THE INTERNATIONAL TELEGRAPH AND TELEPHONE CONSULTATIVE COMMITTEE

CCITT

SIXTH PLENARY ASSEMBLY

GENEVA, 27 SEPTEMBER - 8 OCTOBER 1976

ORANGE BOOK

VOLUME VI.1

TELEPHONE SIGNALLING AND SWITCHING

Published by the
INTERNATIONAL TELECOMMUNICATION UNION
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CONTENTS OF THE CCITT BOOK
APPLICABLE AFTER THE SIXTH PLENARY ASSEMBLY (1976)

ORANGE BOOK

Each volume also contains, for its field and where appropriate:

— definitions of specific terms used;
— supplements for information and documentary purposes.

CONTENTS OF VOLUME VI OF THE ORANGE BOOK

VOLUME VI.1 – Contents

PRELIMINARY NOTES

1. The Recommendations in Volume VI of the *Orange Book* are in agreement with Series E of the CCITT Recommendations (Volume II.2 of the *Orange Book*) and with the provisions of the *Instructions for the International Telephone Service.*

2. The following expressions, which are in conformity with the ITU *List of Definitions* (see Definitions 16.19, 16.20, 17.53 and 17.54), have been used in Volume VI of the *Orange Book.*

a) *Semi-automatic service* (or working), to designate a "service in which the calling subscriber's booking is given to an operator in the outgoing exchange, who completes the call through automatic switches".

b) *Automatic service* (or working), to designate a "system in which the switching operations are performed without the intervention of operators, the calling subscriber dialling (or keying) the called subscriber direct". This expression must be used to the exclusion of all others, such as "fully automatic service".

If a recommendation applies to both automatic and semi-automatic working, this should be explicitly specified in each sentence, since the CCITT has not defined a general expression to cover both of these services.

However, it has been agreed that the expressions

"automatic circuit" and "automatic equipment"

should, unless otherwise stated, be taken to indicate circuits or equipment which may be used either for semi-automatic or for automatic working.

The strict observance of the specifications for standardized international signalling and switching equipment is of the utmost importance in the manufacture and operation of the equipment. Hence these specifications are obligatory except where it is explicitly stipulated to the contrary.

The values given in Volumes VI.1, VI.2 and VI.3 are imperative and must be met under normal service conditions.

In this Volume, the expression "Administration" is used for shortness to indicate both a telecommunication Administration and a recognized private operating agency.

PART 1

Series Q Recommendations (Q.1 and Q.2)

SIGNALLING IN THE INTERNATIONAL MANUAL SERVICE

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SIGNALLING IN THE INTERNATIONAL MANUAL SERVICE

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SIGNALLING IN THE INTERNATIONAL MANUAL SERVICE

Recommendation Q.1

SIGNAL RECEIVERS FOR MANUAL WORKING

In 1934 (CCIF *White Book*, Volume III, Xth Plenary Assembly, Budapest, 1934), a signalling current having a frequency of 500 Hz ± 2%, interrupted at a frequency of 20 Hz ± 2% was provisionally chosen for manually-operated international circuits.

500 Hz was chosen as the frequency to be transmitted, under normal conditions, by carrier terminal equipment and line repeaters. To avoid false operation due to speech currents, it was also considered desirable to interrupt the 500 Hz signalling current at low frequency. The use of a uniform interruption frequency of 20 Hz enables a high degree of selectivity to be obtained in signal receivers.

The effective power produced by the signalling current, when not interrupted, is fixed at 1 milliwatt at a zero relative level or an absolute power level of zero (with a tolerance of ± 1 decibel) which corresponds to an average power for the interrupted signalling current of 0.5 milliwatt, with a tolerance of ± 1 decibel.

The power levels specified above were chosen in 1954 (XVIIth CCIF Plenary Assembly, Geneva, 1954) on the basis of the limit imposed for the maximum energy which can be transmitted by signals during the busy hour; it must not exceed 2.5 microwatthours or 900 microwattseconds at a zero relative level point. A reasonable value for the number of calls, or attempted calls, on a circuit during the busy hour was assumed and 2 seconds was assumed to be the sending duration of the signalling current to line by operation of the operator's ringing key.

On outgoing circuits from an international exchange, where the 500/20 Hz signals are liable to be sent over wideband carrier systems (coaxial carrier systems) it is desirable, to avoid overloading the repeaters, that the duration of the 500/20 Hz signals sent to line should not exceed 2 seconds and they should be limited to this value by automatic means.

Since, in general, the *Instructions for the International Telephone Service* (Article 32) require the signalling current sent over an international circuit to have a duration of at least 2 seconds to avoid the risk of signals being undetected at the incoming end, the means for limiting the sending duration of the signalling current will generally consist of an arrangement which controls the sending duration independently of the time the ringing key is operated and which automatically fixes that duration at 2 seconds.

Note. — In the case of short 2-wire circuits, it may be economical to use, by agreement between the Administrations concerned, a low-frequency signalling current (either between 16 and 25 Hz or 50 Hz).

ANNEX

(to Recommendation Q.1)

Basic technical clauses of a model specification for the provision of 500/20-Hz voice-frequency signalling sets (signal transmitters and receivers) intended for manually-operated circuits

a) *Sending of signals*

Power. — The signal transmitted shall supply a sinusoidal current at a frequency of 500 Hz ± 2% interrupted at a frequency of 20 Hz ± 2%.

The effective mean power of the 500/20-Hz current is fixed at 0.5 milliwatt or an absolute power level of -3 dBm (with a tolerance of $\pm$ 1 dB) at a zero relative level point.

Every precaution should be taken to avoid unbalance effects in the circuit during the transmission of a 500/20-Hz signalling current.

b) *Reception of signals*

Sensitivity. – The signal receiver shall operate correctly when the 500/20-Hz current at the input to the signal receiver is within the following limits:

$$-8.5 + n \leqslant N \leqslant +2.5 + n \text{ dB}$$

where n is the relative power level at the point of the circuit at which the signal receiver is connected.

The limits take account of the tolerances indicated above for the transmitted power level and include a margin of $\pm$ 4 decibels on the nominal absolute power level of the 500/20 Hz current received at the input to the signal receiver. This margin allows for variations in transmission conditions on international circuits.

Tuning. – Tuning should be such that the signal receiver operates only at a frequency of 500 Hz guaranteed to within $\pm$ 2% and at an interrupting frequency of 20-Hz guaranteed to within $\pm$ 2%.

Delay. – The delay, i.e. the time which elapses between the application of the signalling voltage and the operation of the signal receiver, must be long enough for the signal receiver to remain insensitive to all speech currents which normally flow in the circuit to which it is connected. The duration of this delay must, however, be less than 1200 milliseconds. (In other words, 1200 milliseconds is the maximum signal recognition time within which a signal has to be recognized).

Selectivity (resulting from the tuning of the resonant circuit and the delay mentioned above). – The receipt of a speech (or noise) current circulating in the circuit must not give rise to a current liable to cause the operation of the signalling equipment and, in consequence, to cause a wrong indication to be given on the international positions even though the speech (or noise) voltage reaches the maximum value likely to be met in practice. In particular, the signal receiver must not operate when a speech power not exceeding 6 milliwatts is applied at a zero relative level point.

Insertion loss. – The insertion loss introduced by the signal receiver in the circuit with which the signalling set is associated must be less than 0.3 dB for any frequency effectively transmitted by the circuit.

Recommendation Q.2

SIGNAL RECEIVERS FOR AUTOMATIC AND SEMI-AUTOMATIC WORKING, USED FOR MANUAL WORKING

The directives relating to 500/20-Hz signalling sets are provisional. An Administration intending to purchase new signalling sets for use on international circuits which for the time being are to be operated on a manual basis, may find it advantageous, by agreement with the Administrations interested in the operation of the circuits concerned, to use signal receivers and transmitters conforming to the specifications for international automatic equipment. This will permit a greater technical uniformity of installations and will avoid having to replace the signal receivers when, ultimately, these circuits are operated on an automatic or semi-automatic basis.

The signal receivers must therefore conform with the specifications for the applicable recommended CCITT systems.

Sending of signals

The frequency and power level of the signalling current must be in accordance with the specifications for international automatic equipment. If two-frequency signal receivers are concerned, the two frequencies (compound signal) must be transmitted simultaneously.

The nominal duration of a signal sent to line is fixed at 2 seconds so as to be the same as that specified for 500/20 Hz signalling.

Reception of signals

At the receiving end, provision must be made for a splitting arrangement conforming to the specifications for international automatic equipment. This splitting arrangement can be:

– either an integral part of the signal receivers, or

– placed at the end of the circuit after the signal receiver.

The signalling equipment (at the output of the signal receiver) which causes the lighting of the calling and clearing lamps shall have a signal recognition time of between 100 and 1200 milliseconds:

– 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 1200 ms has been chosen so as to permit the partial use of 500/20-Hz signal-receiver equipment.

Note 1. – The characteristics of signal receivers of the types used for automatic or semi-automatic working could possibly also be used to provide signals and supplementary facilities for operators if the Administrations concerned consider that the operational advantages to be obtained justify the equipment modifications involved at the international exchanges.

Note 2. – The time quoted in this Recommendation for the signal length and the signal recognition times would also be appropriate for out-band signalling systems using discontinuous signals for a manual service.

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PART II

Series Q Recommendations (Q.5 to Q.49)

GENERAL RECOMMENDATIONS RELATING TO SIGNALLING AND SWITCHING IN THE AUTOMATIC AND SEMI-AUTOMATIC SERVICES

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GENERAL RECOMMENDATIONS RELATING TO SIGNALLING AND SWITCHING IN THE AUTOMATIC AND SEMI-AUTOMATIC SERVICES

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SECTION 1

CCITT BASIC RECOMMENDATIONS ON INTERNATIONAL AUTOMATIC AND SEMI-AUTOMATIC WORKING

Recommendation Q.5

ADVANTAGES OF SEMI-AUTOMATIC SERVICE IN THE INTERNATIONAL TELEPHONE SERVICE

(Geneva, 1954)

The CCITT,

considering

a) the large economies in personnel that can result from the introduction of semi-automatic service at the incoming exchange;

b) the very small number of faults due to the equipment used for the international semi-automatic service;

c) the improvement in the "efficiency" (ratio of chargeable time to total holding time) of circuits using semi-automatic service compared with the efficiency of manual circuits operated on a demand basis;

d) the improvement in the quality of the service given to users due to the reduction in the time of setting up a call;

e) the fact that any type of call can be set up without difficulty over semi-automatic circuits, so that semi-automatic circuits can be used exclusively on an international relation,

draws the attention of Administrations

to the advantages of semi-automatic service from the point of view of economy and of the quality of service given to subscribers.

Recommendation Q.6

ADVANTAGES OF INTERNATIONAL AUTOMATIC WORKING

(New Delhi, 1960)

The CCITT,

considering

a) that the advantages of semi-automatic working mentioned in Recommendation Q.5 apply as well to automatic working in respect of reliability, circuit efficiency and the satisfaction given to subscribers;

b) that the advantages of automatic working are even greater as regards staff economy, since outgoing operators are dispensed with;

c) that the changeover from semi-automatic to automatic working may be accomplished without any major modification to the international circuits or to the switching equipment at transit and incoming exchanges;

d) that by 1960 the above advantages had been widely confirmed by experience on a number of international relations which had been using automatic service up to that time;

e) that such experience has also shown that when a relation changes from demand working (manual or semi-automatic) to automatic working, there is a considerable increase in traffic;

f) that the introduction of an international automatic service follows logically on the introduction of a national automatic service;

draws the attention of Administrations

to the additional advantages resulting from the introduction of an international automatic service.

Recommendation Q.7

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

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

A. The CCITT,

considering

a) that standardization of the signalling systems to be used for international automatic and semi-automatic 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 systems have been standardized *for general use* in international automatic and semi-automatic working:

- System No. 3 (formerly called "one-frequency system") standardized by the CCIF in 1954;
- System No. 4 (formerly called "two-frequency system") standardized by the CCIF in 1954;
- System No. 5, standardized by the CCITT in 1964;
- System No. 5 *bis*, standardized by the CCITT in 1968;
- System No. 6, standardized by the CCITT in 1968;

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

- System R1 (Regional System No. 1, formerly called the North American System), standardized by the CCITT in 1968;
- System R2 (Regional 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 systems may be expected to give acceptable results for international semi-automatic and automatic working;

desiring

that the CCITT Recommendation concerning the signalling systems for international automatic and semi-automatic 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 working, one or more of the standard systems mentioned in b) and c) above.

Note 1. – The signalling systems standardized by the CCITT *for general use* are designated by serial numbers as follows:

No. 1:	is assigned to the 500/20-Hz signalling system used in the international manual service (see Recommendation Q.1);
No. 2:	is assigned to the 600/750-Hz signalling system recommended by the CCIF in 1938 (Volume I *ter* of the *White Book*, Oslo, 1938) for international service on 2-wire semi-automatic circuits but which was never used in international service;
No. 3, No. 4, No. 5 and No. 5 *bis*	are assigned to the four in-band systems recommended for semi-automatic and automatic working;
No. 6:	is assigned to the signalling system using a separate channel for all signals and recommended for automatic and semi-automatic service.

Note 2. – The signalling systems standardized by the CCITT *for regional use* are designated by the serial numbers R1 and R2.

B. *Characteristics and field of application of the CCITT standard systems for general use*

SYSTEM No. 3

Described and specified in the *Red Book*, Volume IV, Part V (New Delhi, 1960). [1]

Suitable for one-way operation of the circuits.

Uses one "in-band" signalling frequency (2280 Hz) for the transmission of both line and register signals.

Applicable for semi-automatic and automatic working.

Used for terminal traffic on the European continent.

Not to be used for new relations.

SYSTEM No. 4

Described and specified in Volume VI, *Green Book*, Part IX. [2]

Suitable for one-way operation of the circuits.

Uses two "in-band" signalling frequencies (2040 and 2400 Hz) for the end-to-end transmission of both line and register signals.

Applicable for semi-automatic and automatic working.

Initially used for international traffic on the European continent.

Suitable for terminal and transit traffic; in the latter case 2 or 3 circuits equipped with System No. 4 may be switched in tandem.

[1] See an amendment in Part VIII of this Volume.

[2] See an amendment in Part IX of this Volume.

Suitable for submarine or land cable circuits and microwave radio circuits. Not applicable for TASI-equipped systems. The use of this system via satellite links may not be practicable, since the call set-up speed will be slow, due to the compelled digit-by-digit technique.

Capable of interworking with Systems No. 5, No. 5 *bis* and No. 6 in the combinations:

No. 4-No. 5 and No. 5-No. 4: see Part XI of Volume VI, *Green Book.*

No. 4-No. 5 *bis* and No. 5 *bis*-No. 4: see Part XIII of Volume VI, *Green Book.*

No. 4-No. 6 and No. 6-No. 4: see Part I, Section 4 of Volume VI.2, *Orange Book.*

SYSTEM No. 5

Described and specified in Part X of Volume VI of the *Green Book.* [3)]

Suitable for both-way operation of the circuits.

Uses two "in-band" signalling frequencies (2400 and 2600 Hz) for the link-by-link transmission of line signals and six "in-band" signalling frequencies (700, 900, 1100, 1300, 1500 and 1700 Hz) in a two-out-of-six code (numerical information transmitted en bloc) for the link-by-link transmission of register signals.

Applicable for semi-automatic and automatic working.

Initially used for intercontinental traffic via TASI-equipped submarine cables.

Suitable for terminal and transit traffic; in the latter case two or more circuits equipped with System No. 5 may be switched in tandem (see, however, the Note below).

Suitable for submarine or land cable circuits and microwave radio circuits, whether TASI is used or not and for satellite circuits (see, however, the Note below).

Capable of interworking with Systems No. 4, No. 5 *bis* and No. 6 in the combinations:

No. 5-No. 4 and No. 4-No. 5: see Part XI of Volume VI, *Green Book.*

No. 5-No. 5 *bis* and No. 5 *bis*-No. 5: see Part XIII of Volume VI, *Green Book.*

No. 5-No. 6 and No. 6-No. 5: see Part I, Section 4 of Volume VI.2, *Orange Book.*

Note. – When, with automatic working, three or more international circuits equipped with this system are switched in tandem, there is increasing probability that the called subscriber will release prematurely because the conditions for effective conversation have not been established quickly enough. There is also a small probability of a premature release of the connection of a satellite link if included. The CCITT prefers to reserve its recommendation in the matter of automatic operation over more than two circuits switched in tandem and equipped with System No. 5 (or, No. 5 *bis*). For restrictions regarding the use of tandem satellite connections refer to 4. of Recommendation E.171.

SYSTEM No. 5 *bis*

Described and specified in Part XII of Volume VI of the *Green Book.*

Standardized in 1968 by CCITT and introduced, as a variant of System No. 5, in order to provide more facilities.

Suitable for both-way operation of the circuits.

Uses the same line signalling as System No. 5, i.e. two "in-band" signalling frequencies (2400 and 2600 Hz for the link-by-link transmission of those signals.

Uses, in both forward and backward direction, six "in-band" signalling frequencies (700, 900, 1100, 1300, 1500 and 1700 Hz) in a two-out-of-six code in combination with a guard and TASI-locking frequency (1850 Hz) for the link-by-link transmission of register signals, providing forward and backward exchange of information during call set-up. [4)]

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3) See an amendment in Part X of this Volume.

4) The specifications of System No. 5 *bis* provide the possibility of using common interregister signalling equipment on relations using System No. 5 and on those using System No. 5 *bis*.

Applicable for semi-automatic and automatic working.

Suitable for terminal and transit traffic; in the latter case two or more circuits equipped with System No. 5 *bis* may be switched in tandem (see, however, the Note below).

Suitable for submarine or land cable circuits and microwave radio circuits, whether TASI is used or not and for satellite links (see, however, the Note below).

Capable of interworking with Systems No. 4, No. 5 and No. 6 in the combinations:

No. 5 *bis*-No. 4 and No. 4-No. 5 *bis*: see Part XIII of Volume VI, *Green Book*;

No. 5 *bis*-No. 5 and No. 5-No. 5 *bis*: see Part XIII of Volume VI, *Green Book*;

No. 5 *bis*-No. 6 and No. 6-No. 5 *bis*: see Part I, Section 4 of Volume VI.2, *Orange Book*.

Note. – When, with automatic working, three or more international circuits equipped with this system are switched in tandem, there is increasing probability that the called subscriber will release prematurely because the conditions for effective conversation have not been established quickly enough. There is also a small probability of a premature release of the connection if a satellite link is included. The CCITT prefers to reserve its Recommendation in the matter of automatic operation over more than two circuits switched in tandem and equipped with System No. 5 *bis* (or No. 5). For restrictions regarding the use of tandem satellite connections refer to 4. of Recommendation Z.171.

SYSTEM No. 6

Standardized in 1968 by the CCITT and based on the principles of "(completely) separate channel signalling" mentioned in the first part of Recommendation Q.20.

Fully described and specified in Volume VI.2 of the *Orange Book*.

Suitable for both-way operation of the circuits.

Uses a signalling link, common for a number of speech circuits, carrying all signalling information for the calls using these circuits, by means of a serial mode of data transmission.

In the analogue version of the system, the data is normally transmitted at a rate of 2400 bit/s. For the digital version, the 1544 kbit/s and 2048 kbit/s standardized PCM primary multiplexes (Recommendation G.733 and Recommendation G.732) are treated differently. In the case of 1544 kbit/s, signalling information is transmitted at 4 kbit/s over a derived channel operating at 4 kbit/s. In the case of 2048 kbit/s, signalling information is transmitted at 4 kbit/s over a derived channel operating at 64 kbit/s. In addition, the rate of 56 kbit/s may be used with the 2048 kbit/s international digital multiplex.

Applicable for semi-automatic and automatic working.

Suitable for terminal and transit traffic.

Suitable for submarine or land cable circuits and microwave radio circuits, whether TASI is used or not and for satellite circuits (see, however, the details in the specification).

Capable of interworking with Systems No. 4, No. 5 and No. 5 *bis* in the combinations:

No. 6-No. 4 and No. 4-No. 6

No. 6-No. 5 and No. 5-No. 6, and

No. 6-No. 5 *bis* and No. 5 *bis*-No. 6

See Part I, Section 4 of Volume VI.2 of the *Orange Book*.

C. *Characteristics and field of application of the CCITT standard systems for regional use*

SYSTEM R1

Described and specified in Parts I and II of Volume VI.3 of the *Orange Book.*

Suitable for both-way operation of the circuits.

Uses six "in-band" signalling frequencies (700, 900, 1100, 1300, 1500 and 1700 Hz) in a two-out-of-six code for the link-by-link transmission of forward register signals.

Line signalling is handled differently in the analogue and digital versions. In the analogue version, continuous tone type signalling using 2600 Hz is used. The digital version of System R1 is specified for use with the 1544 kbit/s primary multiplex (Recommendation G.733). In the digital version, the 2600 Hz line signal is not normally applied to the speech paths unless the digital systems are connected in cascade with analogue channels to form a circuit. The line signalling is channel associated, in-slot, providing two signalling channels per speech channel, and utilizing bit sharing of the eighth bit of each channel every sixth frame.

Applicable for semi-automatic and automatic working.

Suitable for terminal and transit traffic.

Suitable for use on satellite links.

Not applicable to TASI-equipped systems.

SYSTEM R2

Fully described and specified in Parts III and IV of Volume VI.3 of the *Orange Book.*

Suitable for both-way operation of circuits.

