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**GENERAL RECOMMENDATIONS ON TELEPHONE
SWITCHING AND SIGNALLING**

**INTERNATIONAL AUTOMATIC AND
SEMI-AUTOMATIC WORKING**

**SIGNALLING SYSTEMS TO BE USED FOR
INTERNATIONAL MANUAL AND AUTOMATIC
WORKING ON ANALOGUE LEASED
CIRCUITS**

ITU-T Recommendation Q.8

(Extract from the *Blue Book*)

NOTES

1 ITU-T Recommendation Q.8 was published in Fascicle VI.1 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 Q.8

SIGNALLING SYSTEMS TO BE USED FOR INTERNATIONAL MANUAL AND AUTOMATIC WORKING ON ANALOGUE LEASED CIRCUITS

The CCITT,

considering

(a) that standardization of signalling systems to be used for international manual and automatic working on analogue leased circuits brings advantages to Administrations, manufacturers and users;

(b) that manual and automatic operation of international leased circuits require different technical arrangements;

(c) that the standard signalling systems set out in Recommendation Q.7 are primarily intended for the public service;

(d) that the national circuit sections of international leased circuits may need to conform to local regulations of the Administration(s) concerned;

(e) that the method of signalling will be affected by the type of transmission and vice versa;

(f) that the method of signalling will be affected by the characteristics of the service(s) carried on the circuit;

recommends

that Administrations should use for manual international analogue leased circuits the standard signalling system specified in § 1 below;

and *draws the attention* of Administrations

to the guidance clauses and related annexes concerning automatic signalling on international analogue leased circuits, as set out in § 2 below.

1 Signalling on manual international analogue leased circuits

1.1 Signalling shall take place by the transmission of a single frequency signalling current, analogous to the signalling method used in the international manual service and specified in Recommendations Q.1 and Q.2.

1.2 The signalling current shall have a nominal frequency of either 2280 Hz or 2600 Hz. One of these frequencies shall be chosen for both directions of transmission by bilateral agreement between the Administrations concerned. Failing such an agreement, each Administration shall determine which of the two frequencies it wishes to receive.

1.3 The duration of the transmitted tone shall be between 300 ms and 2 seconds. The upper limit of 2 seconds allows the partial use of signalling equipment designed for 500/20 Hz working according to Recommendation Q.1.

1.4 The signal recognition time shall be between 100 ms and 200 ms:

- The minimum duration of 100 ms has been chosen so as to avoid the recognition of false signals due to imitation by speech currents;
- The maximum duration of 200 ms has been chosen so as to allow a safe margin between this time and the minimum transmission time.

Exceptionally, a maximum signal recognition time of 1200 ms may be used where it is known that the transmitted signal has a 2 second duration. Such arrangements allow the partial use of signalling equipment designed for 500/20 Hz working according to Recommendation Q.1.

1.5 Other technical clauses for 2280 Hz signalling are set out in Annex A to this Recommendation.

1.6 Other technical clauses for 2600 Hz signalling are set out in Annex B to this Recommendation.

2 Signalling on automatic international analogue leased circuits

2.1 This section refers to international analogue leased circuits employing automatic signalling. Such circuits are considered to form part of a private network extending across international frontiers and linking exchanges carrying out the switching function in a private network. The exchanges may be Private Automatic Branch Exchanges (PABXs), Private tandem exchanges, or switching equipments provided by the Administration to carry out switching functions in a private network. Where the exchanges are privately owned, part of the signalling function may be provided by the Administration.

This Recommendation does not cover the case of international leased circuits directly connecting subscriber lines to remote switching equipment. However, most of the following text is equally applicable to this case. Annex D, § D.3 and Annex E give further information on such signalling.

2.2 Many Administrations have regulations concerning the use of signalling frequencies on leased circuits and these may apply to international leased circuits also. These regulations are intended to ensure non-interference between parts of the voice spectrum used for signalling and those available for use by subscriber apparatus. This does not create exceptional difficulties for manual working since the frequencies used (2280 Hz, 2600 Hz) can be converted to other acceptable frequencies at the Terminal International Centre. However, for automatic circuits it should be the aim to provide an uninterrupted path between the ends of the leased circuit.

