INTERNATIONAL TELECOMMUNICATION UNION

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

Q.7

GENERAL RECOMMENDATIONS ON TELEPHONE SWITCHING AND SIGNALLING

INTERNATIONAL AUTOMATIC AND SEMI-AUTOMATIC WORKING

SIGNALLING SYSTEMS TO BE USED FOR INTERNATIONAL AUTOMATIC AND SEMI-AUTOMATIC TELEPHONE WORKING

ITU-T Recommendation Q.7

(Extract from the *Blue Book*)

NOTES

1 ITU-T Recommendation Q.7 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.

Recommendation Q.7

SIGNALLING SYSTEMS TO BE USED FOR INTERNATIONAL AUTOMATIC AND SEMI-AUTOMATIC TELEPHONE WORKING

(Geneva, 1954 and 1964, Mar del Plata, 1968, Geneva, 1976 and 1980)

The CCITT,

considering

(a) that standardization of the signalling systems to be used for international automatic and semiautomatic telephone working is necessary to keep to a minimum the number of different types of equipment serving the various routes at any one exchange;

(b) that the following signalling systems have been standardized and are applicable for *general use* in international automatic and semi-automatic working:

- Signalling System No. 4, standardized by the CCIF in 1954;
- Signalling System No. 5, standardized by the CCITT in 1964;
- Signalling System No. 6, standardized by the CCITT in 1968;
- Signalling System No. 7, standardized by the CCITT in 1980;

(c) that the following signalling systems have been standardized and are applicable for *regional use* in international automatic and semi-automatic telephone working:

- Signalling System R1 (Regional Signalling System No. 1, formerly called the North American System), standardized by the CCITT in 1968;
- Signalling System R2 (Regional Signalling System No. 2, formerly called the MFC Bern System), standardized by the CCITT in 1968;

(d) that, under the conditions and subject to the reservations stated below, these signalling systems may be expected to give acceptable results for international automatic and semi-automatic telephone working;

desiring

that the CCITT Recommendation concerning the signalling systems for international automatic and semi-automatic telephone working be generally applied by all Administrations;

unanimously recommends

that, under the conditions and subject to the reservations stated below, Administrations should use, for international automatic and semi-automatic telephone working, one or more of the standard signalling systems mentioned in (b) and (c) above.

1 Criteria for selecting a signalling system

Many factors influence the selection of a given signalling system for a particular application. Factors that should be considered include:

1.1 *Satellite systems* because of long round-trip propagation delays (540 ± 40 ms)

The inclusion of one satellite link in a telephone connection requires subscribers to keep more discipline than usual during a conversation. If use is made of two satellite links in tandem, requirements are even more stringent. In addition, there is the question of what transmission objectives are attainable on such a connection.

According to Recommendation Q.13 the inclusion of two satellite links in a connection should be avoided in all but exceptional cases. To facilitate the observance of this Recommendation, it is advisable to inform the subsequent transit centres by means of signalling that a satellite link is already included in the connection. During the following routing process the transit centre(s) should select a terrestrial link.

1.2 *Echo suppressors*

Both long terrestrial telephone links and satellite links call for the insertion of echo suppressors. Recommendations G.131 [1] and Q.115 include basic requirements for the insertion of echo suppressors.

Therefore, signalling systems should be arranged to act in cooperation with switching equipment to achieve the goals covered by Recommendations G.131 [1] and Q.115. This would be facilitated where the signalling system to be used provides the possibility of controlling the inclusion of echo suppressors.

In the future, the use of echo cancellers may need to be considered (see Recommendation G.165 [2]).

1.3 *Speech interpolation systems (e.g. TASI)*

In the case of a transmission system with speech interpolation, it must be ensured that the signalling system to be used is compatible with speech interpolation.

2 Further criteria for selecting a signalling system

Once Administrations decide to establish a route, they will have to specify the general requirements to be met by the signalling system.

In the following, some questions are drawn up which may serve as a guideline:

a) Does the transmission system provide for sufficient bandwidth (e.g. for outband line signalling)?

b) Is the signal capacity sufficient to allow the setting-up of an ordinary connection?

c) Is an additional exchange of information required, e.g.:

- for echo suppressor control,
- to increase routing facilities,
- to obtain or to offer detailed information on congestion,
- to obtain or to offer information on the condition of the called subscriber line,
- to obtain or to offer information on the nature of the call:
  i) for identification or
  ii) for management purposes?

d) What requirements have to be set for the speed of the signalling system? What post-dialling and answering delays are to be tolerated?

e) Is there any interdependence between the minimum bundle size and signalling (e.g., as in the case of pilot interruption control of Signalling System R2)?

f) In the case of satellite systems, does the earth station require an extra interface between the terrestrial access circuits and the satellite links?

g) Is it necessary to introduce a new signalling system?

h) Is the signalling system suitable for application to the particular exchange type, e.g., electromechanical exchanges?