Uses two groups of "in-band" signalling frequencies (1380, 1500, 1620, 1740, 1860 and 1980 Hz for forward signalling), (1140, 1020, 900, 780, 660, 540 for backward signalling) in a two-out-of-six code for the end-to-end, continuous compelled, transmission for register signals.

The analogue version of the link-by-link continuous type line signalling uses one low-level "out-band" signalling frequency at 3825 Hz. The digital version of the line signalling uses signalling channels derived from the 2048 kbit/s primary multiplex (Recommendatin G.732).

Applicable for semi-automatic and automatic working.

Suitable for terminal and transit traffic.

Not applicable to TASI equipped systems or 3 kHz spaced channels.

Suitable for restricted use on satellite links. See Annex 4 to the specifications of System R2 and the Annex to Question 6/XI.

Capable of interworking with Systems No. 4, No. 5, No. 5 *bis* and No. 6 in the combinations:

No. 4-R2 and R2-No. 4
No. 5-R2 and R2-No. 5
No. 5 *bis*-R2 and R2-No. 5 *bis*
No. 6-R2 and R2-No. 6

D. *Interworking of standardized CCITT signalling systems with demand assignment satellite signalling systems*

The CCITT has specified in Recommendation Q.48 those features of demand assignment (abbreviated as DA) satellite signalling systems which are considered necessary to assure the proper interworking of these systems with CCITT standardized signalling systems for general and regional use.

SECTION 2

NUMBERING PLAN AND DIALLING PROCEDURES IN INTERNATIONAL SERVICE

Recommendation Q.10

DEFINITIONS RELATING TO NATIONAL AND INTERNATIONAL NUMBERING PLANS [1)]

1. **international prefix**

The combination of digits to be dialled by a calling subscriber making a call to a subscriber in another country, to obtain access to the automatic outgoing international equipment.

2. **country code**

The combination of one, two or three digits characterizing the called country.

3. **trunk prefix**

A digit or combination of digits to be dialled by a calling subscriber, making a call to a subscriber in his own country but outside his own numbering area. It provides access to the automatic outgoing trunk equipment.

4. **trunk code**

A digit or combination of digits (not including the trunk prefix) characterizing the called numbering area within a country (or group of countries, included in one integrated numbering plan).

The trunk code has to be dialled before the called subscriber's number where the calling and called subscribers are in different numbering areas.

5. **subscriber number** [2)]

The number to be dialled or called to reach a subscriber in the same local network or numbering area.

This number is the one usually listed in the directory against the name of the subscriber.

[1)] This Recommendation is an extract of Recommendation E.160 of Volume II.2. For the examples relating to 1 to 7 of Recommendation Q.10, see Volume II.2.

[2)] Care should be taken not to use the term "local number" instead of "subscriber number".

6. **national (significant) number**

The number to be dialled following the trunk prefix to obtain a subscriber in the same country (or group of countries, included in one integrated numbering plan) but outside the same local network or numbering area.

The national (significant) number consists of the trunk code followed by the subscriber number.

It should be noted that, in some countries, it is customary to consider *for national purposes* that the trunk prefix is included in the national number [which is then not the national (significant) number]. A careful distinction must therefore be made between such national definition or practice and the CCITT definition, which is internationally valid. In order to avoid misunderstanding, the CCITT definition includes the word "significant" between brackets, reading as follows: "national (significant) number".

7. **international number**

The number to be dialled following the international prefix to obtain a subscriber in another country.

The international number consists of the country code of the required country followed by the national (significant) number of the called subscriber.

Recommendation Q.11

NUMBERING AND DIALLING PROCEDURES FOR INTERNATIONAL SERVICE [3)]

1. *National numbering plan*

1.1 Each telephone Administration should give the most careful consideration to the preparation of a *national numbering plan* [4)] for its own network. This plan should be designed so that a subscriber is always called by the same number in the trunk service. It should be applicable to all incoming international calls.

1.2 *Numbering analysis*

1.2.1 The national numbering plan of a country should be such than an analysis of a minimum number of digits of the national (significant) number [5)]:

a) gives the most economical routing of incoming international traffic from various other countries;

b) indicates the charging area in those countries where there are several.

1.2.2 In the case of a country with a two- or three-digit country code, not more than two digits of the national (significant) number should be analyzed for these purposes.

If the country code has only one digit, three or more digits of the national (significant) number should be analyzed for these purposes.

1.2.3 In the case where an integrated numbering plan covers a group of countries the digit analysis specified in 1.2.2 above should also determine the country of destination.

1.2.4 For the requirements relating to frontier traffic see Recommendation E.290 R.

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3) This Recommendation is an extract of Recommendation E.161 of Volume II.2.

4) See the CCITT *Manual on National Telephone Networks for the Automatic Service* for a comprehensive study of national numbering plans from the national point of view.

5) See definitions in Recommendation Q.10.

2. *Limitation of the number of digits to be dialled by subscribers*

2.1 *International number*

The CCITT recommended in 1964 that the number of digits to be dialled by subscribers in the automatic international service should not be more than 12 (excluding the international prefix). It is emphasized that this is the maximum number of digits and Administrations are invited to do their utmost to limit the digits to be dialled to the smallest possible number.

2.2 *National (significant) number*

Noting that:

a) the international number (excluding the international prefix) consists of the country code followed by the national (significant) number;

b) the smallest possible number of digits to be dialled in the automatic international service is achieved by limiting the number of digits of the country code and/or of the national (significant) number;

c) in some countries where telephony is already developed to an advanced stage, the national numbering plans in force enable the number of digits of the international number to be limited to less than 12;

d) some other countries which drew up their national numbering plans some time ago have taken steps to ensure that the number of digits of the international number will not exceed 12 and may even be less;

the CCITT recommended in 1964 that countries which had not yet established their national numbering plan ensure that, as far as practicable, the maximum number of digits of the international number be 11, at least for a period corresponding approximately to the life of automatic switching equipment (i.e. a minimum of 25 years).

For these countries, the number of digits of the national (significant) number should be equal to a maximum of $11 - n$ (at least for the period of consideration), n being the number of digits of the country code.

3. *Digit capacity of international registers*

The CCITT considers it advisable to recommend that the digit capacity of registers dealing with international traffic should allow for future conditions that may arise, but not possible to specify at the present time. In this regard, registers dealing with international traffic should have a digit capacity, or a capacity that can be expanded, to cater for more than the maximum 12-digit international number envisaged at present. The increase in the number of digits above 12 is left as a matter of decision to be taken by individual Administrations.

4. *Use of figures and letters in telephone numbers*

4.1 For automatic international service, it is preferable that the national numbering plan should not involve the use of letters (associated with figures).

. . . .

5. *Rotary dials*

5.1 For countries which have not yet adopted any specific type of dial, the figures on the dial should be arranged in the following order: 1, 2, 3,..., 0.

. . . .

6. *Push-button telephone sets*

6.1 *10-button sets*

. . . .

6.2 *12-button sets*

6.2.1 *Arrangement*

In the 12-button set the standard arrangement for 10-button sets is extended by two additional buttons, one to the left and the other to the right of the button 0, thus making a pattern of 4 horizontal rows of three buttons each forming a 4 × 3 array.

Two buttons may also be added to a 5 × 2 array arrangement also used for 10-button sets. These should be located below and in line with buttons 9 and 0, thus making a 6 × 2 array.

6.2.2 *Symbols*

On the 4 × 3 array the symbol on the button which is immediately to the *left* of the button 0 (in the 6 × 2 array, the corresponding button is located below the button 9) and which, according to Recommendation Q.23, is used to transmit the frequency pair 941 Hz and 1209 Hz, should have a shape easily identified as the general shape shown in Figure 1/Q.11.

The symbol will be shown as the *star* as translated in the various languages. In France, the term asterisk may also be used for this symbol.

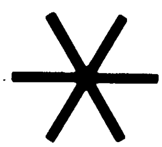

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FIGURE 1/Q.11

On the 4 × 3 array the symbol on the button which is immediately to the *right* of the button 0 (in the 6 × 2 array, the corresponding button is located below button 0) and which, according to Recommendation Q.23, is used to transmit the frequency pair 941 Hz and 1477 Hz, should conform in shape to the specifications given in Figure 2 or 3/Q.11.

The symbol will be known as the *square* or the most commonly used equivalent term in other languages [6].

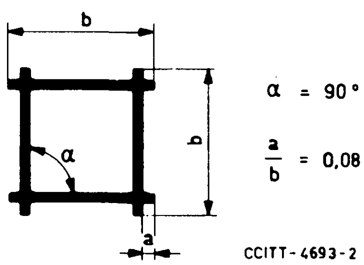

FIGURE 2/Q.11

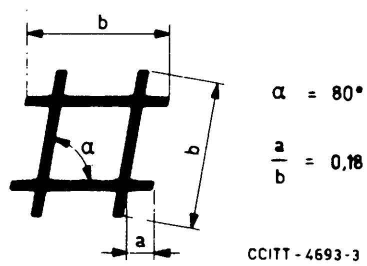

FIGURE 3/Q.11

[6] In some countries an alternative term (e.g. "number sign") may be necessary for this purpose, unless further investigation indicates that "square" is suitable for the customers.

The additional buttons with these symbols will be placed as shown below:

For the standard 4 X 3 array

1	2	3
4	5	6
7	8	9
*	0	#

For the 6 X 2 array

1	2
3	4
5	6
7	8
9	0
*	#

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6.3 *16-button sets*

6.3.1 *Arrangement*

In the 16-button set, the 4 × 3 array shown in 6.2.2 above is extended by four additional buttons placed to the right in such a way as to form a 4 × 4 array.

6.3.2 *Symbols*

On the 4 × 4 array, the symbols on the additional buttons are A, B, C and D.

The additional buttons with these symbols will be placed as shown below:

1	2	3	A
4	5	6	B
7	8	9	C
*	0	#	D

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. . . .

7. *Additional buttons for use on telephones*

7.1 *General*

For purposes other than dialling, additional buttons may be required on a telephone. For example, a telephone may have a button to recall during an active call, control logic (e.g. a register) or an operator, or to effect the transfer of an active call to another station. To prevent subscriber confusion it may be desirable that the symbols used on those buttons which have identical functions be standardized.

7.2 *Specific Recommendations*

7.2.1 *Register recall button*

For the recall of a register during an active call the following methods are possible:

- a switch-hook flash,
- a depression of one of the buttons of the normal 10, 12 or 16 button array,
- a depression of another button specially provided for this purpose, the register recall button.

From the human factors viewpoint the depression of a button for register recall seems to be preferable to the use of a switch-hook flash.

If a special register recall button is used, this button should be designated with the symbol R (capital) on or next to the button. The button should be clearly distinguishable and spatially separated from the standard 12 or 16 button array.

This symbol is recommended because:

a) it symbolizes the term "recall" in a number of languages;

b) studies have shown that it is subject to minimal auditory and visual confusion;

c) it avoids the difficulties inherent in specific technical terms for lay subscribers.

The exact position, shape and colour of the button should not be standardized at the present time. Such standardization would inhibit design innovation and be unnecessarily restrictive.

8. *Prefixes and codes*

8.1 *International prefix* [7)]

International standardization of a code for access to the international network for automatic international operation has not been possible since it was in conflict with national numbering plans already in existence. (Standardization of a code for access to the international automatic network would have been useful to international travellers.)

8.2 *Country code* [7)]

8.2.1 Country codes will be used:

- in semi-automatic working, to route calls to the required country when the calls are transit calls or when, on the outgoing positions, there is common dialling access to all the outgoing routes;
- in automatic working.

8.2.2 The list of country codes is given in the *Plan Book*, Geneva, 1975, of the World Plan Committee which is responsible for keeping it up to date. This list is also reproduced in Volume II.2 of the *Orange Book*, as an Annex to Recommendation E.161.

8.3 *Trunk prefix* [7)]

8.3.1 The *national (significant) number* (see definition 6. of Recommendation Q.10) does not include the trunk prefix. Accordingly, in international service, the trunk prefix of the country of destination must not be dialled.

It should be noted that, in some countries, it is customary to consider *for national purposes* that the trunk prefix is included in the national number [which is then not the national (significant) number]. A careful distinction must therefore be made between such national definition or practice and the CCITT definition, which is internationally valid. In order to avoid misunderstanding, the CCITT definition includes the word "significant" between parentheses, reading as follows: "national (significant) number".

8.3.2 It is recommended by the CCITT that the Administrations of countries that have not yet adopted a trunk prefix for access to their national automatic trunk network should adopt a prefix composed of a single digit, preferably 0.

The reasons for this recommendation are:

- to provide the maximum degree of standardization of the trunk prefixes used in different countries, so that dialling is made as easy as possible for a person travelling in different countries, and
- to minimize the number of digits to be dialled in the national automatic service.

8.3.3 In the automatic international service, following the international prefix and country code of the called country, the caller should dial the national (significant) number of the called subscriber (i.e. without dialling the trunk prefix).

8.3.4 The use and printing of symbols and separators in national and international telephone numbers is detailed in Recommendation E.162.

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7) See definition in Recommendation Q.10.

SECTION 3

ROUTING PLAN FOR INTERNATIONAL SERVICE

Recommendation Q.12

OVERFLOW-ALTERNATIVE ROUTING-REROUTING-AUTOMATIC REPEAT ATTEMPT [1)]

1. When a call cannot find a free circuit in one group of circuits (first choice), technical arrangements can be made to route the call automatically via another group of circuits (second choice), at the same exchange; this process is called *overflow*. There may also be overflow, at the same exchange, from a second choice group of circuits to a third choice group of circuits, etc.

2. When the group of circuits over which the overflow traffic is routed involves at least one exchange not involved in the previous choice route, the process is called *alternative routing*.

3. It should be noted that overflow can occur without alternative routing for cases such as, when there are in one relation two groups of circuits, one group reserved for one-way operation and the other group used for both-way operation. In this case, when all one-way circuits are busy, the call can overflow to the both-way circuit group.

4. When congestion occurs at a transit exchange, arrangements can be made in some signalling systems, at the outgoing international exchange on receipt of a busy-flash signal or a congestion signal sent by the transit exchange, to reroute the call automatically from the outgoing international exchange over another route. This process is called *re-routing*. The use of rerouting is not envisaged in the International Routing Plan.

. . . .

5. When a difficulty is encountered in the setting-up of a connection – such as double seizure on both-way circuits or error detection – arrangements can be provided to make another attempt to set up the connection for that call from the point where the first attempt took place. This process is called *automatic repeat attempt*.

An automatic repeat attempt may take place:

– on the same circuit; or

– on another circuit of the same group of circuits; or

– on a circuit in another group of circuits.

[1)] This Recommendation is an extract of Recommendation E.170.

Recommendation Q.13

THE INTERNATIONAL ROUTING PLAN [2)]

1. *Introduction*

. . . .

1.3 The International Routing Plan concerns automatic and semi-automatic traffic.

. . . .

2. *Structure of the international routing plan*

2.1 *Switching of international calls*

International calls originated in a national telephone network will be switched to the worldwide telephone network through a transit centre (called hereafter CT) which can interconnect national circuits and international circuits. This CT acts as international originating centre.

A similar transit centre (called hereafter CT) serves the incoming international calls to be switched to the national network. That CT centre acts as international destination centre.

Between an international originating centre and an international destination centre, a number of international transit centres which can interconnect international circuits, may, if necessary, be used to switch the calls through the worldwide telephone network.

2.2 *Transit centres*

There are three categories of transit centres, called CT1, CT2 and CT3.

According to the theoretical final route structure of the network described below, each CT1 and each CT2 interconnects international circuits, thus acting as an international transit centre.

A CT3 normally acts as a transit centre interconnecting only a national network (or part of it) and international circuits. However, there are cases where a CT3, permanently or temporarily, may act as a transit centre of another category for specified routes.

. . . .

[2)] This Recommendation is an extract of Recommendation E.171.

SECTION 4

GENERAL RECOMMENDATIONS RELATIVE TO SIGNALLING AND SWITCHING SYSTEMS (NATIONAL OR INTERNATIONAL)

A. POWER LIMITS OF SIGNALS OF A SIGNALLING SYSTEM

Recommendation Q.15

NOMINAL MEAN POWER DURING THE BUSY HOUR [1)]

To simplify calculations when designing carrier systems on cables or radio links, the CCITT has adopted a *conventional* value to represent the *mean absolute power level* (at a zero relative level point) of the speech plus signalling currents, etc., transmitted over a telephone channel in one direction of transmission during the busy hour.

The value adopted for this mean absolute *power* level corrected to a zero relative level point is – 15 dBm0 (mean power = 31.6 microwatts); this is the mean with time and the mean for a large batch of circuits.

The reference to "the busy hour" above is to indicate that the limit (of – 15 dBm0) applies when transmission systems and telephone exchanges are at their busiest so that the various factors concerning occupancy and activity of the various services and signals are to be those appropriate to such busy conditions.

It is not intended to suggest that an integrating period of one hour may be used in the specification of the signals emitted by individual devices connected to transmission systems. This could lead to insupportably high short-term power levels being permitted which give rise to interference for durations of significance to telephony and other services.

Note 1. – This conventional value was adopted by the CCIF in 1956 after a series of measurements and calculations had been carried out by various Administrations between 1953 and 1955. Annex 6 (Part 4 of Volume III of the *White Book*) reproduces the documentation assembled. The adopted value of about 32 microwatts is based on the following assumptions:

- mean power of 10 microwatts for signalling and tones;
- mean power of 22 microwatts for other currents, namely:
  - speech currents, including echoes, assuming a mean activity factor of 0.25 for one telephone channel in one direction of transmission;
  - carrier leaks [see Recommendations G.232, E., G.233, K., G.235, e), H.14, c), H.15, c) of Volume III];
  - telegraph signals, assuming that few telephone channels are used for VF telegraphy systems [output signal power 135 microwatts, Recommendation H.23A, b) of Volume III] or photo-telegraphy [amplitude modulated signal with a maximum signal power of about 1 milliwatt, Recommendation H.41B, c) of Volume III].

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1) This Recommendation is, basically, an extract of Recommendation G.223 in the Series G (*Line transmission*, Volume III).

On the other hand, the power of pilots in the load of modern carrier systems has been treated as negligible.

Hence, the maximum *energy* which may be transmitted by all the signals and tones [2] during the busy hour is:

36 000 microwattseconds for one direction of transmission;

72 000 microwattseconds for both directions of transmission.

Note 2. – The question of revising the assumptions leading to the conventional value of – 15 dBm0 arose in 1968 for the following reasons:

- changes in the r.m.s. power of speech signals, due to the use of more modern telephone sets, to a different transmission plan, and perhaps also to some change in subscriber habits;
- change in the mean activity factor of a telephone channel due, inter alia, to different operating methods;
- increase in the number of VF telegraphy bearer circuits and sound-programme circuits;
- introduction of circuits used for data transmission, and rapid increase in their number.

A limited study of measurements of speech signal power was carried out by various Administrations in 1966 and 1967; it produced the results shown in Supplement No. 5 of Volume III of the *White Book*. These results are too fragmentary to warrant a change in the conventional value of – 15 dBm0. The IVth Plenary Assembly of the CCITT (Mar del Plata, 1968) agreed to keep this value, since it was considered that the increase in the load of carrier systems due to the growth of uses other than telephony (for which the permissible levels are generally higher than – 15 dBm0) will probably be compensated by a reduction in the speech current power and that the margin with which carrier systems are calculated in practice will enable a slight increase in the mean power transmitted per channel to be tolerated without serious inconvenience.

However, this favourable situation may not last indefinitely or may not apply for all systems.

At this point in time there is not sufficiently firm information to justify an alteration to the value of the *conventional* load per channel of – 15 dBm0 (32 μW0) long-term mean, currently recommended.

Indeed the steps envisaged by Administrations to control and reduce the levels of non-speech signals indicate that the situation could be contained despite the increase in the non-speech services.

The economic aspects of changing (in particular increasing) the conventional load per channel would need to be thoroughly investigated before a change could be recommended.

Nevertheless there are sufficient indications that the study of all relevant factors must continue. Accordingly, Question 1/CMBD is under study in the period 1977-1980.

As regards the subdivision of the 32 μW into 10 μW signalling and tones and 22 μW speech and echo, carrier leaks, and telegraphy, again there is no evidence which would justify proposals to alter this subdivision.

As a general principle, it should always be the objective of Administrations to ensure that the *actual* load carried by transmission systems does not significantly differ from the *conventional* load assumed in the design of such systems.

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[2] See Supplement No. 1 in Volume VI, *Green Book*, for a calculation of the energy transmitted for the national tones and signals.

Recommendation Q.16

MAXIMUM PERMISSIBLE VALUE FOR THE ABSOLUTE POWER LEVEL OF A SIGNALLING PULSE [3]

The CCITT recommends that, for crosstalk reasons, the absolute power level of each component of a short duration signal should not exceed the values given in Table 1:

TABLE 1 - Maximum permissible value of power at a zero relative level point

Signalling frequency (Hz)	Maximum permissible power for a signal at a zero relative level point (microwatts)	Corresponding absolute power level. Decibels referred to 1 mW (dBm0)
800	750	1
1200	500	3
1600	400	4
2000	300	5
2400	250	6
2800	150	8
3200	150	8

If the signals are made up of two different frequency components, transmitted simultaneously, the maximum permissible values for the absolute power levels are 3 decibels below the above figures.

The values given in this table result from a compromise between the characteristics of various existing channel filters.