Some World regions have existing or proposed signalling systems which meet the regulatory arrangements in those regions and a summary of two such systems are given in Annexes C and D to this Recommendation. Administrations are invited to note these existing systems that may meet their needs for automatic signalling on analogue leased circuits.

2.3 In order to reduce the cost of providing leased circuits some inter-regional leased circuits may be provided with various forms of bandwidth economizing systems, such as speech interpolation systems and digital voice compression. These systems usually have their own internal digital signalling capability and these are not covered by this Recommendation, except that the effect that speech interpolation equipment has on analogue signalling is discussed.

2.4 In the most general case, the choice of signalling and transmission in a private network will be determined by the availability of suitable equipment, and by the decisions of the network user and the Administrations concerned. The following sections give guidance on transmission factors which affect signalling, the important characteristics of signalling systems which could affect the choice of transmission medium, and the interaction between signalling and non-voice services.

2.5 *Transmission factors*

2.5.1 Recommendations for the transmission characteristics of leased circuits forming part of a private telephone network are given in Recommendation G.171.

2.5.2 Where large groups of circuits are concerned and the transmission multiplex equipment is on the renter's premises, it is advisable to protect against the effects of faulty transmission on groups of circuits. Recommendation Q.33 gives details of such measures.

2.5.3 *Satellite systems*

- i) Some signalling systems will not function correctly over satellite links since the long propagation delay (270 ± 20 ms one way) exceeds that assumed by the line signalling specification. Amongst the standard systems for public telephony, Signalling System R2 incorporates special precautions because of this delay. In addition the speed of multi-frequency compelled interregister signalling is affected, which may cause undesirable post-dialling delay. If signalling systems based on R2 are used in private networks then reference should be made to information contained in Recommendations Q.7 and Q.400 to Q.490.

- ii) Consideration should be given to the possibility that two satellite links may, in some cases, need to be connected in tandem. Means to prevent this may also need to be considered. (Further information is contained in Recommendations E.171, G.131, Q.14 and Q.115.)
- iii) If satellite links via Time Division Multiple Access Systems with Digital Speech Interpolation (TDMA/DSI) are used, then guidance on circuit supervision signalling arrangements can be found in Recommendation Q.33. However, Digital Non-Interpolated (DNI) channels are usually assigned for leased circuits and these exhibit fewer problems for signalling.
- iv) If satellite links via Single Channel Per Carrier (SCPC) systems are used, then it should be noted that these systems employ voice activated carriers for telephony type circuits. On transmission systems of this type, the use of tone-on-idle signalling systems should be avoided, since such signalling systems would override the voice activation feature of SCPC systems.

2.5.4 *Echo control*

Paragraph 9 of Recommendation G.171 should be observed concerning the location of echo control devices where these are required. All analogue channel associated signalling systems operate more effectively if the line signal receiver, and often the line signal sender also, are located on the line side of any echo control device. In addition, some signalling systems require echo control devices to be locally disabled during interregister signalling. For these reasons, the echo control device should be located at the private renter's premises and not the terminal international centre.

2.5.5 *Speech interpolation*

Some signalling systems may not be compatible with speech interpolation systems for the following reasons:

- i) Signalling systems employing continuous state tone signalling will cause permanent operation of the speech detectors and thus permanent trunk to channel association. This prevents the correct operation of the interpolation process.
- ii) The speech interpolation equipment may not be transparent to out-band signalling.
- iii) The speech interpolation equipment may cause excessive clipping of pulse signals resulting in their non-recognition by the distant signalling equipment.
- iv) The speech interpolation equipment may not provide sufficient speech detector hangover to allow the successful transmission of some signals, e.g. en bloc multi-frequency signals.

Information on the characteristics of some speech interpolation systems is given in Supplement No. 2 of Fascicle VI.1, though different systems may also be used on leased circuits.