3 Characteristics of the standard CCITT Signalling Systems for general use

3.1 *Signalling System No. 4*

Described and specified in Fascicle VI.2.

Suitable for one-way operation.

Suitable for terminal and transit working; in the latter case two or three circuits equipped with Signalling System No. 4 may be switched in tandem.

Signalling System No. 4 is used in Europe and the Mediterranean Basin.

It makes use of a two-frequency code within the speech band.

A four-element binary code is employed for interregister signalling. Each of these elements consists of one of the two signal frequencies.

Each digit is acknowledged. In the case of long propagation times, these acknowledgements have an adverse effect because the propagation time is included twice in one signalling cycle. This disadvantage is more or less compensated for by the overlap mode of operation.

Signalling System No. 4 has a signal capacity of 16 codes for forward interregister signals and no register signals in the backward direction other than the acknowledgement signals.

One signal is provided for echo suppressor control on mutual agreement.

A signal is not provided to indicate whether the connection already includes a satellite link.

Not suitable for operation on transmission systems with speech interpolation.

3.2 *Signalling System No. 5*

Described and specified in Fascicle VI.2.

Suitable for both-way operation.

Suitable for terminal and transit working; in the latter case two or three circuits equipped with Signalling System No. 5 may be switched in tandem.

A multifrequency code (MFC: 2 out of 6) within the speech band is used for interregister signalling. The line signals consist of 1 or 2 frequencies within the speech band.

The entire address information is stored up to the last signal. It is then transmitted en bloc as a rapid sequence of pulsed multifrequency code signals.

The application of the en bloc mode of operation may result in an increased post-dialling delay, especially if the ST condition is determined by time out.

Signalling System No. 5 has a signal capacity of 15 codes for forward interregister signals and no backward interregister signals.

Signals are not provided either for echo suppressor control or for indicating whether the connection already includes a satellite link.

Suitable for operation on transmission systems with speech interpolation and on satellite links.

3.3 *Signalling System R1*

Described and specified in Fascicle VI.4.

Signalling System R1 is mainly used in North America.

Suitable for both-way operation.

Specified for terminal working.

A multifrequency code (MFC: 2 out of 6) within the speech band is used for interregister signalling.

In the analogue version of the Signalling System R1 line signalling, one frequency within the speech band is used. In the digital version of the Signalling System R1 line signalling, the two resultant signalling channels per speech circuit may be regarded as outband channels.

The following three modes of operation can be used to transmit the address information:

- en bloc,
- en bloc/overlap, or
- overlap.

The mode of operation selected influences:

- the seizing time of the next link, as well as
- the post-dialling delay.

The address information is transmitted as pulsed MFC signals.

Signalling System R1 has a signal capacity of 15 codes for forward interregister signals but no backward interregister signals.

Signals are not provided either for echo suppressor control or for indicating whether the connection already includes a satellite link.

Signalling System R1 can be used on satellite links. A variant of Signalling System R1 may be suitable for operation on transmission systems with digital speech interpolation, provided that the systems are designed and engineered to be transparent to pulsed interregister signals.

3.4 *Signalling System R2*

Described and specified in Fascicle VI.4.

Used for one-way operation on analogue transmission systems. Both-way operation is possible on digital transmission systems.

Suitable for terminal and transit working.

Signalling System R2 is used in both national and international telephone networks in several regions of the world.

A multifrequency code (MFC: 2 out of 6) within the speech band is used for interregister signalling. Since two different sets of six frequencies in separate bands are defined for forward and backward interregister signals, Signalling System R2 interregister signalling is suitable for use on 2-wire circuits as well as on 4-wire circuits.

For the analogue version of the Signalling System R2 line signalling, use is made of a low-level tone-on-idle method out of band. In addition, pilot interruption control is used.

The digital version of the line signalling uses two signalling channels to transmit the signalling information and for circuit supervision. For 2048 kbit/s PCM systems, the signalling information of the 30 speech circuits is transmitted in the Time Slot 16 (see Recommendation G.732 [3]).

It should be noted that the analogue version of the line signalling can be used on digital links; the signalling states are sent coded on one signalling channel. This use of the analogue version on digital links is not recommended on international circuits.

When a circuit is composed of both digital and analogue links, a conversion between the two versions of the line signalling can occur at the interface (see Recommendation Q.430).

Compelled signalling is used to transmit the address information in the overlap mode as multifrequency code signals, i.e., each forward interregister signal is acknowledged by a backward interregister signal. Considering that four times the propagation time is to be included in one signalling cycle, the exchange of signals is rather slow if the propagation time is long. This disadvantage **is** more or less compensated for by the overlap mode of operation.