B. SIGNALLING IN THE SPEECH FREQUENCY BAND AND OUTSIDE THE SPEECH FREQUENCY BAND

Recommendation Q.20

COMPARATIVE ADVANTAGES OF "IN-BAND" AND "OUT-BAND" SYSTEMS

Signalling over telephone circuits may be effected *in* the frequency band used for speech ("in-band" signalling), or *outside* it ("out-band" signalling). In the latter case, the same channel carries both the signalling and speech frequency bands, the signalling band being separate from the speech band, and signalling equipment is an integral part of the carrier system.

In a further type of out-band signalling, a circuit, not used for speech, can be used to effect the signalling requirements of a number of speech circuits. This may be termed "separate channel signalling". The separate channel may be:

a) a channel in a carrier system used to effect the signalling requirements of the remaining channels in the same carrier system which are used for speech, signalling equipment being an integral part of the carrier system: this may be termed "built-in separate channel signalling";

b) completely separate, in which case signalling equipment is not an integral part of the carrier system; this may be termed "completely separate channel signalling".

[3] This Recommendation also appears as Recommendation G.224 in Series G (*Line transmission*, Volume III).

A. *Advantages of in-band signalling*

1. In-band signalling can be applied to any type of line plant. The application of out-band signalling, and built-in separate channel signalling, is limited to carrier systems.

2. Through-signalling can be employed at transit points, and at carrier system terminals when a telephone circuit comprises two or more carrier links. No direct current repetition and thus no delay and no distortion of signals arises at such points. Out-band signalling and built-in separate channel signalling require a direct current repetition at such points.

3. Replacement of a faulty line section is easy. In the case of completely separate channel signalling, replacement of a faulty line section is based on security arrangements.

4. It is impossible to set up a connection on a faulty speech path. In the case of completely separate channel signalling, a continuity check of the speech path is required.

5. The full bandwidth of the speech channel is available for signalling. This facilitates the use of more than one signalling frequency. Normally the full bandwidth permits faster signalling than with a smaller signalling bandwidth. With in-band signalling, realization of this advantage is limited to those signals not required to be protected against signal imitation due to speech currents.

B. *Advantages of out-band signalling*

1. Relative freedom from disturbances due to speech currents; freedom from disturbances due to echo-suppressors; freedom from disturbances which might arise from connections to other signalling systems. With in-band signalling it is necessary to take steps to guard against such disturbances.

2. Possibility of signalling, during the setting-up of the call, by either discontinuous or continuous transmission, and the possibility of transmitting those signals during speech. Signalling during speech is not compatible with in-band signalling.

3. Simplicity of terminal equipment due to 1 above and to the possibility of continuous signalling.

Out-band signalling (where the same channel carries both speech and signalling) also has advantage 3 of in-band signalling.

Built-in separate channel signalling has advantages 1, 2 and 3 of out-band, and advantage 3 of in-band signalling.

Completely separate channel signalling has advantages 1 and 2 of out-band signalling and, compared with out-band signalling and built-in separate channel signalling, has the additional advantages that no direct current repetition is necessary, and no distortion of signals arises, at carrier system terminals when a circuit comprises two or more carrier links.

Recommendation Q.21

SYSTEMS RECOMMENDED FOR OUT-BAND SIGNALLING

When Administrations wish to make mutual agreements to use out-band signalling systems, the CCITT considers it desirable, from the transmission viewpoint, for them to use one of the types of signalling systems (outside the speech band) defined in the following Annexes:

Annex 1: Normal carrier systems with 12 channels per group;

Annex 2: Carrier systems with 8 channels per group.

RECOMMENDED CHARACTERISTICS FOR OUT-BAND SIGNALLING SYSTEMS

ANNEX 1

(to Recommendation Q.21)

Out-band signalling systems for carrier systems with 12 channels per group

(The signal levels are quoted in terms of absolute power level at a zero relative level point in dBm0.)

Type I (discontinuous signals)

Frequency: virtual carrier (zero frequency).
Level: high,
for example −3 dBm0.

Type II

A. (discontinuous signals)

Frequency: 3825 Hz.
Level: high,
for example −5 dBm0.

B. (semi-continuous signals)

Frequency: 3825 Hz
Level: low,
for example −20 dBm0.

The *Type I* signalling system is compatible with only those group and supergroup reference pilots having a displacement from the virtual carrier frequency (zero frequency) of 140 Hz.

Types II-A and II-B are compatible with only those group and supergroup reference pilots having a displacement from the virtual carrier frequency (zero frequency) of 80 Hz.

ANNEX 2

(to Recommendation Q.21)

Out-band signalling systems for carrier systems with 8 channels per group

[The signal levels are quoted in terms of absolute power level (reference 1 mW) at a zero relative level point.]

Frequency: 4.3 kHz ± 10 Hz.
Level:
– discontinuous signals: −6 dBm0;
– semi-continuous signals: value between −20 dBm0 and −17.4 dBm0.

Recommendation Q.22

FREQUENCIES TO BE USED FOR IN-BAND SIGNALLING

To reduce the risk of signal imitation by speech currents, the frequencies for an in-band signalling system should be chosen from the frequencies in the band in which speech signal power is lowest, i.e. frequencies above 1500 Hz.

The desirability of this was confirmed by tests carried out in London, Paris and Zürich in 1946 and 1948 to choose the signalling frequencies of systems standardized by the CCITT. These tests led to the conclusion that, if relative freedom from false signals was to be obtained other than by undue increase in signal duration, frequencies of at least 2000 Hz would have to be used.

C. SIGNALLING FREQUENCIES FOR PUSH-BUTTON TELEPHONE SETS

Recommendation Q.23

TECHNICAL FEATURES OF PUSH-BUTTON TELEPHONE SETS

1. The introduction of push-buttons on telephone sets may have an effect on the operation of international circuits:

a) owing to the greater dialling speed, the post-dialling may be longer, since national and international networks will only be gradually adapted to allow for this greater speed;

b) when pressing the buttons after an international call has been set up, the signalling frequencies for push-button sets may cause interference to foreign signalling systems on the connection. However, the subscriber can be warned of the possible disadvantages of touching the buttons in conditions different from those prescribed.

2. There can be no doubt that, owing to the high dialling speed which can be obtained with push-button sets, their use is bound to spread widely and rapidly and it is desirable for the signalling methods for such sets to be internationally standardized.

One factor in favour of such standardization is the advantage it offers for countries which have to import their equipments from various other countries. This argument, admittedly, applies to any type of telephone equipment.

Other advantages of standardization are:

- the possibility of using the push-button of such sets for signalling directly from one subscriber to another subscriber via a national and/or international connection;
- the standardized allocation of signalling frequencies for push-button sets facilitates the choice of signalling frequencies in the frequency band of a telephone circuit for any other use (data transmission, telephone signalling system, etc.) for which provision might have to be made. The risk of mutual interference among the signalling systems (see Recommendation Q.25) makes it necessary to have an orderly arrangement of the spectrum of frequencies used for signalling.

3. The general use of push-button sets for purposes other than telephone dialling is envisaged by some Administrations. However, some Administrations observe that it would seem advisable to reserve such uses for a network of relatively limited extent; in their view the reliability of standards for data transmission should not make any demands on the push-button set system other than those required for the transmission of telephone numerical information to the local exchange, if the design of push-button sets is to remain within economical limits compatible with their widespread use.

However, the CCITT considered, at Mar del Plata in 1968 that, even if the transmission of data from a push-button telephone set is at present to be envisaged in international traffic on a limited scale only, it would nonetheless be wise not to rule out the possibility of such transmission of data on a general scale.

4. In choosing a signalling system for push-button sets, Administrations may be guided by conditions which vary considerably from one country to another. Economic considerations may, for instance, lead them to prefer a direct current system which might be less expensive than a voice-frequency system. The numerical dialling information would then be transmitted only as far as the telephone exchange to which the subscriber is connected. There are no tones that could affect the connection after its establishment. Data would not be transmitted from the push-button sets unless a suitable converter were used in the exchange.

Standardization of a direct current system for signalling from push-button sets does not seem justified at the international level; it may depend on the conditions peculiar to the local networks of the country concerned.

5. The signalling system for push-button sets recommended by the CCITT applies solely to voice-frequency signals.

A multifrequency code for such signalling is recommended in which the dialling signal is composed of two frequencies emitted simultaneously when a button is pressed. It is planned to have 10 decimal digits and 6 reserve signals, making 16 signals in all. The two frequencies composing each signal are taken from two mutually exclusive frequency groups of four frequencies each, a code known as the "2 (1/4) code".

6. The low group frequencies of this 2 (1/4) code are:

697, 770, 852, 941 Hz.

The high group frequencies are:

1209, 1336, 1477 and 1633 Hz.

The allocation of frequencies to the various digits and symbols of a push-button set appears in Figure 1/Q.23.

7. The frequency variation tolerances and the permissible intermodulation products are defined as follows:

7.1 each transmitted frequency must be within ± 1.8% of the nominal frequency;

7.2 the total distortion products (resulting from harmonics or intermodulation) must be at least 20 dB below the fundamental frequencies.

8. The CCITT determined, at Mar del Plata in 1968, that it was not practicable to specify a standardization of the levels for the frequencies transmitted when a push-button is pressed, as these level conditions depend essentially on national transmission plans which are not the same in all countries.

However, the sending level conditions must be such that on an international connection they do not exceed the values specified in Recommendation Q.16 (maximum permissible value for the absolute power level of a signalling pulse).

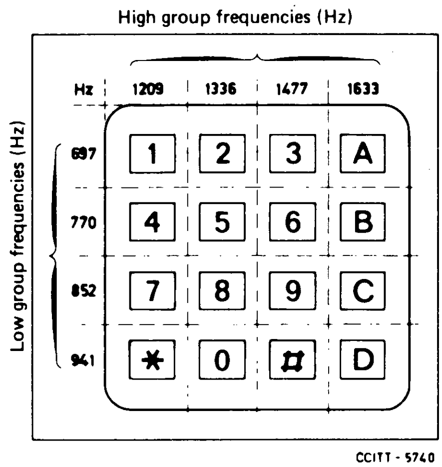

FIGURE 1/Q.23 – **Allocation of frequencies to the various digits and symbols of a push-button set**

D. PROTECTION OF "IN-BAND" SIGNALLING SYSTEMS AGAINST EACH OTHER

Recommendation Q.25

SPLITTING ARRANGEMENTS AND SIGNAL RECOGNITION TIMES IN "IN-BAND" SIGNALLING SYSTEMS

1. *General*

In each "in-band" signalling system precautions should be taken so that, when the signalling in that system is taking place:

1.1 no interference in the voice-frequency range from outside the system can pass into the system (i.e. into the transmission path between the sending end and the receiving end of the voice-frequency signals), and

1.2 as far as possible, no signalling current used in the system can pass into other systems, connected in tandem.

2. *Sending-end splitting arrangements*

2.1 In order to satisfy condition 1.1 above, care should be taken that the correct operation of the signal receiver at the other end of the circuit is not disturbed by:

- surges (transient currents) caused by the opening or closing of direct current circuits connected to the speech wires of the switching equipment, whether these surges precede or follow the sending of a signal;
- noise, speech currents, etc., coming from tandem switched circuits, preceding or during the sending of a signal.

2.2 For this reason the following arrangements have been made in the CCITT Systems No. 3, No. 4, No. 5 and No. 5 *bis* for the transmission of voice-frequency signals on the international circuit:

i) The exchange side of the circuit shall be disconnected 30 to 50 ms before a voice-frequency signal is sent over the circuit.

ii) The exchange side of the circuit will not be reconnected for 30 to 50 ms following the end of the sending of a voice-frequency signal over the circuit.

2.3 Arrangements of the same type are required on System R1 and on national in-band systems [see 3.4.1 b) below].

3. *Receiving-end splitting arrangements*

3.1 *General*

3.1.1 In order to satisfy condition 1.2 above, the length of the part of a signal which passes into another system is limited by splitting the speech wires beyond the signal receiver when a signal is received and detected by this receiver.

The time during which the first part (sometimes called *spill-over*) of a received signal passes into another system, until the splitting becomes effective, is called "splitting time".

Too long a splitting time may result in interference to signalling on a tandem system depending on the signal recognition time on the tandem system.

Too short a splitting time may result in an increase in the number of false operations of the splitting device by speech currents (*signal imitation*) and so impair speech transmission.

The splitting time must therefore be a compromise between the above two factors.

The splitting device also serves to limit the duration of signals on one path of the 4-wire circuit from returning over the other path by reflections at the termination; these reflections may give rise to faulty operation of signalling equipment on the other path.

3.1.2 The protection against mutual interference between in-band signalling systems in international service involves limitations of the length of any part of:

3.1.2.1 the *international* signal that may be able to pass:

a) from the international signalling system into a national signalling system (protection of the national system);

b) from one international signalling system into another international signalling system, when they are switched in tandem (protection of the international systems);

c) from one international circuit into another international circuit of the same system when they are switched in tandem in the case of link-by-link signalling.

3.1.2.2 the *national* signal that may be able to pass:

a) from the national signalling system into an international signalling system (protection of the international system);

b) from one national signalling system into the national signalling system of another country via an international connection (protection of the national system).

3.2 *Protection of national and international systems against international systems*

Conditions 3.1.2.1 above are met because international signalling systems have a splitting device on each circuit. The splitting times of such systems are:

55 milliseconds for the compound signal element in System No. 4;
35 milliseconds for a signal in Systems No. 5 and No. 5 *bis*;
20 milliseconds for a signal in System R1.

3.3 *Protection of the international system against national systems*

Condition 3.1.2.2 *a)* above is generally covered because:

– the values given in the specifications of the CCITT standard systems as the minimum recognition time of a line signal are in general greater than the splitting times of national systems (see the tables giving the basic characteristics of national signalling systems in Supplement No. 3 to this Volume);

– the signalling frequencies used in the international systems are, in the majority of countries, different from those used in national systems.

It may be necessary, if the splitting time of a national signalling system is greater than the minimum signal recognition time of an international system and the signalling frequencies used in the national system and international system are the same or nearly the same, to insert a device at the international exchange which will prevent a part of the national signal from passing into the international circuit for longer than this recognition time.

3.4 *Interference between national signalling systems when they are interconnected via an international circuit*

3.4.1 To ensure protection of national signalling systems one against the other [protection defined under 3.1.2.2 *b)* above], it has been recommended by the CCITT since 1954 that new national in-band signalling systems should comply with the following two clauses:

a) not more than 35 milliseconds of a national signal should be able to pass into another country;

b) the connection between an international circuit and a national circuit should be split on the national circuit at the international exchange 30 to 50 milliseconds before that exchange sends any signal over the national signalling system.

Note. – The object of these two clauses is to avoid interference, especially in conditions that may exist on international automatic connections.

3.4.2 Clause 3.4.1 *a)* permits the signalling system used in country A to have a minimum signal recognition time based on this value of 35 milliseconds. It will then be possible to ensure, without taking any other precautions at the incoming end of an international circuit, that no fraction of a signal coming from country B, and being of the same, or nearly the same, frequency as that used in country A, will be wrongly recognized as a signal in country A.

One method of meeting clause 3.4.1 *a)* is to adopt a splitting time of less than 35 milliseconds for the national systems.

Another method exists which does not involve such a limitation in the splitting times of national systems, and which might be preferred when the design of the national signalling system is such that a short splitting time is not normally justified for that system alone. This second method involves the introduction, in the international exchange, of an arrangement for limiting the length of national signals which are liable to pass into the international circuit. Such an arrangement would be used only on circuits to those countries where there is a danger that interference might arise.

3.4.3 Clause 3.4.1 *b)* avoids the false operation of the guard circuit of a signal receiver situated at the distant end of a national circuit.

E. MISCELLANEOUS PROVISIONS

Recommendation Q.26

DIRECT ACCESS TO THE INTERNATIONAL NETWORK FROM THE NATIONAL NETWORK

The choice of the method of access to an outgoing international exchange from the national network is a purely national matter. Nevertheless, if an international connection is set up by automatic switching from an exchange other than the international exchange which is the outgoing point of the international circuit used, arrangements should be made in the national network to transmit over the international circuit at least the signals required to ensure the satisfactory setting-up, control and clearing-down of the international connection.

In addition, where a group of national circuits used in the above manner carries both semi-automatic and automatic traffic, means should be provided for distinguishing between these two classes of traffic for the purposes of international accounting (see Recommendation E.260).

Recommendation Q.27

TRANSMISSION OF THE ANSWER SIGNAL

It is essential for the answer signal to be transmitted with a minimum of interference to the transmission of speech currents, because the called subscriber may already be announcing his presence at this stage of the call.

On a connection which has been set up, the answer signal generally entails, at a certain number of points:

a) repetitions and conversions, which delay transmission; and

b) splitting of the speech path, where in-band signalling is used.

It is therefore desirable to minimize the delays and the duration of the interruption of the speech path. Minimization of the latter can be achieved by:

– short send line splitting;

– short duration of the signal; and

– fast termination of the sending and receiving splits on cessation of the signal.

Recommendation Q.28

DETERMINATION OF THE MOMENT OF THE CALLED SUBSCRIBER'S ANSWER IN THE AUTOMATIC SERVICE

1. Arrangements should be made in the national signalling system of the incoming country to determine (in the outgoing international exchange) the moment when the called subscriber replies; this information is necessary in the international service for the purposes of:

– charging the calling subscriber (see Recommendation E.202);

– measuring the call duration (see Recommendation E.260).

2. Where subscribers in an outgoing country have direct access to an operator's position (in a manual exchange, for instance) in an incoming country, arrangements should be made in the national network of the incoming country to ensure that – in the outgoing country – the calling subscriber is charged, and the call duration measured, only from the moment when the called subscriber replies [4]. These provisions are set out in detail for CCITT standardized systems (see Recommendation Q.102).

Recommendation Q.29

CAUSES OF NOISE AND WAYS OF REDUCING NOISE IN TELEPHONE EXCHANGES

Circuit noise may be classified as follows:

1) power supply noise,

2) noise generated in the speech path circuit,

3) noise induced in the speech path circuit.

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[4] This means that an answer signal is not sent when the operator in the incoming country replies.

1. *Power supply noise*

1.1 *Power sources*

The interference resulting from the harmonics, ripple and current fluctuation of machines, rectifiers and batteries.

This noise may be reduced by d.c. generators with low harmonics and good regulation and rectifiers with good regulation, effective filters, and batteries with large capacity (i.e. with low internal impedance).

1.2 *Supply leads*

The interference in the speech circuits of an exchange due to power supply equipment originates mainly in the common impedances of the supply paths of speech and switching circuits, and is caused mainly by the sudden fluctuation of the current resulting from the sudden operation and release of the different relays, magnets and contacts.

These common impedances may be reduced by:

1.2.1 the use of common power supply leads of sufficiently low resistance, the use of large capacitors fitted at apparatus ends of supply leads with minimum impedances, e.g. minimum distance between bus bars, or coaxial feeders. Another method employs close-spaced cables with alternate polarity;

1.2.2 the use of a common battery with separate power supply leads for speech and switching circuits. Better results may be obtained at an increased cost by independent batteries adequately separated;

1.2.3 the arrangement of the cells of the battery in a U formation.

1.3 *Earth returns*

Independent earth returns should be used for signalling-frequency supply circuits.

2. *Noise generated in the speech circuit*

2.1 *Contact noise caused by vibration*

This kind of noise is caused by contact resistance variations of the various commutator, switch and relay contacts due to mechanical vibration.

This contact noise may be reduced by:

2.1.1 the use of damping devices to reduce the generation of vibration caused in particular by relay sets, mechanical and electromagnetic clutches;

2.1.2 the use of multiple brushes, spring or resilient mountings to reduce the transmission of vibration;

2.1.3 a suitable choice of contact materials;

2.1.4 the use of the best contact shape and of twin contacts;

2.1.5 maintaining atmospheric conditions at an appropriate relative humidity and the use of air filters; use of dust covers on equipment, arranging design of columns, window sills, radiators and floor to avoid harbouring dust;

2.1.6 careful maintenance cleaning and lubrication in accordance with specifications.

2.2 *Frying noise*

In speech circuits some contact materials are liable to cause frying noise.

This noise may be reduced by the use of suitable contact materials and by keeping an appropriate relative humidity.

2.3 *Contact noise caused by wetting currents*

Speech circuits without d.c. currents are liable to fading due to contact resistance fluctuations. Fading may be reduced by wetting. However, wetting currents may introduce frying noise on the lines.

2.4 *Charge and discharge clicks*

Clicks may frequently be caused by the charging or discharging of capacities (cable capacity) by switches when rotating over occupied and non-occupied terminals.

Objectionable clicks are also likely to result from sudden battery reversals, dialling and other abrupt changes in the current flowing in the speech circuits.

These effects may be reduced:

2.4.1 by disconnecting the speech circuits from the brushes during the hunting period of the switch;

2.4.2 by the use of twisted pairs, by limiting the length of cabling and also by locating relays as close as possible to the selectors they control.

2.5 *Unsound contacts*

Objectionable noise may be due to unsound contacts on distribution frames, particularly when work is in progress such as adding or changing jumpers, etc. Such unsound contacts may be due to "dry" contacts inadequately soldered, poorly wrapped joints, or to the use of distribution frame equipment having inadequate contact pressure. It is suspected that this type of trouble is responsible for most of the "hits" and "misses" and usually for an increase in noise.

2.6 *Tapping losses*

When lines are tapped for service interception, observation, etc., the tapping circuit should be designed to give the minimum of unbalance to earth and the transmission loss introduced should be a minimum. Semi-permanent connections should be used in preference to base-metal sliding connections at the tapping point.