In the case of continuous state tone signalling, compatibility with speech interpolation systems can be achieved by converting the tone signalling to interface with any in-built signalling capability the system may provide. If the transmission difficulty only exists in the interregister signalling phase, then this can be obviated by the simultaneous transmission of a speech interpolation locking tone, e.g. 2800 Hz.

Note that fully compelled signalling techniques are compatible with speech interpolation systems.

2.6 *Characteristics of signalling systems*

2.6.1 *Line signalling systems*

Analogue line signalling systems can be divided into in-band and out-band systems. In addition, two signalling techniques may be employed: pulse signalling or continuous signalling.

Information on the comparative advantages of in-band and out-band systems can be found in Recommendation Q.20. General requirements for signalling equipment are contained in Recommendations Q.112 to Q.114.

i) *In-band systems*

According to Recommendation Q.22, signalling frequencies above 2000 Hz should be used (but see also §§ 2.7.1 and 2.7.2 below).

The preferred power level for in-band signalling is -9 dBm0 for pulsed signals and -20 dBm0 for continuous signals (also see Recommendation Q.16).

In-band systems require the use of a guarding characteristic to prevent false operation of the signalling equipment by speech currents. Even so, occasional receiver misoperation by speech can occur, and thus in the speech phase a suitable minimum signal recognition time should be chosen.

In-band systems require the use of splitting techniques in order to confine the signalling frequencies to the link concerned, and this has an impact on minimum signal recognition times. Further information can be found in Recommendation Q.25.

If the leased circuit contains a digital transmission system in the terminal national section and this connects directly to a renter's digital PABX using a first order PCM system, then the detection of in-band signalling requires digital filtering techniques.

ii) *Out-band systems*

Recommendation G.171 does not provide for the use of out-band signalling on leased circuits. Because of the frequencies used, out-band signalling requires the use of a transparent 4 kHz bandwidth between the two signalling equipments. Part of the signalling equipment is usually provided within the transmission equipment.

Nevertheless, where the required transmission facilities can be assured, out-band signalling may provide a useful alternative to in-band signalling. Preferred signalling frequencies and power levels for out-band signalling are set out in Recommendation Q.21.

iii) *Pulsed signalling*

Pulsed signalling allows a greater signal repertoire than continuous signalling, but requires more complex signal recognition arrangements. In general, the signalling tone is recognized by the signal receiver but requires persistence checking and correlation with the circuit state before the signal is validated.

iv) *Continuous signalling*

Usually continuous signalling is arranged to operate with "*tone-on-idle*". Such systems have the inherent advantage of allowing immediate identification of circuit availability.

Since only two signal states are available in each direction, the possible signal repertoire is lower than pulsed systems, but recognition arrangements are simpler. A single persistence timing is usually provided to validate changes of signalling state.

Where continuous in-band signalling uses the "*tone-on*" condition after the interregister signalling phase, means must be provided to prevent the calling or called parties from hearing the signalling tone without undue interference to the transmission of speech currents and tones. A band stop filter as used in Signalling System R1 (see Recommendation Q.313, § 2.3.4) may be suitable. Alternatively, to obviate these difficulties, pulsed signalling could be used in the speech phase.

2.6.2 *Interregister signalling*

The following types of interregister signalling may be suitable for use on leased circuits:

i) *Decadic signalling*

Signalling takes place using the same frequency and sender/receiver equipment as the line signalling. Forward signals are composed of a sequence of tone pulses analogous to subscriber line signalling employing rotary dials. Backward signals may not always be provided, but *proceed-to-send* and *address complete* signals can be used to advantage.

ii) *Multi-frequency signalling*

Multi-frequency (MF) signalling has the advantage of greater speed and signal repertoire than decadic systems. To provide both an adequate repertoire and signalling reliability, signals are composed of two frequencies from a set of 4, 5, 6 or 8 frequencies. Different frequencies may be used for signalling in the backward direction. The frequencies used for MF signalling should lie below 2000 Hz in order that they do not interfere with in-band line signalling.