failure. There are three ways in which it may be used:

a) when in special cases no provision is made for recourse either to a recorded announcement or to an operator, the equipment at the point which the calls have reached must:

1) *either* connect the special information tone to the call,

2) *or* preferably, if technically available, send an appropriate backward signal such that connection to the special information tone will be made by equipment which is nearer to the caller;

b) when the call is connected to a recorded voice machine; the tone is then given during the silent intervals between transmissions of the announcement;

c) under arrangements made at manual positions serving lines which have been abnormally routed so that by operating a key the operators may send the special information signal when, for example, the calling subscriber fails to understand the operator.

When the special information tone is applied with or without a recorded announcement, it should be recognized that customers may refer to an operator if they fail to understand the meaning of the recorded announcement and/or the special information tone.

7.2 The special information tone has a tone period theoretically equal in length to the silent period.

Tone period – The tone period consists of three successive tone signals, each lasting for 330 ± 70 milliseconds. Between these tone signals there may be a gap of up to 30 milliseconds.

Silent period – This lasts for 1 000 ± 250 milliseconds.

7.3 The frequencies used for the three tone signals are: 950 ± 50 Hz; 1 400 ± 50 Hz; 1 800 ± 50 Hz, sent in that order.

8 Warning tone to indicate that a conversation is being recorded

Where a conversation is being recorded at a subscriber's station, it is recommended that the Administration require the use of a warning tone to indicate that the conversation is being recorded. When such a tone is applied, it is recommended that:

a) it consists of a 350-500 ms pulse every 15 ± 3 seconds of recording time, and

b) the frequency of the tone should be 1 400 Hz ± 1.5%.

9 Payphone recognition tone

9.1 Where Administrations see the necessity of application of a payphone recognition tone in order to allow operators to recognise that a call originates at a payphone station or that the called number belongs to a payphone station it is recommended to use a payphone recognition tone.

The application of the tone will depend on the operational requirements of individual Administrations, e.g., in some cases the tone will only be required on an incoming call to the payphone, whilst in others there may be a requirement for the tone to be present on originating calls and throughout the period of the call.

9.2 The tone is a combination of two frequencies f_1 and f_2 in the range:

f_1: 1 100-1 750 Hz

f_2: 750-1 450 Hz

with the ratio: f_1 / f_2 = 1,2 to 1.5

and with a cadence (frequency sequence) as follows:

f_1 on 200 ms, silence 200 ms, f_2 on 200 ms, silence 2 s (one cycle is therefore 2.6 s).

9.3 *Duration and level*

9.3.1 A principal purpose of the payphone recognition tone in international telephony is to identify a called station as a payphone where the possibility exists of attempted fraud on a collect call. For this purpose the tone must be produced as soon as a payphone answers a call, it must be clearly audible to an operator, and it must cease before it can seriously interfere with conversation.

When the tone is used on an incoming call to payphone, it should have, in addition to those characteristics defined in § 9.2, a duration of 5 complete cycles (13 s).

9.3.2 If the tone is used to identify payphones which are originating calls, its duration is not specified.

9.3.3 The specification in § 9.3.1 applies only to the first five cycles of the tone when the payphone is the receiving station.

For use throughout a call or during conversation, the level and duration of the tone have to meet two contradictory requirements:

– the public exchange operator should be able to detect and recognise the tone in the presence of the highest expected levels of speech;

– the tone should not interfere unduly with normal conversation.

Experience of customer reaction to the tone requires that the time during which the tone is applied should be as short as possible, subject to operational requirements. Similarly the level of the tone should be as low as possible and significantly lower than the recommended levels for other tones (e.g., –20 dBm at the payphone output). The duration of the tone and the level at which it is applied are interdependent factors, the shorter the duration the higher the level and vice versa. (Further studies on the recommended levels and duration will be carried out.)

10 Call waiting tone

10.1 The call waiting tone is used to advise a subscriber who is engaged on a call that another subscriber is attempting to call.

10.2 The tone is intended to be sufficiently alerting to succeed in its purpose without interfering with existing conversation.