2.7 *Reduction of the number of switching contacts*

Circuits should be designed so that at each switching stage there is a minimum number of contacts in the speech circuit in order to reduce the risk of microphonic noise from "dry" contacts.

3. *Noise induced in the speech circuit*

3.1 *Noise induced in the speech circuit may be due to*:

3.1.1 speech crosstalk;

3.1.2 signalling frequency crosstalk;

3.1.3 induction from tone supplies;

3.1.4 direct current pulses;

3.1.5 clicks caused by abrupt changes in inductive and capacitive circuits.

Clicks may be reduced at the source by the use of spark quench devices or other means to reduce the steepness of the interfering wave-front concerned. In addition, noise may be reduced by balancing, by using twisted pairs and/or by screening.

3.2 *Noises due to unbalanced transmission bridge circuits*

A well-balanced circuit is necessary for the transmission bridge to avoid noise interference. This can be achieved by:

3.2.1 the use of balanced components;

3.2.2 the separation of components used for speech from those used for control and switching;

3.2.3 the separation of individual transmission bridges by screening or spacing;

3.2.4 the addition of balancing components, e.g. balancing transformers of retardation coils;

3.2.5 taking the precautions listed at the end of 3.1 above.

3.3 *Low-level speech circuits*

Low-level electronic speech circuits are particularly susceptible to noise induction and should therefore be screened.

3.4 *Longitudinal interference*

Such noise may be induced into the speech circuit from the line by power distribution systems and traction circuits or by earth potential differences.

These may be reduced by balancing the line or by the addition of transformers.

Note. – Interference which is sufficiently severe to cause unwanted operation of relays, etc., may be overcome by the use of loop circuits which should also reduce noise.

Recommendation Q.30

IMPROVING THE RELIABILITY OF CONTACTS IN SPEECH CIRCUITS

The following methods can be used for improving the reliability of contacts in speech circuits:

a) use of precious metals such as platinum, palladium, gold, silver, or alloys of these metals. If, for one reason or another, it is not desired to "wet" the contacts, or if enough contact pressure cannot be provided, it is preferable to use the metals or alloys mentioned above, with the exception of pure silver;

b) use of high contact pressure;

c) double contacts;

d) lubrication (with suitable oils) of certain non-precious metal contacts in the case of sliding contacts;

e) direct current "wetting" of contacts, care being taken to avoid the introduction of noise due to transients when the contacts are made or broken;

f) air filtration or other protective measures to avoid dust;

g) the maintenance of suitable humidity;

h) the use of protective covers;

i) protection against fumes, vapours and gases;

j) avoidance of the use, near contacts, of materials likely to be detrimentral to the contacts.

When voice-frequency signals are sent over a transmission path, as it is not possible to use direct current wetting for the voice-frequency signal transmitting contacts due to the surges which occur on closing and opening the contact, it is preferable to use static modulators with rectifier elements.

Recommendation Q.31

NOISE IN A NATIONAL 4-WIRE AUTOMATIC EXCHANGE

It is desirable that the requirements concerning noise conditions for a national 4-wire automatic exchange be the same as for an international exchange (see Recommendation Q.45, 5.).

Recommendation Q.32

REDUCTION OF THE RISK OF INSTABILITY BY SWITCHING MEANS

Arrangements should be made in the incoming country to reduce the risk of instability:

- during the period between the moment when the speech path is established and the moment when the called suscriber answers; and

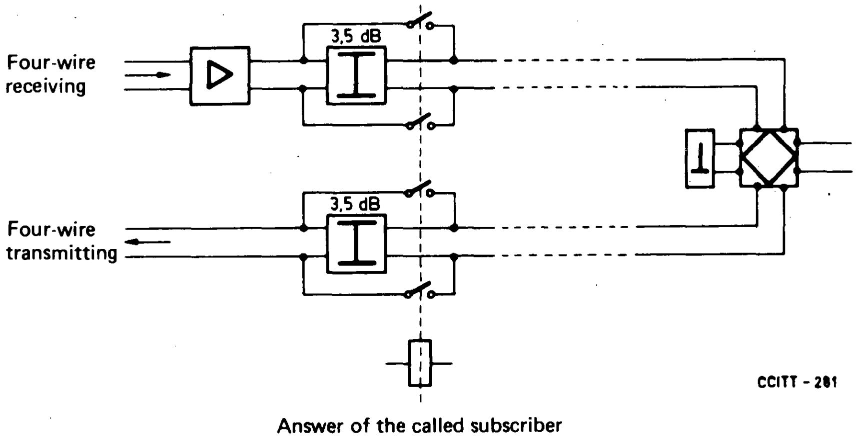
- also the period between the moment when the called subscriber clears and the moment when the circuits are released.

This can be achieved in principle by any of the methods *a), b)* or *c)* shown in Figures 1/Q.32, 2/Q.32, 3/Q.32.

It is recommended that, whatever method is used, the measures are taken in the incoming (in the traffic sense) country. Taking into account experience already acquired and also the stability calculations referred to in Recommendation G.131, Volume III, it is considered sufficient to arrange for the stability [5)] of the 4-wire chain of circuits (made up of international circuits and national extension circuits, interconnected on a 4-wire basis) to be augmented by 3.5 dB.

This recommendation applies to all signalling and switching (national or international) systems which could be used on international connections.

[5)] It should be noted that Recommendation Q.32 always refers to *stability* (Definition 05.46 of the *List of definitions of essential telecommunication terms* published by the I.T.U., Part I) and never to singing margin (Definition 05.48) which is approximately double the stability. The methods described in Figures 1, 2 and 3/Q.32 are examples of possible means of increasing the stability of the 4-wire chain of circuits by 3.5 dB.



Note. – In principle, the attenuators may be inserted in any of the exchanges, e.g. the incoming international centre.

FIGURE 1/Q.32 – *Method a)* **Inserting an attenuator in each channel of the 4-wire chain of the connection**

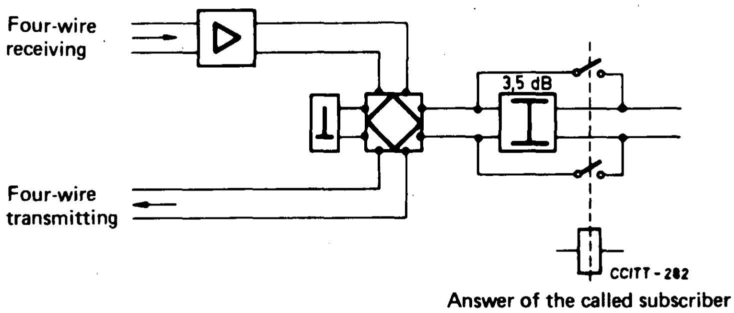


FIGURE 2/Q.32 – *Method b)* **Inserting an attenuator in the 2-wire extension of the connection**

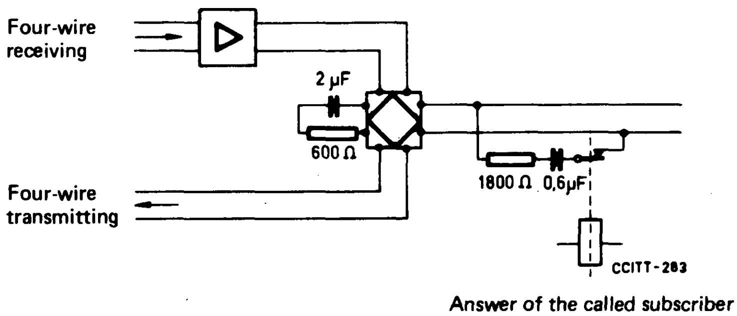


FIGURE 3/Q.32 – *Method c)* **Bridging a terminating impedance across the 2-wire extension of the connection**

FIGURES 1/Q.32, 2/Q.32 and 3/Q.32 – **Possible methods for reducing the risk of instability**

Recommendation Q.33

PROTECTION AGAINST THE EFFECTS OF FAULTY TRANSMISSION ON GROUPS OF CIRCUITS

Although certain signalling systems may have the capability to provide an indication when an individual circuit is faulty, in order to maintain the required availability of the public network, it is considered necessary to provide alarm facilities to alert maintenance staff when a group of circuits provided by multiplex transmission system is faulty.

It is considered desirable if the faulty circuits could be removed from service automatically and restored to service automatically when the fault condition no longer exists.

Failure of an FDM system can possibly be indicated by means of pilot supervision.

Failure of a PCM system is indicated at both ends by the loss of frame alignment (or multiframe alignment as appropriate); see Recommendations G.732 and G.733.

These failure indicators provide the means whereby the circuits affected can be removed from service and restored automatically by the switching control of an international exchange.

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SECTION 5

TONES FOR NATIONAL SIGNALLING SYSTEMS

Recommendation Q.35

CHARACTERISTICS OF THE RINGING TONE, THE BUSY TONE, THE CONGESTION TONE, THE SPECIAL INFORMATION TONE AND THE WARNING TONE

(See the text of Recommendation E.180 in Volume II.2)

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SECTION 6

GENERAL CHARACTERISTICS FOR INTERNATIONAL TELEPHONE CONNECTIONS AND INTERNATIONAL TELEPHONE CIRCUITS

1.0 General

Recommendation Q.40

THE TRANSMISSION PLAN [1)]

A. *Principles*

The transmission plan of the CCITT established in 1964 (Geneva) was drawn up with the object of making use, in the international service, of the advantages offered by 4-wire switching.

. . . .

However, the recommendations in the plan are to be considered as met if the use of technical means other than those described below gives an equivalent performance at the international exchange.

Recommendation G.122 of Volume III, describes the conditions to be fulfilled by a national network for this transmission plan to be put into effect.

Note 1. – From the point of view of the transmission plan, no distinction is made between intercontinental circuits and other international circuits.

Note 2. – Short trans-frontier circuits are not covered by this plan and should be the subject of agreement between the Administrations concerned.

. . . .

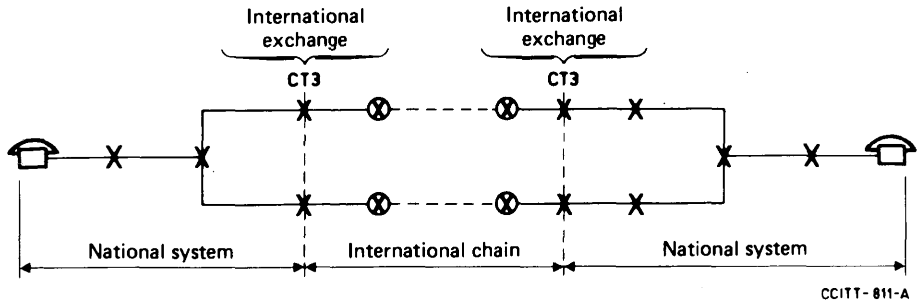
B. *Definition of the constituent parts of a connection*

a) *The international chain and the national systems*

A complete international telephone connection consists of three parts, as shown in Figure 1/Q.40.

- *An international chain* made up of one or more 4-wire international circuits. These are interconnected on a 4-wire basis in the international transit centres and are also connected on a 4-wire basis to national systems in the international centres.
- *Two national systems*, one at each end. These may comprise one or more 4-wire national trunk circuits with 4-wire interconnection, as well as circuits with 2-wire connection up to terminal exchanges and to the subscribers.

[1)] This Recommendation is an extract of Recommendation G.101 in the Series G (*Line transmission*, Volume III). The suspensive points show where a passage in Recommendation G.101 has not been reproduced under Q.40.



X Switching exchange

⊗ International transit centre (CT1 and CT2)

FIGURE 1/Q.40 – **Definition of the constituent parts of an international connection**

A 4-wire circuit is defined by its *virtual switching points* in an international transit exchange or an international exchange. These are theoretical points with specified relative levels (see Figure 2/Q.40; for further details see Recommendation G.141, Volume III).

The difference between the sending and receiving nominal relative levels at the reference frequency is, by definition, *the nominal transmission loss* of the 4-wire circuit *between virtual switching points.*

In an international exchange, the division between the international chain and the national system is determined by the virtual switching points of the international circuit.

The virtual switching points may not be the same as the points at which the circuit terminates physically in the switching equipment. These latter points are known as the *circuit terminals*; the exact position of these terminals is decided in each case by the Administration concerned.

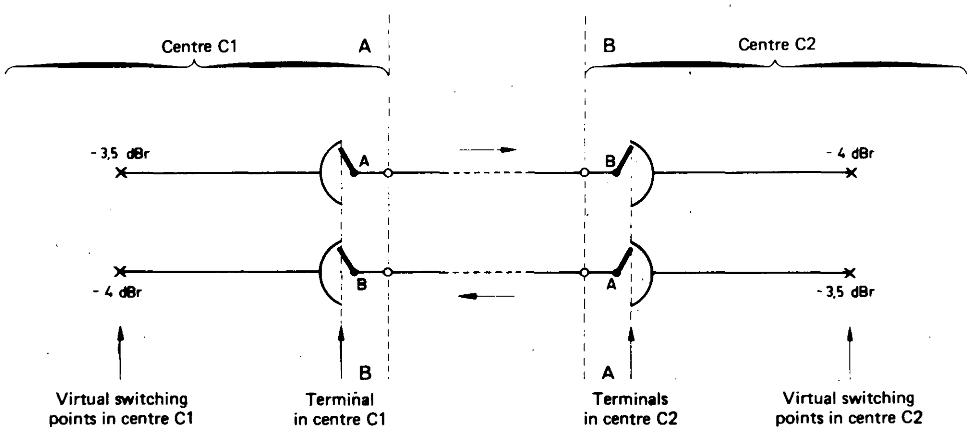


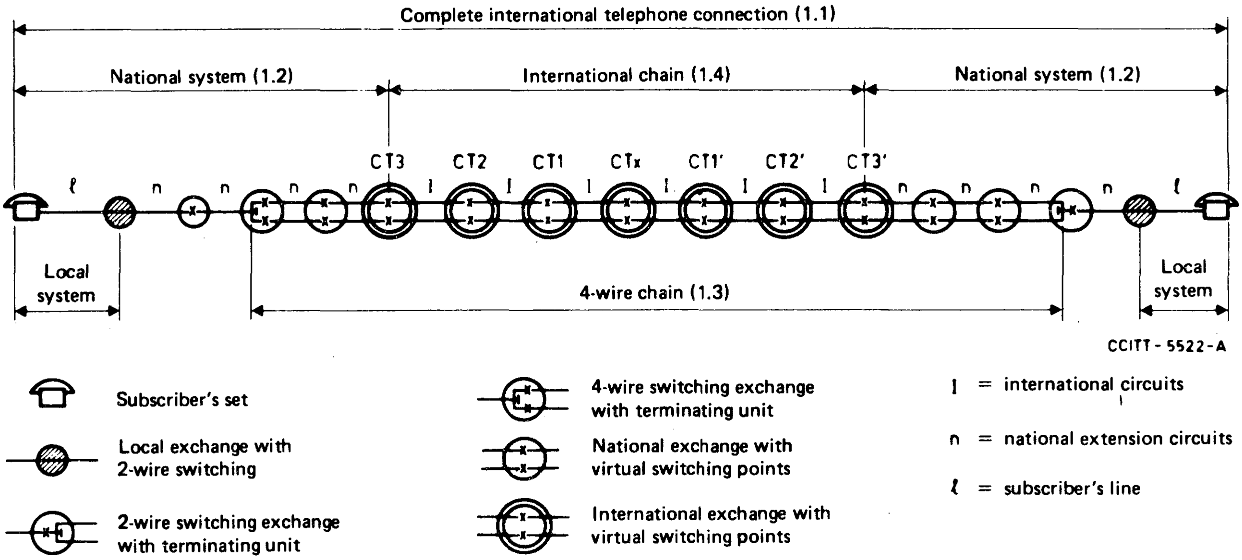
FIGURE 2/Q.40 – **Definitions for an international circuit**

b) *National extension circuits: 4-wire chain*

When the maximum distance between an international exchange and a subscriber who can be reached from it does not exceed about 1000 km or, exceptionally, 1500 km, the country concerned is considered as of average size. In such countries, in most cases, not more than three national circuits are interconnected on a 4-wire basis between each other and to international circuits. These circuits should comply with Recommendation G.141, Volume III.

In a large country, a fourth and possibly a fifth national circuit may be included in the 4-wire chain, provided it has the nominal transmission loss and the characteristics recommended for international circuits used in a 4-wire chain (see Recommendation Q.43 and Recommendation G.151, Volume III).

Note. – The abbreviation "a 4-wire chain" (see Figure 3/Q.40) signifies the chain composed of the international chain and the national extension circuits connected to it, either by 4-wire switching or by some equivalent procedure (as understood in A. above).



Note. – The arrangements shown for the national systems are examples only. The numbers given in brackets refer to the subsection of Section 1 (of Volume III, Part 1) in which Recommendations may be found relevant to that part of the connection. In addition, the circuits making up this chain must individually meet the requirements of subsection 1.5.

FIGURE 3/Q.40 – **An international connection to illustrate the nomenclature adopted**

C. *Maximum number of circuits*

a) *National circuits*

It seems reasonable to assume that in most countries any *local exchange* can be connected to the international network by means of a chain of 4 (or less) national circuits. Five national circuits may be needed in some countries, but it is unlikely that any country may need to use more than 5 circuits. Hence the CCITT has reached the conclusion that 4 circuits is a representative figure to assume for the great majority of international connections.

In most modern national networks, the four circuits will probably include three 4-wire amplified circuits (usually set up on carrier systems) and one 2-wire circuit, probably unamplified. In some instances, however, local exchanges will be reached by 4 circuits, all of which may be 4-wire circuits.

The representative maximum international connection considered by the CCITT for the study of transmission performance (see Figure 3/Q.40 and Figure 1/G.103) thus includes 8 national circuits, besides the international ones. The cumulative distortion of these 8 circuits is likely to be large, and close to the maximum allowable value. Consequently, the international circuits must not introduce any further appreciable deterioration. This principle has been borne in mind during the drafting of the Recommendations dealing with such circuits.

b) *International circuits*

Implementation of the routing plan for automatic and semi-automatic international telephone traffic (Recommendation Q.13) presupposes that the transmission plan is applied. In the routing plan, the CCITT has defined three classes of international centres, CT1, CT2 and CT3, and has arranged to restrict *the number of international circuits to five* or, exceptionally, to six or seven. The CT3s connect international and national circuits; the CT2s and CT1s interconnect international circuits. In some connections, an international centre designated CTX, as well as the CT1s, may be encountered as shown in Figure 3/Q.40. Certain exceptional routings, moreover, involve a seventh international circuit.

c) *Hypothetical reference connections*

(See Recommendation G.103, Volume III.)

1.1 General characteristics of a complete international telephone connection

Recommendation Q.41

MEAN ONE-WAY PROPAGATION TIME [2]

A. *Limits for a connection*

It is necessary in an international telephone connection to limit the propagation time between two subscribers. As the propagation time is increased, subscriber difficulties increase, and the rate of increase of difficulty rises, see *b)* below. Relevant evidence is given in the bibliography of Recommendation G.114, Volume III.

The CCITT therefore *recommends* the following limitations on mean one-way propagation times [3] when echo sources exist and appropriate echo suppressors are used:

a) 0 to 150 ms, acceptable.

Note. – Old-type echo suppressors may be used; they should be modified for delays above 50 ms.

b) 150 to 400 ms, acceptable, provided that increasing care is exercised on connections as the mean one-way propagation time exceeds about 300 ms, and provided that echo suppressors designed for long delay circuits are used.

c) above 400 ms, unacceptable. Connections with these delays should not be used except under the most exceptional circumstances.

. . . .

[2] This Recommendation is an extract of Recommendation G.114 in the Series G (*Line transmission*, Volume III). The suspensive points show where a passage in Recommendation G.114 has not been reproduced under Q.41.

[3] Means of the times in the two directions of transmission.

B. *Values for circuits*

In the establishment of the general interconnection plan within these limits the one-way propagation time of both the national extension circuits and the international circuits must be taken into account.

a) *National extension circuits*

. . . .

b) *International circuits*

International circuits will use a high-velocity transmission system; the one-way propagation times, or velocity, that should be assumed for planning purposes are:

1. *Terrestrial lines* (land lines and submarine cables)

160 km/ms.

This propagation velocity includes an allowance for terminal and intermediate multiplex equipment likely to be associated with a transmission line.

2. *Satellite links*

The mean one-way propagation times between earth stations for two illustrative single-hop communication satellite systems are:

Satellite at 14 000 km altitude: 110 ms;

Satellite at 36 000 km altitude: 260 ms.

The one-way propagation times do not include any allowance for the distance from the earth stations to locations where the satellite circuits can either be extended on other international transmission systems or switched to other national or international circuits. These additional times should be taken into account for planning purposes. The practical distances between earth stations depend not only on the altitude of the satellites but also on the orbits and positions of the satellites relative to the earth stations. Exact account should be taken of these parameters in particular applications.

The magnitude of the mean one-way propagation time for circuits on high altitude communication satellite systems makes it desirable to impose some routing restrictions of their use. Details of these restrictions are given in Recommendation Q.13, 4 of Volume VI, *Green Book.*

Note. – The propagation time referred to above is the group delay as defined in the ITU *List of Definitions of Essential Telecommunication Terms* (Definition No. 04.17); the numerical values are calculated at a frequency of about 800 Hz.