Signalling System R2 has a higher signalling capacity than Signalling Systems No. 4, No. 5 and R1. The interregister signals allow, amongst others:

- improved routing,
- detailed information on congestion,
- information on:
  i) the nature of call,
  ii) the condition of the called subscriber line,
- no-charge calls, and
- address-complete information.

Signalling System R2 includes both forward and backward interregister signals for echo suppressor control.

In Signalling System R2, two signals are specified which indicate whether *or not* the connection already includes a satellite link.

Signalling System R2 may be suitable for use on satellite circuits, especially when it is already employed in the national or regional telephone networks concerned.

When Signalling System R2 is to be used on satellite links, the following must be borne in mind:

- In the case of analogue line signalling, intervals T1 and T2 have to be adapted.
- Pilot interruption control requires bundles comprising a multiple of 12 speech circuits.
- The register at the incoming end of a satellite link using Signalling System R2 shall be operated as an outgoing R2 register.
- The guard time for blocking and recognition of forward signals when pulsed signals are transmitted should be adapted to the propagation time on the satellite link.

Signalling System R2 may be suitable for operation on transmission systems with digital speech interpolation, provided the systems are designed and engineered to be transparent to pulsed interregister signals.

With 3 kHz spaced channels, the interregister signalling of Signalling System R2 may be used with the line signalling of Signalling System No. 4.

3.5 *Signalling System No. 6*

Fully described and specified in Fascicle VI.3.

Suitable for both-way operation.

Suitable for terminal and transit working.

During the period from 1970 to 1972 Signalling System No. 6 was tested internationally.

Some Administrations have introduced it for international telephone traffic. A variant of Signalling System No. 6 is employed in the national telephone network of the United States.

A common signalling link is used for signalling.

May be used in either an associated or quasi-associated mode of operation. Use in a quasi-associated mode may be more economic for small bundles of circuits.

Signalling is performed by means of signal units. Each unit is 28 bits in length, including 8 check bits. Transmission is at a speed of 2400 bit/s for the analogue version and 4 kbit/s (optionally 56 kbit/s) for the digital version.

Each signal unit within a block of 11 signal units is acknowledged and retransmitted in case of errors.

The address information can be transmitted en bloc and in the overlap mode. Because the transmission speed of Signalling System No. 6 is considerably higher than that of channel-associated signalling systems, the influence of the mode of operation on the post-dialling delay is reduced substantially.

The signal capacity (including the spare codes) of Signalling System No. 6 is much higher than that of Signalling Systems No. 4, No. 5, R1 and R2.

Signalling System No. 6 contains signals for echo suppressor control as well as signals indicating whether a satellite link is already included in the connection.

Signalling System No. 6 can be used for all types of telephone circuits including those with speech interpolation.

Signalling System No. 6 can be used on satellite links.

3.6 *Signalling System No. 7*

Fully described and specified in Fascicles VI.7, VI.8 and VI.9.

Suitable for both-way operation.

Suitable for terminal and transit working.

A common signalling link is used for signalling.

Signalling System No. 7 can be used in national and international telecommunication networks.

Signalling System No. 7 can be used for dedicated networks (e.g. data transmission, telephone) and within an integrated services digital network. It is the preferred signalling system between Integrated Digital Network (IDN) exchanges and within the Integrated Services Digital Network (ISDN).

Signalling System No. 7 may be used in either an associated or quasi-associated mode of operation. Use in a quasi-associated mode may be more economical for small bundles of circuits.

Variable length signal units with an integer number of octets are used of which 6 perform message transfer part functions. Signalling System No. 7 is optimized for a digital bearer with transmission speed of 64 kbit/s, but operation at lower speeds (e.g. 4.8 kbit/s) on analogue bearers is possible.

Two error control methods (basic and preventive cyclic retransmission) are specified, each with its own field of application. In the basic method each signal unit is acknowledged and retransmitted in case of errors while in the preventive cyclic retransmission method no negative acknowledgements occur and error correction is performed by retransmission during idle periods of not yet acknowledged signal units.

The address information can be transmitted en bloc and in the overlap mode. Because the transmission speed of Signalling System No. 7 is considerably higher than that of channel-associated signalling systems, the influence of the mode of operation on the post-dialling delay is reduced substantially.

The signal capacity (including the spare codes) of Signalling System No. 7 is much higher than that of Signalling Systems No. 4, No. 5, R1 and R2.

Signalling System No. 7 contains signals for echo suppressor control as well as signals indicating whether a satellite link is already included in the connection.

Signalling System No. 7 can be used for all types of telephone circuits including those with speech interpolation.

Signalling System No. 7 can be used on satellite links.

References

[1] CCITT Recommendation *Stability and echo,* Vol. III, Rec. G.131.

[2] CCITT Recommendation *Echo cancellers,* Vol. III, Rec. G.165.

[3] CCITT Recommendation *Characteristics of primary PCM multiplex equipment operating at 2048 kbit/s,* Vol. III, Rec. G.732.