10.3 The *recommend* specification of the tone is one or more cycles defined by a frequency *f* in the range:

f : 400 to 450 Hz

and with a cadence (frequency sequence) as follows:

a) *f* on 300 to 500 ms, silence 8 to 10 s (*f* = 300 ms is preferable to the longer tone since the ongoing conversation would be interrupted for a briefer interval); or

b) *f* on 100 to 200 ms, silence 100 to 200 ms, *f* on 100 to 200 ms (the total to be no more than 500 ms); 8 to 10 s silence.

Other tones may be *acceptable*.

10.4 The second and subsequent cycles may be at a lower level than the initial one.

10.5 Where the tone continues for more than one cycle, it should preferably cease when it is no longer possible to accept the waiting call.

11 Caller waiting tone

11.1 This tone advises a caller that a called station, though busy, has a call waiting service active.

11.2 It is intended that, if this tone is not correctly interpreted by subscribers, it be misinterpreted as the ringing tone.

11.3 To dissuade a caller from waiting indefinitely, the tone may cease 30 seconds [4)] after it starts and may be replaced by busy tone, or an Administration may decide to disconnect the calling station.

11.4 The caller waiting tone consists of a ringing tone followed, after a silent interval of 0 to 200 ms, by one of the following:

a) the tone defined in § 10.3 a)

b) the pair of tones defined in § 10.3 b)

c) another call waiting tone in use by an Administration, provided that it can be appended to each sounded part of the ringing tone.

11.5 The caller waiting tone, as defined in § 11.4, should be distinguishably different from the ringing tone when directly compared with it.

12 Machine recognition of tones

The CCITT appreciates the value of machine recognition of tones for the purpose of service observations, maintenance, testing or for the collection of statistics where equivalent electrical signals do not exist. However, the CCITT considered, at Mar del Plata in 1968, that such machine recognition should not be a substitute for electrical signals. Where machine recognition of audible tones is to be introduced, the tone frequencies and cadences must be within close limits of precision.

For dial tone, ringing tone, busy and congestion tones a working frequency tolerance of ± 1% should be met.

Note – The figure of 1% is taken as a compromise out of several national specifications which vary between ± 0.5% and ± 1.5%. (See also Supplement No. 3.)

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4) The specification of this time needs further study.

ANNEX A

(to Recommendation E.180)

Digital generation of tones

The practice of several Administrations and equipment designers for digital generation of tones is known to deviate largely:

– in the frequency chosen within the recommended range;

– in the power level which varies with the national application;

– in the mechanism of generation of tones and signal frequencies where, in part, the same equipment is used.

Therefore, it was found difficult to standardize on a fixed number of samples with a coded bit-stream, which represents one frequency with one distinct power level.

On the other hand there is no necessity for standardizing digital generated tones in a more stringent way than analogue generated tones for the following reasons:

– It is to the interest of Administrations that subscribers should not be confused by hearing different tones for the same purpose within their national networks. Consequently the practice already in use for analogue generated tones should be maintained for reasons associated with the human factor.

– The advantages that can be achieved by standardizing the code words for the tones in order to allow automatic recognition of tones by monitoring the bit stream seem to be so small that they do not justify a stringent restriction on all possible methods for digital generation of any frequency allocated with any level.

– For a long period of time a mixture of analogue and digital networks will exist. Thus, machine recognition of tones will have to be performed also with analogue receivers.

However, when Administrations have full freedom to make new decisions about tones in future networks, especially with respect to an all-digital network, they may consider a preferred solution for the digital generation of dial tone, busy tone, congestion tone and ringing tone having a uniform frequency of 425 Hz, as recommended by CCITT.

ANNEX B

(to Recommendation E.180)

Examples for limitation of spurious components of the dial tone with respect to interference with the frequencies recommended for pushbutton telephone sets in Recommendation Q.23

B.1 *Method A* (used by ATT)

The total distortion power should be at least 33 dB less than the dial tone power, and the distortion power in any 100 Hz band above 500 Hz should be at least 40 dB less than the dial tone power.

B.2 *Method B* (used by the Federal Republic of Germany)

In the frequency range from 500 to 2 000 Hz [i.e., the range of multifrequency pushbutton (MFPB) frequencies] the distortion power in any 100 Hz band should be at least 40 dB below the dial tone power. In addition, in the frequency range above 2 000 Hz up to 4 000 Hz the total distortion power should be at least 25 dB below the dial tone power.

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