1.2 General characteristics of national systems forming part of international connections

(See Recommendations G.121 to G.125, Volume III, *Orange Book.*)

1.3 General characteristics of the "4-wire chain" formed by the international telephone circuits and national extension circuits

(Overall characteristics for the 4-wire chain are defined in Recommendation Q.40, B.)

Recommendation Q.42

STABILITY AND ECHO (ECHO SUPPRESSORS)[4]

(See Recommendation G.131 in Volume III)

1.4 General characteristics of the 4-wire chain of international circuits; international transit

Recommendation Q.43

TRANSMISSION LOSSES, RELATIVE LEVELS[5]

1. *Relative levels specified at the virtual switching points of international circuits*

The virtual switching points of an international 4-wire telephone circuit are fixed by convention at points of the circuit where the nominal relative levels at the reference frequency are:

- sending: −3.5 dBr;
- receiving: −4.0 dBr.

The nominal transmission loss of this circuit at the reference frequency between virtual switching points is therefore 0.5 dB.

Note 1. – See the definitions in 2. below. The position of the virtual switching points is shown in Figure 2/Q.40 and in Figure 1/G.122.

Note 2. – Since the 4-wire terminating set forms part of national systems and since its actual attenuation may depend on the national transmission plan adopted by each Administration, it is no longer possible to define the relative levels on international 4-wire circuits by reference to the 2-wire terminals of a terminating set. In particular, the transmission loss in terminal service of the chain created by connecting a pair of terminating sets to a 4-wire international circuit cannot be fixed at a single value by CCITT Recommendations. The virtual switching points of circuits might therefore have been chosen at points of arbitrary relative level. However, the values adopted above are such that in general they permit the passage from the old plan to the new to be made with the minimum amount of difficulties.

Note 3. – If a 4-wire circuit forming part of the 4-wire chain contributes negligible delay and variation of transmission loss with time, it may be operated at zero nominal transmission loss between virtual switching points. This relaxation refers particularly to short 4-wire tie-circuits between switching centres – for example, circuits between a CT3 and a CT2 in the same city.

2. *Definitions*

2.1 **transmission reference point**

A hypothetical point used as the zero relative level point in the computation of nominal relative levels. Such a point exists at the sending end of each channel of a 4-wire switched circuit preceding the virtual switching point; on an international circuit it is defined as having a level +3.5 dB above that of the virtual switching point.

With the CCITT transmission plan this point does not necessarily coincide with the 2-wire termination point as was the case with the old plan. The level of transmitted load at this point is the subject of Recommendation Q.15.

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[4] See also Recommendation Q.115.

[5] This Recommendation is an extract of Recommendation G.141 in the Series G (*Line transmission*, Volume III).

2.2 **relative (power) level**

The expression in transmission units of the ratio P/P_0, where P represents power at the point concerned and P_0 the power at the transmission reference point.

2.3 **circuit test-access point**

The CCITT has defined circuit test-access points as being "4-wire test-access points so located that as much as possible of the international circuit is included between corresponding pairs of these access points at the two centres concerned". These points, and their relative level (with reference to the transmission reference point), are determined in each case by the Administration concerned. They are used in practice as points of known level to which other transmission measurements will be related. In other words, for measurement and lining-up purposes, the level at the appropriate circuit test-access point is the level with respect to which other levels are adjusted.

2.4 **measurement frequency**

For all international circuits 800 Hz is the recommended frequency for single-frequency maintenance measurements. However, by agreement between the Administrations concerned, 1000 Hz may be used for such measurements.

A frequency of 1000 Hz is in fact now widely used for single-frequency measurements on some international circuits.

Multifrequency measurements made to determine the loss/frequency characteristic will include a measurement at 800 Hz and the frequency of the reference measurement signal for such characteristics can still be 800 Hz.

3. *Interconnection of international circuits in a transit centre*

In a transit centre, the virtual switching points of the two international circuits to be interconnected are considered to be connected together directly without any intermediate pad or amplifier.

In this way a chain of n international circuits has a nominal transmission loss in transit of n times 0.5 dB in each direction of transmission which contributes to the stability of the connection; see Recommendation G.131, A.

Recommendation Q.44

ATTENUATION DISTORTION [6)]

1. The conditions laid down for carrier terminal equipment by Recommendation G.232, A, guarantee that a chain of six circuits, each equipped with a single pair of channel-translating equipments in accordance with that Recommendation, will exhibit an attenuation distortion in terminal service that will meet the limits of Figure 1/Q.44, including the distortion contributed by the seven international centres traversed.

Note. – To assess the attenuation distortion of the international chain, the limits indicated for international circuits in Recommendation G.151, A, of Volume III must not be added to the limits for international centres mentioned in Recommendation Q.45. In fact, on the one hand, some exchange equipment would be counted twice if this addition were made; on the other, the specification limits of Recommendation Q.45 apply to the worst possible connection through an international exchange, while the maintenance limits of Recommendation G.151, A, apply to the poorest international circuit. The specification of the various equipments are such that the mean performance will be appreciably better than could be estimated by the above-mentioned addition.

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6) Recommendation Q.44 is an extract of Recommendation G.142 (1. of Q.44) and Recommendation G.132 (2. of Q.44) of Volume III.

2. The objectives for the variation with frequency of transmission loss in terminal condition of a worldwide 4-wire chain of 12 circuits (international plus national extensions), each one routed over a single group link, are shown in Figure 1/Q.44, which assumes that no use is made of high-frequency radio circuits or 3-kHz channel equipment.

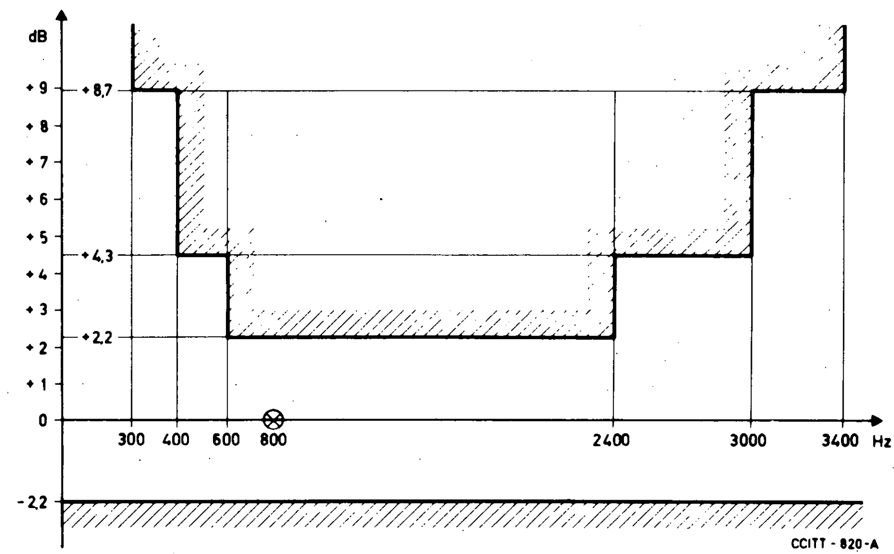


FIGURE 1/Q.44 – Permissible attenuation variation with respect to its value measured at 800 Hz (objective for worldwide chain of 12 circuits in terminal service)

Recommendation Q.45

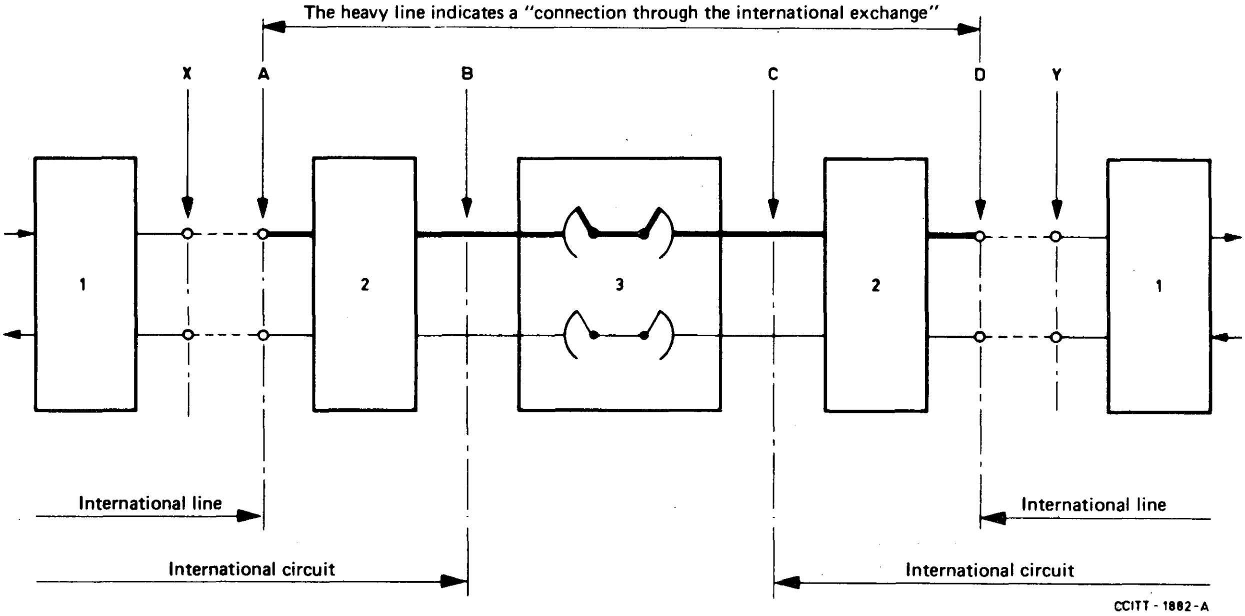
TRANSMISSION CHARACTERISTICS OF AN INTERNATIONAL EXCHANGE

1. *Introduction*

1.1 For the purposes of this Recommendation, an international exchange is a collection of equipment regarded as an entity by the Administration concerned. In the case of an international transit centre, it extends from the end of the incoming international line to the beginning of the outgoing international line (e.g. between such points as A and D in Figure 1/Q.45 or any other suitable pair of points).

In the absence of an international agreement on the choice of the points delimiting an international exchange, it has proved impossible to draw up model specifications showing the limits to be observed for quantities measured between these points. The CCITT recommendations given hereafter have been issued regardless of the actual arrangement.

Automatic international exchanges should be provided with circuit test access points (see Recommendation M.700 complying with Recommendation M.640 B (Volume IV). This Recommendation will ensure that circuit line-up and maintenance testing procedures are referred to points at or near the switchblock (Points B and C of Figure 1/Q.45).



1 = channel translating equipment
2 = incoming and outgoing relay set
3 = automatic switching equipment

Note. – Between points X and A and points D and Y, there may be equipment such as echo suppressors, compandors, equalizers, line signal receivers, etc., in addition to the cabling.

FIGURE 1/Q.45 – International exchange

1.2 The essential transmission requirements for an international exchange are:

a) The *transmission loss* through the centre should be substantially constant with time and independent of the routing through the centre.

b) *Crosstalk and noise* should be negligible.

c) The *distortions* introduced should be small. These include attenuation distortion, non-linear distortion and intermodulation products.

d) *Impedance* and *balance with respect to earth* at the points in the international exchange to which the lines are connected should be closely controlled.

1.3 The following recommendations apply to new automatic 4-wire international exchanges of the electromechanicl type. It is desirable that they should apply to new national 4-wire exchanges. They may also be applicable to electronic exchanges having metallic contact crosspoints.

These recommendations are intended to be used only as type tests, acceptance tests, or for special investigations. They do not constitute a complete specification. Generally the recommended tests should be conducted on a sampling basis.

2. *Definitions*

2.1 *Definition of a "connection through an exchange"*

Crosstalk and noise conditions for a 4-wire international exchange are defined by reference to a "connection through this exchange". By "connection through an exchange" is to be understood the pair of wires corresponding to one direction of transmission (GO direction or RETURN direction) and connecting the input point of one circuit incoming in the exchange and the output point of a different circuit outgoing from the exchange (these input or output points are often taken at the test-jack frame).

A connection through the international exchange is shown by a heavy line in Figure 1/Q.45.

2.2 *Definition of switching equipment input and output points*

Although the virtual switching points, which are points at which the two circuits are considered to be directly connected, are theoretical points, in practice it will always be possible to choose a point considered as the *switching equipment input* for the receive channel of a circuit and a point considered as the *switching equipment output* for the transmit channel of a circuit.

The exact position of each of these points depends on national practice and it is unnecessary for the CITT to define it. Only the national authority responsible for each international transit centre can fix the position of these points in each case.

The switching equipment input point associated with a receive channel may be such that the nominal relative level is different from −4.0 dBr. Let this nominal relative level be R [7].

The switching equipment output point associated with a transmit channel may be such that the nominal relative level is different from −3.5 dBr. Let this nominal relative level be S [7].

Consider a circuit between the switching centre concerned and the adjacent centre. Let T be the nominal transmission loss between virtual switching points at the two ends of the channel of this circuit, which is the receive channel in the centre concerned.

When a transit connection is established through a centre by connecting the receive and transmit channels of one circuit to the transmit and receive channels respectively of another circuit, in order to ensure that the virtual switching points have been connected together with additional loss or gain, the *nominal* value of the attenuation (loss) to be introduced between the switching equipment input and the switching equipment output is $R - S + T$.

2.3 *Definition of the net switching loss*

Let the actual value of the attenuation introduced between the switching equipment input and output points be A. The net switching loss is defined to be equal to the difference between this *actual* value and the *nominal* value of the attenuation. Thus:

Net switching loss = actual loss − nominal loss = $A - (R - S + T)$.

[7] If the value of R is chosen to be higher than the value of S, the level difference can be used to offset any inherent transmission loss in the switching equipment and the requirements of the transmission plan can be met without any need to install supplementary audio-frequency amplifiers.

3. *Recommendations concerning transmission loss*

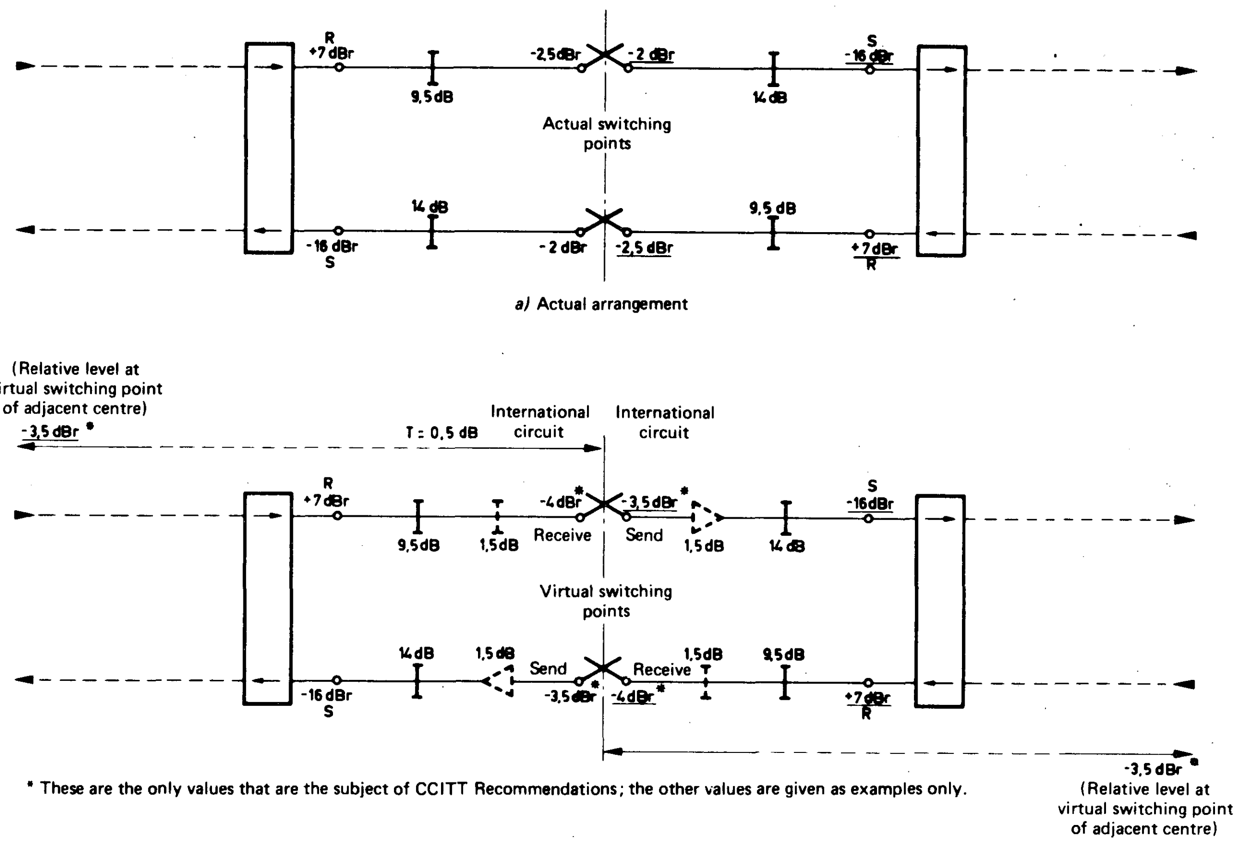
3.1 *Net switching loss*

Ideally, the net switching loss of an international exchange would always be zero. That is, the *actual* loss (A) should equal the *nominal* loss ($R - S + T$).

Example. – The relationship between the actual switching points and the virtual switching points in a practical international exchange is illustrated in Figure 2/Q.45.

In this arrangement:

R = +7 dBr,
S = −16 dBr,
and T is assumed to be 0.5 dB



* These are the only values that are the subject of CCITT Recommendations; the other values are given as examples only.

b) Hypothetical arrangement indicating possible position of the virtual switching points of the two circuits

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Note. – Underlined values of relative level refer to the circuit on the right of the point concerned. Values of relative level not underlined refer to the circuit on the left of the point concerned. In an actual switching centre the virtual switching points would not physically exist.

FIGURE 2/Q.45 – **Example showing a simplified representation of a transit connection in an international exchange with actual arrangement and possible location of virtual switching points**

so that the nominal transmission loss needed between the +7 and −16 dBr points is:

$$(+7) - (-16) + (0.5) = 23.5 \text{ dB}.$$

In practice, different connections established by the switching equipment will introduce different values of net switching loss so that a distribution of net switching losses will arise. The mean value of this distribution should be very close to zero but does not need to be specified.

3.2 *Loss dispersion*

According to Recommendation M.640 (Volume IV), circuit test-access points are located at or near the switchblock (points B and C of Figure 1/Q.45). Moreover, the dispersion of loss is mainly due to the diversity of paths in the switchblock. It is therefore only necessary to consider the dispersion of loss between the points B and C.

The standard deviation of loss measured at 800 Hz of all possible paths between points B and C should be as small as possible. For purposes of calculation a value of 0.2 dB may be assumed.

In order to conform to this value, it is considered sufficient that, for purposes of design and acceptance testing, the difference between the losses at 800 Hz of the shortest and longest paths from point B to point C in no case exceeds 0.8 dB. For a practical assessment of the average value of net switching loss, the contribution from the switchblock can be taken as the mean of the maximum and minimum values of loss between points B and C.

These values apply for connections routed directly, and once only, through the switchblock. Due to the fact that the switchblock contains only switches and associated cabling, the actual loss between points B and C in any case can only have positive values.

If special re-entrant trunking arrangements are used, requiring the connection to pass through the switchblock twice (this may be a convenient way to extend the availability of the switching network or to introduce additional equipment, e.g. echo suppressors), the maximum loss and loss dispersion will be increased. In view of this, the re-entrant technique should not be used to such an extent as to increase significantly the mean net switching loss of the exchange.

3.3 *Non-linear distortion*

The transmission loss measured on any "connection through the international exchange" should not vary by more than 0.2 dB when the level of the test-tone is varied from −40 dBm0 to +3.5 dBm0.

3.4 *Loss-frequency distortion referred to 800 Hz*

The difference between the transmission loss measured on any "connection through the international exchange" over the frequency bands indicated below and that measured at 800 Hz [8)], should lie within the following limits:

300- 400 Hz: −0.2 dB to +0.5 dB,
400-2400 Hz: −0.2 dB to +0.3 dB,
2400-3400 Hz: −0.2 dB to +0.5 dB.

4. *Crosstalk recommendations*

4.1 Crosstalk should be measured in exchanges at a frequency of 1100 Hz in accordance with Recommendation G.134 (Volume III).

4.2 *Crosstalk between connections established (between points A and D)*

In an international 4-wire exchange the signal to crosstalk ratio measured at points A and D between any two "connections through the international exchange" (see definition in 2.1 above) should be 70 dB or better.

This limit of 70 dB should normally apply to the most unfavourable case, in which two "connections" have parallel paths throughout the international exchange. It should be noted that this does not occur in practice, because normal cabling layout is such that when, at one switching stage, two "connections" use adjacent switches, in the following stage the two "connections" generally use switches which are not adjacent.

4.3 *GO to RETURN crosstalk of the same path (between points A and D)*

The signal-to-crosstalk ratio between the two "connections" which constitute the GO and RETURN channels of a 4-wire path established through the international exchange should be 60 dB or better.

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8) 1000 Hz is an acceptable alternative reference frequency.

5. *Noise recommendations*

For a 4-wire international exchange, noise measurements should be performed on a "connection through the exchange" during the busy-hour. (The busy-hour is defined in the ITU *List of Definitions of Essential Telecommunication Terms*, Definition 17.47.) Each channel of the connection should be terminated at points A and D of Figure 1/Q.45, in 600 ohms. The noise should be measured at the downstream end of each channel and should be referred to a point zero relative level in that channel. Thus, in Figure 1/Q.45 the noise in the upper channel is measured at D and the noise in the lower channel is measured at A.

5.1 *Mean noise power during the busy-hour*

The mean of the noise over a long period during the busy-hour should not exceed the following values:

- Psophometrically weighted noise: −67 dBm0p (200 pW0p),
- Unweighted noise: −40 dBm0 (100 000 pW0) measured with a device with a uniform response curve throughout the band 30-20 000 Hz.

Note. – A sufficient variety of connections should be chosen to ensure that the measurements are representative of the various possible routes through the exchange.

5.2 *Impulsive noise during the busy-hour*

Noise counts should not exceed 5 counts in 5 minutes at a threshold level of −35 dBm0 (see Annex 1 to this Recommendation for measurement procedure).

Note. – Figure 3/Q.45 shows the maximum number of impulsive noise counts acceptable on a 5-minute period.

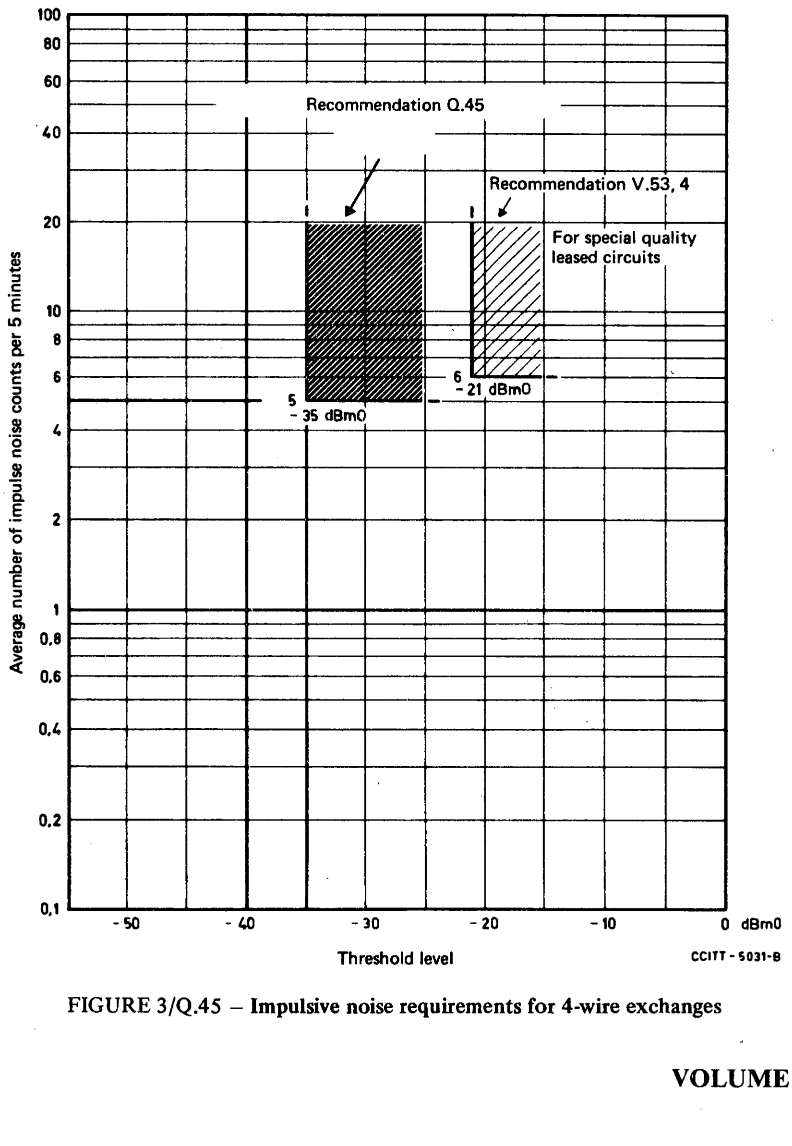

FIGURE 3/Q.45 – **Impulsive noise requirements for 4-wire exchanges**

6. *Other transmission recommendations*

6.1 *Intermodulation products (measured at A and D)*

The intermodulation products to be taken into account for end-to-end multifrequency signalling and for data transmission are those of the third order, of type $(2f_1 - f_2)$ and $(2f_2 - f_1)$ where f_1 and f_2 are two signalling frequencies.

For a measurement of the intermodulation products, the two frequencies to be used are 900 Hz and 1020 Hz (see Recommendation G.162, Volume III). With each frequency f_1 and f_2 at a level of −6 dBm0, the difference between the level of either frequency f_1 or f_2 and the level of either of the intermodulation products at $(2f_1 - f_2)$ or $(2f_2 - f_1)$ should be at least 40 dB.

6.2 *Group delay distortion (measured between A and D)*

The group delay distortion measured on any "connection through the international exchange" over the band 600-3000 Hz should not exceed 100 microseconds.

6.3 *Return loss (measured at A and D, from A towards D and from D towards A)*

At any frequency from 300-600 Hz the return loss measured against 600 ohms should be not less than 15 dB. The corresponding value from 600-3400 Hz should be not less than 20 dB.

6.4 *Impedance unbalance to earth*

6.4.1 The impedance unbalance to earth measured, at points A and D, should not be worse than:

300-600 Hz: 40 dB;

600-3400 Hz: 46 dB.

Note. – Some Administrations guided by their knowledge of local conditions may feel a need to specify a figure for a lower frequency, for instance, 50 Hz.

6.4.2 The degree of unbalance to earth is defined as the ratio u/U measured as shown on Figure 4a) or b)/Q.45 and is expressed in decibels as the reciprocal of this ratio in transmission units.

The diagrams of Figure 4/Q.45 used for measurement of unbalance differ only in respect of the presence or absence of an earth at the mid-point of the termination. Unbalance measurements according to Figure 4a) or b)/Q.45 can give quite different results according to the nature of the unbalance.

6.4.3 The CCITT has recommended in 1968 that the set of limit values of 6.4.1 above should be met for unbalance to earth measured with *both* measuring diagrams according to Figure 4/Q.45.

7. *Use of cables specified by the IEC*

The cables for telephone exchanges in accordance with IEC (International Electrotechnical Commission) publication 189 will meet the electrical characteristics required by the CCITT (especially as regards crosstalk) for ordinary exchanges, but this may no longer hold good for larger exchanges with considerable lengths of cable.

In accordance with Recommendation G.231 (Volume III), it will be for the Administrations or the contractors to check whether standard cables will be satisfactory in equipping an exchange which requires telephone cables of exceptional length.

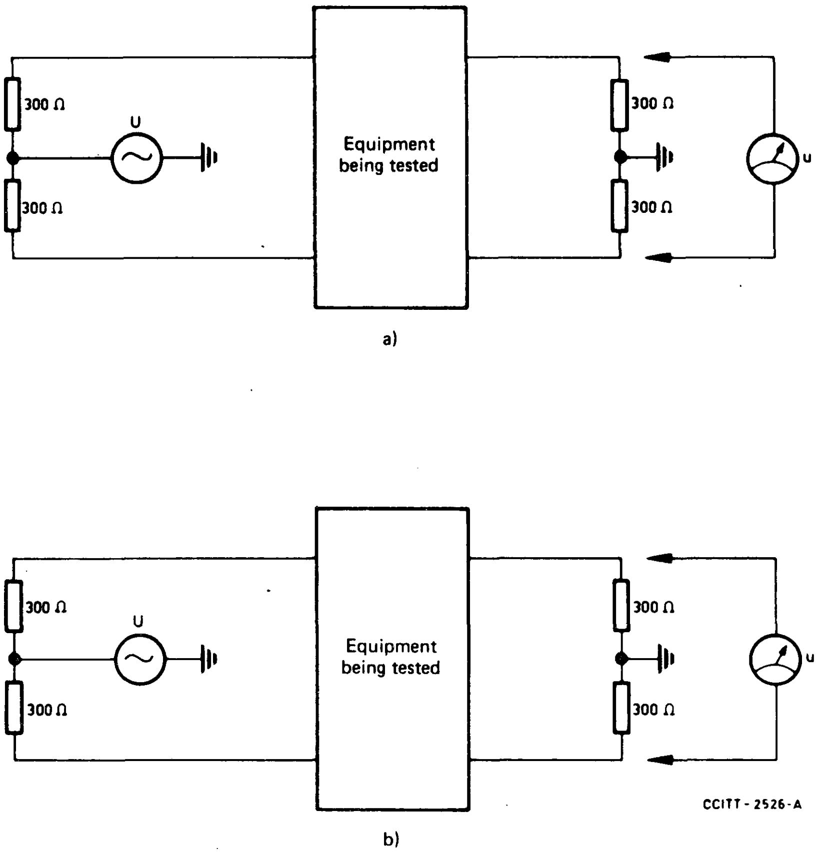

FIGURE 4/Q.45 – **Measurement of the degree of unbalance to Earth**

ANNEX

(to Recommendation Q.45, 5.2)

Procedure for impulsive noise measurements

1. A test circuit should be formed by setting up a connection across the switching unit and terminating the connection on one side of the exchange by the appropriate closing impedance and on the other by the impulse measuring device in parallel to the closing impedance. Those terminating points should be points A and D in the diagram of Figure 1/Q.45 (or equivalent points) to include the switching equipment of the exchange. Where it is the desire of an Administration, measurements may be made at points X and Y if precautions are taken to ensure that the results apply only to the automatic switching equipment, signalling equipment, echo suppressors, relay sets, pads and cabling of the exchange.

2. The measurements should be made using the device specified in Recommendation O.71. The 600-3000 Hz filter network described in 3.5 of Recommendation O.71 should be in the circuit.

3. The measurements should be made at times when the probability of noise occurring is at its highest, that is normally during the busy-hour.

4. The time of observation for each test should be five minutes.

Note. – The number of different test circuits set up across the exchange for measuring should take into account the size and complexity of the switching unit and should be a number sufficient to represent the various possible types of calls and routes through the exchange.

See also Supplement 7 (*Measurements of impulsive noise in a 4-wire telephone exchange*) in the documentary part of Volume VI of the CCITT *Green Book.*

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SECTION 7

PCM MULTIPLEX EQUIPMENT AND UTILIZATION OF CCITT SIGNALLING SYSTEMS ON PCM LINKS

Recommendations Q.46 and Q.47

Two primary PCM multiplex equipments are recommended by the CCITT, viz:

- a primary PCM multiplex equipment operating at 2048 kbit/s, which is described in Recommendation G.732; and
- a primary PCM multiplex equipment operating at 1544 kbit/s, which is described in Recommendation G.733.

Recommendations G.732 and G.733 appear in Volume III.

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SECTION 8

SIGNALLING FOR SATELLITE SYSTEMS

Recommendation Q.48

DEMAND ASSIGNMENT SIGNALLING SYSTEMS

(See also Supplement 8 in Volume VI-4 of the *Green Book*)

1. The term "demand assignment" (abbreviated as DA) should be taken as meaning that the assignment is on a per call basis.

Note. – Satellite circuits with demand assigned multiple access are those circuits which may be set up by assignment of a satellite link to operate between specified earth stations when the actual demand arises.

The origin, destination, or both of the satellite link can be varied. The link is assigned to set up the required telephone circuit according to the call.

This defines the following concepts:

1) variable destination satellite link;

2) variable origin satellite link;

3) fully variable satellite link (the origin and destination of which may both be varied).

The Recommendation covers, when applicable, fully variable and variable destination types of DA systems.

2. The DA signalling system shall be capable of interworking with all currently standardized CCITT signalling systems and shall have the capacity to carry all the telephony signals currently provided by these CCITT signalling systems and shall in addition provide reserve capacity.

Any currently standardized CCITT signalling system shall be able to be applied to any access link. Different CCITT signalling systems may be applied to the various access links at the same time.

3. Account should be taken of the fact that particular earth stations may have special signalling requirements to suit the CTs using these earth stations (e.g. joint use of an earth station by a number of CTs, long distances between CT and earth station, CTs with access to more than one earth station).

4. The DA signalling system shall be an integrated signalling system used both for:

a) signalling for setting up the DA speech circuit; and

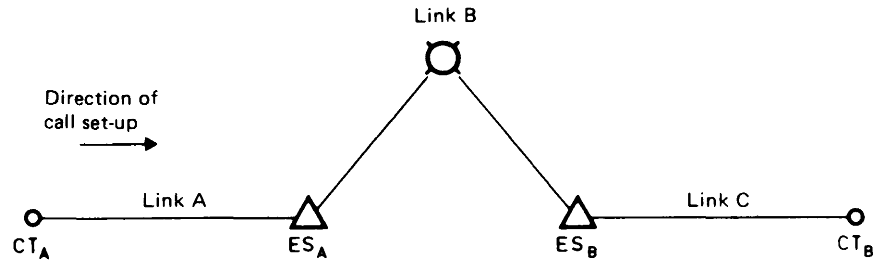
b) transfer of the information flow for telephony.

5. The DA signalling system shall be capable of transmitting address information in both the *en bloc* and the overlap mode of operation. The transmission of address information by the outgoing DA system terminal should be such as to result in minimum delay to these signals in the DA system.

The manner of transmitting signals over the DA signalling system shall be independent of the type of signalling system to be encountered in the access link at the far end.

Accordingly, the interworking arrangements described in Table 1 are recommended. (For definitions of "*en bloc*" and "*en bloc* overlap" see the definitions in Recommendation Q.151.)

TABLE 1 - Interworking arrangements for DA signalling systems



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En bloc – system No. 6	*Case 1* En bloc	En bloc – system No. 5 En bloc system No. 6
En bloc – system No. 6	*Case 2* En bloc	Overlap system R2
En bloc – system No. 5	*Case 3* En bloc-overlap or en bloc	En bloc – system No. 5 En bloc – system No. 6
En bloc – system No. 5	*Case 4* En bloc-overlap or en bloc	Overlap – system R2
Overlap – system No. 6 Overlap – system R2	*Case 5* Overlap	En bloc – system No. 5
Overlap – system No. 6 Overlap – system R2	*Case 6* Overlap	Overlap – system No. 6 Overlap – system R2

6. **The DA signalling system shall send out address digits from ES_B to CT_B in the correct order, that is, the order of dialling.**

7. **Means shall be provided for preventing spillover of signals between successive calls, which use the same satellite channel through the DA signalling system.**

8. **The DA signalling system should be capable, for the sequence *re-answer signal-clear back signal* of correctly extending to CT_A from ES_A, the last state representing the final position of the called party's switch hook.**

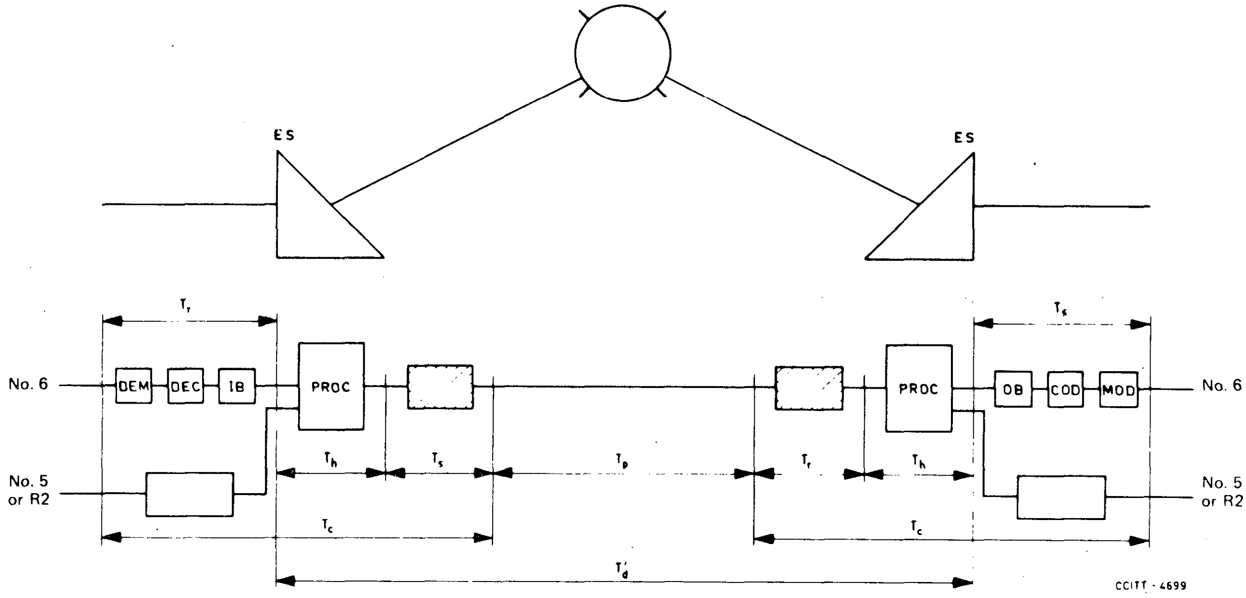
9. **The message structure of the demand assignment signalling system should be such that one message will contain all the information necessary for one event (e.g. answer signal for one particular circuit). Single unit and multi-unit messages should be catered for. Each signal unit should contain both information and check bits.**

10. **All time-outs for both normal and abnormal conditions in the DA signalling system should be designed according to the recommendations concerning the relevant CCITT signalling systems.**

11. Signal transfer time through the DA signalling system should be fast. While no firm time requirements in regard to the various components of signal transfer time have been established, design objectives in terms of average and 95% level values for the signal transfer time (T_d) for answer signals, other one-unit messages and the initial address message are given. These figures are to be viewed as reasonable objectives and not as firm requirements.

11.1 *Signal transfer time in the DA signalling system*

A signal transfer time in the DA signalling system is specified. This signal transfer time is called T'_d in the diagram of Figure 1/Q.48.



$$T'_d = 2T_h + T_s + T_r + T_p = T_h + T_c + T_p$$

T'_d = Signal transfer time in DA signalling system.
(For other symbols, see Recommendation Q.252.)

To facilitate the calculation of the total signal transfer time of the DA system, it is assumed that the time T_r as well as T_s respectively of the terrestrial and satellite transmission links are equal.

FIGURE 1/Q.48 – **Functional signal transfer time diagram**

The value $T_d = T'_d - T_p$ should be used as the design objective for the DA signalling system. The values of T_d calculated for the design of the system are shown in Table 2.

Note. – These figures have to be interpreted as reasonable estimates and not as firm requirements.

TABLE 2 – **Values of signal transfer times for design of a DA signalling system**

Design objectives for T_d

$T_d = T'_d - T_p$

	Type of message	Answer	Other one-unit message	IAM of 5 SU
T_d in ms	AV	52	85	145
	95 % level	85	175	235

For calculation use the following relations:

$$T_d = 2T_h + T_s + T_r = T_c + T_h \quad (1)$$

$$T_{d(AV)} = T_{c(AV)} + T_{h(AV)} \quad (2)$$

$$T_{d(95\%)} = T_{d(AV)} + \sqrt{(\Delta T_c)^2 + (\Delta T_h)^2} \quad (3)$$

where:

$$\Delta T_c = T_{c(95\%)} - T_{c(AV)} \quad (4)$$

$$\Delta T_h = T_{h(95\%)} - T_{h(AV)} \quad (5)$$

For basis of calculation, see Recommendation Q.287 (Annex).

12. *Dependability requirements*

The requirements specified for System No. 6 (Recommendation Q.276, 6.6.1) are recommended as the objectives for the DA signalling system.

12.1 *Signal transfer dependability* [Recommendation Q.276, 6.6.1 *b)* and *c)*]

"*b)* Signal units of any type which give rise to wrongly accepted signals due to undetected errors and causing false operation (e.g. false clear-back signal):

not more than one error in 10^8 of all signal units transmitted, and

c) As in item *b)* but causing serious false operation (e.g., false metering or false clearing of a connection):

not more than one error in 10^{10} of all signal units transmitted."

12.2 *Error correction by retransmission* [Recommendation Q.276, 6.6.1 *a)*]

Although the bit error rate in the DA signalling system has not been determined, the design of the system should be made such that a design objective "not more than one in 10^4 signal units carrying telephone information is allowed to be delayed as a consequence of error correction by retransmission."

12.3 *Interruption of the signalling service* [Recommendation Q.276, 6.6.1 *d)*]

System No. 6 requirements are:

– interruption of duration between 2 seconds and 2 minutes: not more than once a year;

– interruption of duration exceeding 2 minutes: not more than once in 10 years.

Since the speech circuits and the signalling channel in the DA system normally will be interrupted simultaneously, it is understood that the above figures are related to the signalling equipment and not to the transmission media common to both the signalling channel and the speech circuits.

SECTION 9

AUTOMATIC TESTING EQUIPMENT

Recommendation Q.49

SPECIFICATION FOR THE CCITT AUTOMATIC TRANSMISSION MEASURING AND SIGNALLING TESTING EQUIPMENT ATME NO. 2

(The specification for ATME No. 2, appears in Recommendation O.22 of Volume IV.2.)

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PART VII

Series Q Recommendations (Q.101 to Q.118 *bis*)

CLAUSES APPLICABLE TO CCITT STANDARD SYSTEMS

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CLAUSES APPLICABLE TO CCITT STANDARD SYSTEMS

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CLAUSES APPLICABLE TO CCITT STANDARD SYSTEMS

SECTION 1

GENERAL CLAUSES

Recommendation Q.101

1.1 FACILITIES PROVIDED IN INTERNATIONAL SEMI-AUTOMATIC WORKING

1.1.1 The operating methods used in the semi-automatic international service are described in the *Instructions for the International Telephone Service.* These operating methods assume the existence of equipment (operator's positions and automatic switching equipment) involving the following categories of operators:

a) *outgoing* operators;

b) *incoming* operators;

c) *delay* operators;

d) *assistance* operators;

e) *information* or *special service* operators.

1.1.2 The *outgoing operator* controls the setting up of calls at the outgoing exchange. (From the operating point of view she is, in general, the controlling operator and is sometimes so referred to in the *Instructions.*)

She must be able to set up calls to any one of the following points in the called country:

a) subscribers;

b) incoming operators at the incoming international exchange;

c) delay operators, especially a particular delay operator at the incoming international exchange;

d) incoming operators at a local manual exchange in the called country;

e) information or special service operators.

The outgoing operator should be able to recall incoming and delay operators on calls set up via these operators, by sending a forward-transfer signal as defined in the relevant system specifications.

1.1.3 The *incoming operator* [1] at the incoming international exchange is obtained by using a special code 11 signal or a special number. The code 11 signal is a particular combination provided by the signal code. This operator performs the functions of an incoming operator in ordinary manual service for those calls which cannot be routed automatically at the incoming international exchange.

1.1.4 The *delay operator* is obtained by using a special code 12 signal, or a special number. The code 12 signal is a particular combination provided by the signal code. The delay operator may be:

- any of the operators of this category;
- or a particular operator, or one of those operating a particular group of positions; her position or her group of positions is then indicated by a number which follows the code 12 signal or is indicated by the special number.

With respect to the direction in which a required call is set up, the delay operator may be at the outgoing international exchange and may be called by an operator at the incoming international exchange. From the technical point of view and as far as signalling is concerned, however, the delay operator at the outgoing international exchange called back by an operator at an incoming international exchange must be regarded as being at the incoming end of the international circuit over which she has been called back.

1.1.5 *Notes on incoming and delay operators*

a) Incoming and delay operators must be able to speak the *service language* used for the route concerned, and hence may have to belong to a particular language group. A *language (or information) digit*, from 1 to 8, sent on all semi-automatic calls, is used to obtain operators of a particular language group (see Recommendation Q.104) [2].

b) It may be the same operator who acts as an incoming and as a delay operator, and even as an assistance operator. She enters a circuit in any of these capacities in response to the appropriate signal.

c) While an incoming or delay operator is being called, the national ringing tone of the incoming country must be sent back over the international circuit.

1.1.6 The *assistance operator* at the incoming international exchange enters a semi-automatic circuit on a call already set up, when requested by the outgoing operator, because of language difficulties or, for instance, when she is required to interpret a national tone. Access to an assistance operator at an international transit exchange is not possible.

The assistance operator is called by a forward-transfer signal, sent by the outgoing operator when, for example, she operates a key on the outgoing position. An assistance operator in a required language group is obtained in conjunction with the forward-transfer signal by the language digit (or information) sent previously during the setting up of the call. Hence the incoming relay set must store the language digit (or information).

The outgoing operator receives no indication to show that the assistance operator is being called, or to show when she answers or withdraws from the circuit, but if necessary the outgoing operator can send the forward-transfer signal several times on the same call.

The assistance operator must be able:

a) to break into the call as a third party (this she would do, for example, when the language spoken in the country of arrival is other than the service language used in that relation, and the operator intervenes as an interpreter);

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[1] Called alternatively in French "opératrice translatrice", see *Instructions for the International Telephone Service* (art. 125).

[2] The language digit may not be used on some intraregional circuits.

b) to enter a circuit on one side only after having isolated the other. She does this, in particular, when she translates a verbal announcement or interprets an audible tone returned from the incoming end.

In no circumstances will the assistance operator be able to block the international circuit.

Note. – It should be noted that the term "assistance operator" has a very definite meaning in CCITT documents. It stands for an operator who breaks in, as required, as a third party in a circuit already set up. Hence this operator must not be confused with any other operator in the incoming country who may help to *set up* the call in conjunction with the international outgoing operator. Assistance operators may not be available on intraregional circuits.

1.1.7 The *information or special service operator* of the country of destination is obtained by using a special number. This operator is responsible for giving details concerning subscriber number and miscellaneous inquiries.

Recommendation Q.102

1.2 FACILITIES PROVIDED IN INTERNATIONAL AUTOMATIC WORKING

In international automatic working, the calling subscriber can obtain only such subscriber numbers as are made up of the numerical digits appearing on his dial or push-button set. Hence, he cannot obtain operators reached by code 11 or code 12 signal, or an assistance operator reached by a forward-transfer signal. In principle, he should not obtain access to incoming, delay or information operators [3] reached by special numbers.

He can have direct dialling access to manual exchanges in the incoming country only subject to certain conditions (these conditions are defined in Recommendation Q.28, 2., and in Recommendation Q.120, 1.8, and are applicable to all CCITT standard systems).

It is pointless to send a language digit (or information) over an international circuit since the calling subscriber does not have to obtain operators speaking a particular language at the incoming international exchange. On automatic calls, a discriminating digit (or discriminating information) replaces the language digit (or information) sent on semi-automatic calls. This:

- enables the equipment in the outgoing international exchange to make a distinction between semi-automatic and automatic calls as is required when drawing up international accounts, as described in 2. of Recommendation E.260;
- enables, therefore, incoming equipment to serve both automatic and semi-automatic service;
- in Systems No. 4, No. 5 *bis* and No. 6, informs the equipment in the international incoming exchange that it has not to rely on an end-of-pulsing signal (see Recommendation Q.106);
- enables the equipment in the incoming international exchange to prevent automatic calls from having access to certain destinations (special services, for example).

Recommendation Q.103

1.3 NUMBERING USED

1.3.1 *International prefix*

The international prefix (see definition 1 in Recommendation Q.10) which gives subscribers access to the international automatic network is used only in automatic working and is not used in semi-automatic working.

The international prefix is not included in the numerical signals sent out from the international outgoing exchange.

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[3] For information operators, see Recommendation E.115.

1.3.2 *Country code*[4)]

Information about country codes will be found under 8.2 in Recommendation Q.11. In the international outgoing exchange, the country code is used:

a) in automatic working for the purpose of giving access to outgoing circuits;

b) in semi-automatic working it is required to give outgoing operators in the outgoing international exchange access to the circuit by means of selectors.

The country code is sent on the international circuit or signalling channel:

- in the case of transit calls;
- in terminal and transit calls in System No. 5 *bis*;
- in terminal and transit calls to a demand assignment system.

Recommendation Q.104

1.4 LANGUAGE DIGIT OR DISCRIMINATING DIGIT

1.4.1 *Language digit (or language information)*

1.4.1.1 The language digit defined under 1.1.5 above indicates the *service language* to be used between operators in the international service, that is to say, the language to be spoken in the incoming international exchange by the incoming, delay and assistance operators when they come on the circuit. The language digit (or information) must be sent on *all* semi-automatic calls.

1.4.1.2 The digit (or indicator) to be used to select the appropriate language is as follows:

1 = French

2 = English

3 = German

4 = Russian

5 = Spanish

6, 7, 8 — available to Administrations for selecting a particular language provided by mutual agreement (in Systems No. 5 and No. 5 *bis*, however, digit 7 is used on calls requiring access to test equipment)

9 = reserve (see 1.4.2.2 below)

1.4.1.3 The language digit (or information) is either:

- sent by the operator to the outgoing equipment; in this case the operator must send it immediately before the national (significant) number[5)] of the called subscriber; or
- sent automatically by the outgoing equipment.

1.4.2 *Discriminating digit (or discriminating information)*

1.4.2.1 In all automatic calls, the position in the sequence of numerical signals occupied by the discriminating digit (or information) is that occupied by the language digit (or information) in semi-automatic calls (see Recommendations Q.102 and Q.107).

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4) The country code may not be used on some intraregional calls.

5) See definition in Recommendation Q.10.

1.4.2.2 The digit 9 (or its equivalent) in the list of language digits (or calling party's categories) has been kept in reserve for use as extra discriminating information if required. Such use should be for a call with special characteristics, but the digit 9 (or the equivalent information) must not be used merely to take the place of the digit 0 (or its equivalent) in an automatic call [6].

1.4.2.3 Combination 13 in the signal code of System No. 4, combination 9 or 10, Group I in the signal code of System R2 and its equivalent in System No. 6, as well as combination 7 in the signal code of System No. 5 and System No. 5 *bis* serve as a discriminating digit (or information) on calls to automatic testing equipment.

1.4.2.4 Combination 11 and combination 12 in the signal code of System No. 5 *bis* or its equivalent in System No. 6 may be used as a discriminating digit (or calling party's category indicator) on calls originated by a subscriber with priority (combination 11) or on data calls (combination 12).

1.4.2.5 On all automatic calls the discriminating digit must be sent over the international circuit or signalling channel by the country of origin of the call, and this country has to arrange for the automatic insertion of the discriminating digit (or information).

Recommendation Q.105

1.5 NATIONAL (SIGNIFICANT) NUMBER

1.5.1 In automatic working, the subscriber sends the called subscriber's national (significant) number [5] by means of a dial, push-button set, or automatic dialling device.

1.5.2 In semi-automatic working, the operator sends the national (significant) number [5] of the called subscriber by means of a keyset for example.

1.5.3 The outgoing equipment must be designed to cater for a sufficient number of digits in the national (significant) number [5] as specified in Recommendation Q.11, 2.2 and 3.

Recommendation Q.106

1.6 THE SENDING-FINISHED SIGNAL

In semi-automatic working, when the international outgoing operator has finished keying or dialling, she operates a special button on her keyboard or a key so that, after the number, a local signal which is called a *sending-finished* signal is sent to the outgoing equipment to show that there are no more digits to follow. In automatic working, subscribers cannot show when they have finished dialling the number, and so this signal does not apply.

Note. – In semi-automatic working, local sending of the sending-finished signal will cause an *end-of-pulsing* signal to be sent on the international circuit [7] or signalling channel. This has the same function and shows the incoming equipment that there are no more digits to be received. In some cases also in automatic working, when the outgoing equipment decides that there are no more digits to follow, an end-of-pulsing signal is sent on the international circuit or signalling channel, for example in the ST condition of System No. 5 (see Recommendation Q.152).

[6] For example, it might be thought useful to have an additional discriminating digit (or information) when a distinction has to be made between:

a) automatic calls, and

b) semi-automatic calls set up in the outgoing country directly by ordinary operators, in national exchanges and not by international operators in the international exchange, and arriving by the same group of national circuits as calls mentioned in *a)*.

Such a distinction might be necessary because:

– in international accounts, calls mentioned in *b)* are dealt with as semi-automatic calls and are not to be metered by the international equipment,

– for signalling, calls mentioned in *b)* are not accompanied by an end-of-pulsing signal.

[7] In System R2 the sending of end-of-pulsing signal (code 15) may not occur if a *number-received* indication has already been received.

Recommendation Q.107

1.7 SENDING SEQUENCE OF NUMERICAL (OR ADDRESS) SIGNALS

The sequence of numerical (or address) signals sent from the operator, calling subscriber or test equipment to the outgoing equipment is usually as shown in Table 1. This sequence corresponds in general to the sequence of signals sent over the international circuit or signalling channel. For complete details, see the specifications of the signalling systems concerned.

TABLE 1 – **Sequence of numerical (address) signals**

Type of call	Information sent by the user	Numerical (or address) and routing information sent over the circuit or signalling channel in CCITT System					
		No. 4[1]	No. 5[2]	No. 5*bis*	No. 6	R1	R2[3]
Semi-automatic call to a subscriber	– Country code[4,5] L-digit[5] Nat. No.[6] Sending-finished	– Code 14[17] Country code[9] L-digit Nat. No. Code 15	KP1 or KP2 Country code[9] L-digit Nat. No. ST	X-digit Country code Z-digit (L) Nat. No. ST	Routing inf. CP category ind. (L) Country code[9] – Nat. No. ST	KP Country code[15] L-digit[15] Nat. No.[10] ST	Country code indicator[11] Country code[11] L-digit[12] Nat. No. Code 15[13]
Semi-automatic call to an incoming, delay, information or special service operator	– Country code[4,5] L-digit[5] Code 11, code 12 or special No.[7,8] Sending-finished	– Code 14[17] Country code[9] L-digit Code 11, code 12 or special No. Code 15	KP1 or KP2 – Country code[9] L-digit Code 11, code 12 or special No. ST	X-digit Country code Z-digit (L) Code 11, code 12 or special No. ST	Routing inf. CP category ind. (L) Country code[9] Code 11, code 12 or special No. ST	KP Country code[15] L-digit[15] Special No.[10] ST	Country code indicator[11] Country code[11] L-digit[12] Code 11, code 12 or special No. Code 15[13]
Automatic call to a subscriber	– International prefix[16] Country code[16] Nat. No.	– – Code 14[17] Country code[9] D = 0 Nat. No. Code 15[14]	KP1 or KP2 – Country code[9] D = 0 Nat. No. ST	X-digit – Country code Z-digit (D) Nat. No. ST[14]	Routing inf. CP category ind. (D) Country code[9] Nat. No. ST[14]	KP · Country code[15] D = 0[15] Nat. No.[10] ST	Code indicator[11] Country code[11] D = 0 Nat. No.
Test call		– – D = Code 13 Code 12 Digit 0 2 digits Code 15	KP1 – D = Code 7 Code 12 Digit 0 2 digits ST	X-digit Country code Z-digit (D = 7) Code 12 Digit 0 2 digits ST	Routing inf. – CP category ind. (test) – – – X[18] ST	KP – – Digits to be agreed ST	Code 13 – Code 13 2 digits Code 15[13]

Notes to Table 1:

[1] The terminal or transit indication is contained in the seizure signals.

[2] KP1 for terminal calls, KP2 for transit calls.

[3] Calling party's category information may be sent on request.

[4] In some cases the country code will be preceded by a KP signal.

[5] The operator may not have to send this information.

[6] For a call to a subscriber connected to a manual exchange obtained by automatic switching via the incoming international exchange, the national (significant) number consists of:
- the code of the required manual exchange in the national numbering plan;
- possibly the called subscriber's number if, in the incoming country, this number is required for routing the call to the manual exchange.

[7] When a country has more than one incoming international exchange, code 11 or code 12 may be preceded by one extra digit designating the incoming exchange. However, it is recognized that existing design of some present-day equipments does not permit the insertion of the extra digit N_1. In this situation, agreement will be required between the relevant countries concerned that this insertion of N_1 would not be provided for at a particular outgoing international exchange as long as the equipment limitation applied.

[8] For a call to an incoming or to any delay operator, code 11 and code 12 respectively will be followed by the *sending-finished* signal.

For a call to a specific delay operator or to a specific group of delay operators, code 12 will be followed by numerical information designating the desired delay operator or group of delay operators.

For a call to an information operator, special service operator or, in general, for calls to incoming and delay operators in countries not equipped to receive code 11 or code 12 signals, special numbers will be used to designate the operator or group of operators desired.

[9] The country code is not sent to the incoming (terminal) international exchange.

[10] The trunk code (area code) is not sent to the called numbering area (NPA) of a country in an integrated numbering plan.

[11] The country code indicator (= code 12) and the country code are not sent to the incoming (terminal) international exchange.

[12] On bilateral agreement, the L- or D-digit will not be sent to the incoming (terminal) international exchange.

[13] Code 15 is not sent if the incoming international exchange does not request it.

[14] On automatic calls code 15 or the ST-signal *may* be sent when available.

[15] For traffic within an integrated numbering area, the discriminating or language digit (or equivalent information) and the country code may not always be sent.

[16] For traffic within an integrated numbering area, the international prefix and the country code may not always be sent.

[17] When used by multilateral or bilateral agreement for echo suppressor control, code 14 will be sent as the first digit in the sequence of numerical signals in response to each proceed-to-send signal received.

[18] See Recommendation Q.295 for X address signal codes.

The following abbreviations are used throughout Table 1:

L	=	language digit or information;
D	=	discriminating digit or information;
Nat. No.	=	national (significant) number;
CP category ind.	=	calling party's category indicator;
Routing inf.	=	routing information in System No. 6 (terminal or transit indicator, nature of circuit indicator and echo-suppressor indicator).

Recommendation Q.108

1.8 ONE-WAY OR BOTH-WAY OPERATION OF INTERNATIONAL CIRCUITS

1.8.1 *One-way operation*

In order to have as simple as possible equipment in international exchanges and to avoid double seizures, Systems No. 3, and No. 4 have been designed in 1949-1954 for one-way operation of international circuits in semi-automatic and automatic working.

1.8.2 *Both-way operation*

1.8.2.1 These advantages of one-way operation naturally hold good in the case of long international (intercontinental) circuits. However, for these circuits the following considerations have been determining factors in providing both-way circuit operation:

a) When a group of circuits is composed of a small number of circuits, the increase in efficiency due to both-way operation is obviously very important. Moreover, long international (intercontinental) circuits are very costly. Finally, the increase in the cost of terminal equipment which results from both-way operation is small compared with the considerable economic advantage derived from this mode of operation.

b) The two ends of a long international (intercontinental) group of circuits may belong to two time zones which are very far apart and, depending on the difference in time, this is likely to result in important and variable differences between the traffic in the two directions.

1.8.2.2 All circuits in Systems No. 5 and No. 5 *bis*, and the speech circuits in System No. 6 should be equipped to work in both-way operation. Nevertheless, the both-way method of operation would be applied only if it offered a considerable economic advantage. Hence in the case of large groups (for example, more than 40 circuits in each direction), the possibility of maintaining one-way operation might be considered, because of the extra reliability of this type of operation. If, in circumstances necessitating the use of large groups, there are great differences between the busy hours at each end, it would be advisable, if it were desired to maintain one-way operation, to arrange that the circuits be used successively in one or the other direction according to the time of day. This availability of the circuits for routing traffic from country A to country B or vice versa would be arranged by a convenient method.

In certain cases another solution is worthy of consideration. This consists of setting up three groups of circuits, two operated one-way and the third both-way, it being understood that the latter would be used as an overflow route for calls which could not be routed on the first two groups.

1.8.2.3 Attention is drawn to the conditions which should be introduced to avoid double seizing and false blocking on both-way international circuits. In addition, attention is drawn to the fact that in semi-automatic working, as in automatic working, access to the circuits at both ends should be automatic.

In semi-automatic operation, in the event of double seizing, automatic selection of a new circuit should be preferred to the operator's setting up the call again, so that the operator does not become aware of the double seizing. In automatic operation, automatic selection of a new circuit should naturally be the rule.

The necessary arrangements have been made in the specifications of the systems concerning simultaneous seizing in both-way operation.

1.8.2.4 The circuits in Systems R1 and R2 may be equipped to work in both-way operation.

Recommendation Q.109

1.9 TRANSMISSION OF THE ANSWER SIGNAL IN INTERNATIONAL EXCHANGES

For the reasons given in Recommendation Q.27, it is necessary to reduce to a minimum the delays resulting from:

- the conversion of the national answer signal into the international answer signal and vice versa; and
- the transmission of the international answer signal over the international part of the connection,

these delays being additional to any delays due to conversions and repetitions of the answer signal within the national systems of the incoming and outgoing countries.

SECTION 2

TRANSMISSION CLAUSES FOR SIGNALLING

A. Signalling on PCM links

Recommendation Q.110

2.0 GENERAL ASPECTS OF THE UTILIZATION OF STANDARDIZED CCITT SIGNALLING SYSTEMS ON PCM LINKS

2.0.1 *Signalling Systems No. 4, No. 5 and No. 5 bis*

Signalling Systems No. 4, No. 5 and No. 5 *bis* are in-band signalling systems. It is not planned to specify modified versions of these systems for application to PCM transmission systems.

Should it be required to use one of these signalling systems on circuits routed partly or wholly via PCM transmission systems it is recommended that the standard in-band signalling arrangements for both line and interregister signals be used. The circuits should be connected on a 4-wire basis to appropriate analogue inputs and outputs of the PCM transmission system.

These signalling systems are not recommended for use between time division digital exchanges.

2.0.2 *Signalling System No. 6*

For the transmission of signalling information over digital systems a digital version of Signalling System No. 6 has been developed and is specified in Recommendations Q.251 and Q.295.

Alternatively, the analogue version of System No. 6, as also specified in Recommendations Q.251 to Q.295 may be used without modifications by replacing the analogue voice-frequency channel of the signalling data link by PCM voice-frequency channels. In this case, the connection of the modem to the PCM transmission channel should be made on a 4-wire basis to the analogue input and the analogue output.

2.0.3 *Signalling System R1*

Signalling System R1, as specified in Part I of Volume VI.3, may be used without modification on PCM voice-frequency channels by direct connection of the circuits to appropriate analogue inputs and outputs of the PCM transmission system.

An alternative method of transmitting the line signals via a PCM system as specified in Recommendation G.733 has been developed as the digital version of System R1. Details are given in Recommendations Q.310 to Q.332. The multifrequency interregister signals are applied in-band via the analogue input of the speech circuit.

This signalling system is not recommended for use between time division digital exchanges but the digital version may be used between a time division exchange and a space division exchange.

2.0.4 *Signalling System R2*

The line signals of System R2 cannot be transmitted via an analogue input of a PCM transmission system since these signals are sent out-band using a 3825 Hz signalling channel. A digital version of the R2 line signalling system has been developed for use with a PCM system as specified in Recommendation G.732. Details are given in Recommendations Q.421 to Q.424. The multifrequency interregister signals are applied in-band via the analogue input of the speech circuit.

This signalling system is not recommended for use between time division digital exchanges, but the digital version may be used between a time division and a space division exchange.

B. Clauses common to signal receivers (and senders) for Signalling Systems No. 4, No. 5, No. 5 *bis*, R1 and R2 [1)]

Recommendation Q.112

2.1 SIGNAL LEVELS AND SIGNAL RECEIVER SENSITIVITY

2.1.1 *Standardized transmitted power*

The values of the standardized transmitted power for the different line and interregister signals are defined in the relevant parts of the specifications for the CCITT Systems No. 4, No. 5, No. 5 *bis*, R1 and R2. They correspond with the "maximum permissible power" for the signalling frequencies (see Recommendation Q.16).

Note. – The level of leak current which might be transmitted to line, for example when static modulators are used for signal transmission, should be considerably below signal level, as specified.

2.1.2 *Variations of the absolute power level of received signals*

The standardized absolute power level of the signalling current to be transmitted is fixed at the maximum value compatible with circuit transmission requirements and the extreme values of absolute power level, between which received signalling currents may lie, depend on three factors:

1) the overall loss and the variation with time of this loss of the international circuit (link-by-link signalling) or of the chain of international circuits (end-to-end signalling) at 800 Hz;
2) the variation with frequency of the overall loss of these circuits, in relation to the nominal value at 800 Hz;
3) the tolerance on the transmitted absolute power level in relation to the nominal value.

The operate level range of the signal receivers about a nominal value should take account of these three factors. In System No. 4, the operate range (± 9 dB) is appropriate for end-to-end signalling. The maximum number of circuits in the end-to-end signalling situation is normally three but more may be possible depending upon the actual conditions. In Systems No. 5 and No. 5 *bis* the operate range, (± 7 dB) for line signals and for register signals is appropriate for each circuit in link-by-link signalling. For the other CCITT systems see the relevant parts of their specifications.

2.1.3 *Maximum sensitivity of the signal receiver*

It is desirable to limit the maximum sensitivity of the signal receiver, particularly on account of crosstalk between the GO and RETURN paths of a 4-wire circuit, leak currents, etc.

1) For Signalling System No. 6, see Volume VI.2.

Recommendation Q.113

2.2 CONNECTION OF SIGNAL RECEIVERS IN THE CIRCUIT

2.2.1 The line signal receivers are permanently connected to the 4-wire side of the circuit. The register signal receivers in System No. 5 are connected to the 4-wire side of the circuit when the register is associated with the circuit for the setting up of the call; the same is valid for the register signal receivers in System No. 5 *bis* and (in the international exchanges) for the register signal receivers in Systems R1 and R2.

2.2.2 An in-band line signal receiver should be protected against disturbing currents (voice currents or possibly noise), coming from the the near end of the circuit, by a buffer amplifier or other arrangement. The arrangement used should introduce an appropriate supplementary attenuation in such a manner that, at the point where the line signal receiver is connected, these disturbing currents are of such a level that they cannot:

- operate the line signal receiver;
- interfere with the reception of signals by operating the guard circuit of the line signal receiver.

The additional attenuation introduced should in consequence take account of:

a) the relative level n at the point where the signal receiver is connected (this relative level is obtained by assuming a zero relative level at the distant origin of the circuit);

b) the minimum permissibe signal level at the input to the signal receiver, for example:

$-18 + n$ dBm in the case of System No. 4 (see Recommendation Q.123, 3.2.1),

$-16 + n$ dBm in the case of System No. 5 (see Recommendation Q.144, 2.4.1);

c) the maximum permissible level for disturbing currents (voice currents and switching noise) coming from the near end of the circuit. The maximum level of voice current might be assumed to be, for example, +10 dBm0 in the direction *opposite* to that of the signals. The nature of the switching noises depends on the national systems used;

d) any attenuation (terminating set and possibly pads) between the point where the signal receiver is connected and the point where the near-end disturbing currents are considered;

e) a safety margin to give an appreciable reduction of the level of disturbing currents coming from the near end [as defined in *c)*] compared to the minimum level of the signal as defined in *b)*

2.2.3 When a register-signal receiver is connected to the circuit, the exchange side of the circuit is disconnected and hence the receiver is not subject to near-end disturbances.

2.2.4 The Recommendations of Volume III concerning international circuits must still be met after the connection of a signal sender and a signal receiver and of the switching equipment. In consequence, it is necessary to fix the limits of input and output impedance, insertion loss, attenuation distortion, non-linear distortion, balance, and crosstalk of line signal senders and receivers; an example of specification clauses concerning these conditions is given in Recommendation Q.114.

Recommendation Q.114

2.3 TYPICAL TRANSMISSION REQUIREMENTS FOR SIGNAL SENDERS AND RECEIVERS

2.3.1 In-band line signal receivers (including the buffer amplifier or equivalent device), in 2.3.2 to 2.3.7 below, apply only in the case where the signal receiver is a 4-terminal device ("quadripole") and where the nominal circuit impedance is 600 ohms.

2.3.2 *Input and output impedance*

The nominal value of the input and output impedances of the signal receiver is 600 ohms.

Z_E and Z_S, which are respectively the measured values of the input and output impedance of the signal receiver, should meet the following condition throughout the 300 to 3400 Hz frequency band:

$$\left|\frac{Z_E - 600}{Z_E + 600}\right| \leqslant 0.35 \text{ and } \left|\frac{Z_S - 600}{Z_S + 600}\right| \leqslant 0.35.$$

In making these measurements the free terminals should be looped by a resistance of 600 ohms and the voltage applied must not overload the equipment.

2.3.3 *Attenuation*

At 800 Hz, the insertion loss of the signal receiver, measured with a generator and a receiver of internal resistance of 600 ohms, must be between the limits:

$$A \pm 0.5 \text{ decibel}$$

The value A is to be determined from the level diagram of the circuit according to the point of the circuit at which the signal receiver should be connected.

The measurement is made with a 1 mW generator having an internal impedance equal to a pure resistance of 600 ohms and having an e.m.f. of 2 × 0.775 volt (so-called "standard generator"). The e.m.f. of the generator will be adjusted to take into account the relative level of the point of the circuit at which the signal receiver is connected.

If n is the relative level at the signal receiver input, the e.m.f. of the generator will therefore be:

$$1.55 \cdot 10^{\frac{n}{20}} \text{ volts, if } n \text{ is expressed in decibels.}$$

2.3.4 *Attenuation distortion*

The variation in insertion loss of the signal receiver in the 300-3400 Hz frequency band, measured under the conditions of 2.3.3 above, should not exceed the limits shown in Figure 1/Q.114.

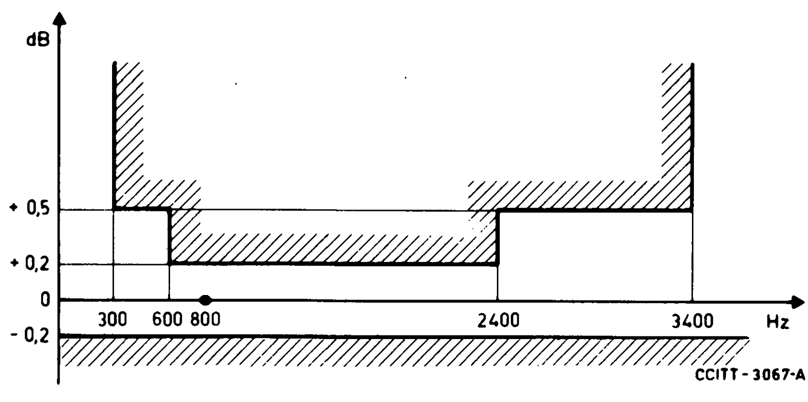

FIGURE 1/Q.114 – **Attenuation distortion of the signal receiver**

As in certain cases Systems No. 5, No. 5 *bis* and R1 may be applied to circuits in transmission systems with a channel spacing of less than 4 kHz, the 300 Hz lower limit shown above may be replaced by 200 Hz for System No. 5.

2.3.5 *Non-linear distortion*

The curve representing the variation (as a function of power) of the output level of the signal receiver, with reference to the nominal value of the output level, should be within the limits shown in Figure 2/Q.114 over the relevant frequency range.

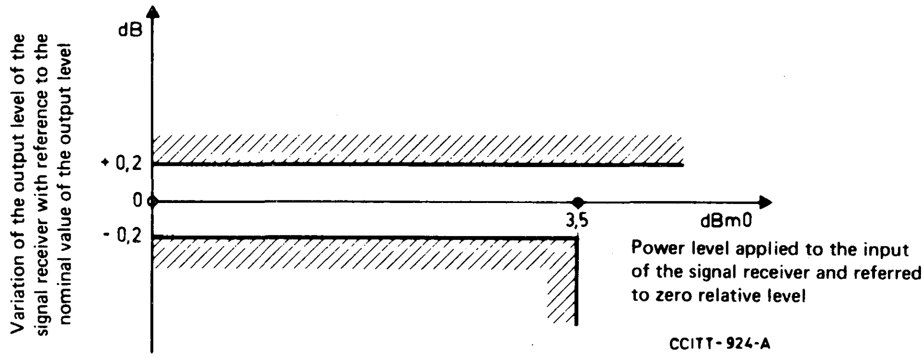

FIGURE 2/Q.114 – **Limits for non-linear distortion due to the insertion of the signal receiver**

2.3.6 *Balance*

The input and output of the signal receiver should have a high degree of balance to earth, the admittance of each terminal to earth being very low.

The same clause should apply to the signal sender.

2.3.7 *Crosstalk between adjacent signal receivers*

The crosstalk ratio between two adjacent signal receivers should not be less than 74 dB in the relevant frequency band.

2.3.8 During the register signalling period no speech transmission takes place. It is not essential therefore for the register signalling equipment of systems having separate equipment for that purpose to take account of 2.3.2 to 2.3.7 above but it is desirable to adopt appropriate clauses for efficient signalling performance.

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SECTION 3

CONTROL OF ECHO SUPPRESSORS

Recommendation Q.115

3. CONTROL OF ECHO SUPPRESSORS

3.1 *General*

In order to achieve transmission objectives on long automatic and semi-automatic telephone connections, it is necessary to take into account the effects of echo. A general discussion of echo considerations is given in Recommendation Q.42 which is an extract of Recommendation G.131. Included there are rules governing the use of echo suppressors. Both ideal rules and practical rules are listed. The characteristics of terminal half-echo suppressors are given in Recommendation G.161.

The various rules mentioned above can be carried out at switching centres only if sufficient information is available to coordinate an overall control action. Logical means to obtain pertinent information and the switching considerations governing its practicable use are detailed below. Control based on the transfer of signals between switching centres is given particular attention. Self-contained control action such as tone disablement of echo suppressors for data transmission is not within the scope of this Section.

In the cases to be discussed, control methods will be applied at international exchanges (CTs), but it is recognized that in some countries covering large geographic areas it may be appropriate to extend the control methods into national networks.

3.2 *Compatibility of echo suppressors and signalling equipment*

a) Arrangements should be incorporated in the switching equipment to prevent echo suppressor action from disturbing simultaneous forward and backward signalling via the speech paths. For this case typical arrangements are:

- i) locating the echo suppressors on the switching side of the signalling equipment;
- ii) inhibiting the action of echo suppressors located on the line side of the signalling equipment by means of an appropriate condition extended from the signalling equipment to the echo suppressor while signalling is in progress.

Note. – The new standard half-echo suppressor (Recommendation G.161) if located on the line side of line signalling equipment may adversely affect signalling. This difficulty is possible because with the new standard half-echo suppressor normal operation will at times cause 6 dB additional loss to appear in the path to a line signalling receiver. Operating margins are correspondingly reduced. For example, with signalling receivers for System No. 5 as specified in Recommendation Q.112, signalling reliability could be impaired. Accordingly, adequate operating margins should be assured or the echo suppressor should not be located on the line side of line signalling receivers. With regard to interregister signalling which requires simultaneous transmission in both directions, similar considerations call for disabling the echo suppressors while interregister signalling is in progress in order to prevent the 6 dB loss.

b) Arrangements should be incorporated in the System No. 6 equipment to prevent echo suppressor action from disturbing the procedure for making the continuity check of the speech path.

3.3 *Terminology*

a) Subsequent discussion of control measures will refer only to the standard terminal half-echo suppressor specified in Recommendation G.161. The term *echo suppressor* will be used to denote this device.

b) Two means for introducing echo suppressors are considered as acceptable, these are, the use of permanently associated echo suppressors and the use of echo suppressors inserted from a common pool of echo suppressors.

c) With respect to d.c. control of permanently associated echo suppressors, control actions are said to *enable* or *disable.*

d) With respect to echo suppressors provided from pools, control actions are concerned with *inserting* or *not inserting.*

e) The signals assigned in Systems R2, No. 5 *bis* and No. 6 (and reserved in System No. 4) for echo suppressor control are in most cases a means to guide subsequent exchanges in taking necessary action with respect to possible introduction of an incoming echo suppressor. Thus the descriptive phrases associated with the various signalling systems, as given below, convey comparable meaning in the control plan.

Systems No. 4, No. 5 *bis* and R2:	incoming half-echo suppressor required,
System No. 6:	outgoing half-echo suppressor included.

f) A secondary signalling function related to echo suppressor control provides for the possibility that echo suppressors may not be available at an originating CT. In this case responsibility for both outgoing and incoming echo suppressors may be delegated by signal.

g) A *long* circuit is considered as one which, if used by itself, would require echo suppression.

h) A *short* circuit is considered as one which, if used by itself, would not require echo suppression.

3.4 *Operation without signals*

In Signalling Systems No. 5 and R1, signals are not available for echo suppressor information. In System No. 4 a signal may be applied only if multilateral or bilateral agreements authorize its use. Accordingly, the recommended control plan relies on means other than signals in cases where it has not been found practicable to provide signals. In the case of System No. 5, the normal field of application to long circuits typically indicates the presence of echo suppressors. In the case of System R1, regional control procedures not requiring signals are applicable.

3.5 *Analysis of information at an outgoing international exchange*

The outgoing international exchange, hereafter designated "A", must make a decision with respect to its echo suppressor requirements at the time an outgoing circuit is selected. Unless echo suppressors are not available, one or more of the following items of information should influence this decision:

i) country code of destination and possibly some additional address digits;

ii) information about the actual routing of the call;

iii) nature of outgoing international circuit at A (e.g. satellite circuit);

iv) nature of incoming national circuit at A;

v) signals received over the incoming national circuit at A.

With respect to iii) and iv), the characteristic of primary interest is propagation time. Two general categories, *long* and *short*, are the basis of control action. See 3.3 g) and h) above, for definition of terminology.

3.6 *Decision to be taken at the outgoing international exchange*

If the factors i) to v) in 3.5 above indicate that there is no need to provide echo suppressors on a particular connection, the outgoing exchange should act accordingly and advise subsequent exchanges by signal or other appropriate means, of its decision.

If the information available indicates that the connection to be established will require echo suppression and if it is known that an outgoing echo suppressor is not already provided in the national network, then the outgoing exchange should provide for the outgoing echo suppressor. The outgoing exchange should also, if signals are available, indicate by signal to subsequent exchanges as appropriate what action it has taken.

In the event that an outgoing exchange is unable to provide an outgoing echo suppressor when a need is known, it may call for cooperative action. (Signals X-4 in System No. 5 *bis* and I-11 in System R2 are specifically assigned to make possible a cooperative transfer of responsibility for echo suppressor control from an originating CT to a transit CT. The signal *outgoing half-echo suppressor not included* could be used with System No. 6, but such an application would in effect assume that a modern exchange found sufficient reason to displace an outgoing echo suppressor from its preferred location).

3.7 *Decision to be taken at an international transit exchange*

The decision at an international transit exchange depends on an assessment of switching and signalling information available after the transit CT has selected an outgoing circuit. Information similar to that listed in 3.5 i) to v) above is of interest.

a) When the first transit CT knows that an outgoing echo suppressor has not yet been provided closer to the call source by a signal of CCITT Systems Nos. 5 *bis*, 6 and R2, or by bilateral agreements for specific exceptions, the transit CT should consider the outgoing circuit selected, the ultimate call destination and such other information as indicated above. If a connection requiring echo suppression may result, an outgoing echo suppressor should be enabled or inserted at the first transit CT.

b) When the transit CT concerned knows that an outgoing echo suppressor is located closer to the call source, the question to be decided is the location of the incoming echo suppressor. The incoming echo suppressor is located at the transit CT only when a location nearer to the called party is not practicable. Specifically, an exception may result when the transit CT selects a *short* terminal circuit equipped with CCITT Signalling Systems Nos. 4, 5, or R1. In this case, an incoming echo suppressor should be enabled or inserted at the transit CT.

c) It follows from the above that in every case where an international transit centre interconnects two circuits and knows that echo suppressors will be provided at a preceding location and also at a more distant location, the transit centre should disable or not insert its own echo suppressors. (Full echo suppressors are not covered in the control plan and should not be affected by the procedures described in this chapter.)

d) It is, of course, commonly the case that an outgoing echo suppressor has not been introduced at the outgoing exchange because none is required. When the transit exchange has reason to know of such a situation, it should not introduce echo suppressors and should advise the subsequent exchange when possible that an incoming echo suppressor is not required (or equivalently, that an outgoing echo suppressor has not been introduced).

3.8 *Decision to be taken at the incoming international exchange*

Short circuits equipped with CCITT Systems Nos. 5, R1 and 4 (unless bilateral agreements are reached), provide no signals at the incoming CT for selective use of echo suppressors. As a result, in the absence of separate circuit groups on the same route or other alternatives, the economic choice is to omit echo suppressors. In the case of a call that has passed through a transit exchange en route to the incoming exchange, the requirement for an incoming echo suppressor should then be met at the preceding CT as covered in 3.7 b) above.

With CCITT Systems Nos. 5 *bis*, 6, R2 and 4 (assuming multilateral or bilateral agreement) selective use of echo suppressors on *short* terminal links is a basic option. Therefore, the terminal CT acts in accordance with the control signal received. When an outgoing echo suppressor has been included at a preceding CT, the incoming CT should enable or insert an incoming echo suppressor.

When no echo suppressor has yet appeared elsewhere in the connection, none should be enabled or inserted at the incoming CT.

3.9 *Other considerations*

It is recognized that when echo suppressors are inserted from pools, there is a small probability that no echo suppressor will be available when needed. In this case an (equipment) congestion signal should be given to the calling subscriber.

Nothing in this Recommendation should be construed as discouraging control measures which may supplement the plan described and lead to improved results in specific situations. For example, regional procedures which introduce loss to control echo may be arranged to satisfy both regional and international needs on a selective basis. It is recognized that possibilities for echo control have not been exhausted. If switching and signalling equipment have a changed role in the application of future procedures, this Recommendation will be subject to revision.

SECTION 4

ABNORMAL CONDITIONS

Recommendation Q.116

4.1 INDICATION GIVEN TO THE OUTGOING OPERATOR OR CALLING SUBSCRIBER IN CASE OF AN ABNORMAL CONDITION

In general, when an abnormal condition occurs in the setting up of a call, the outgoing operator in semi-automatic operation and the calling subscriber in automatic operation should receive an indication to show that it is necessary to make a new attempt to set up the call or to take other appropriate action.

The tables in the specifications of the signalling systems give details of the signals that are received at the outgoing exchange when abnormal conditions occur in setting up a call. Each Administration will decide how these signals are to be translated into appropriate indications for outgoing operators or calling subscribers.

Recommendation Q.117

4.2 ALARMS FOR TECHNICAL STAFF AND ARRANGEMENTS IN CASE OF FAULTS

4.2.1 In general, when an abnormal condition is recognized as being possibly due to a fault, an alarm must be given to indicate this condition and, if possible, any other necessary operation must be carried out to avoid circuits being put out of service unnecessarily and to facilitate fault tracing.

4.2.2 There will be the usual alarm and fault indication arrangements for such items as blown fuses, disconnected heat coils, faulty signalling equipment, failures of power supplies, failures of common control equipment, etc., as provided under the specifications of each Administration.

4.2.3 The occupation of each item of equipment such as line circuit equipment, link circuit, operators' calling equipment, selectors, registers, etc., can be indicated by the lighting of a lamp near to the equipment concerned, or by other suitable means, as may be available, e.g. in exchanges with stored-programme control.

4.2.4 It can be arranged for the progress of a call to be followed, in particular the sending or reception of digits or successive numerical signals. In this respect, each Administration will decide the arrangements it desires to install, taking account of the practice which it normally follows in this matter.

Recommendation Q.118

4.3 SPECIAL RELEASE ARRANGEMENTS

4.3.1 *Answer signal not received by an outgoing exchange after receiving a number-received signal or number-received information (Systems No. 4, No. 5* bis *and R2) or after receiving an address complete signal (System No. 6) or after transmitting the ST signal (System No. 5)*

It is recommended that arrangements should be made either in the national network of the outgoing country or at the outgoing international exchange, for the connection to be released if an answer signal is not received within a delay period of 2 to 4 minutes as soon as it is known, or can be assumed, that the called subscriber's line has been reached.

If an Administration adopts a shorter delay period for this forced release condition, there will be a risk that the international connection will be released prematurely on calls not returning an answer signal. If the maximum delay of 4 minutes is exceeded, it will of course involve an unnecessary occupation of international circuits.

4.3.2 *Delay in clearing by the calling subscriber in automatic service* (arrangements made in the outgoing country)

In automatic working, arrangements must be made to clear the international connection and stop the charging if, between one and two minutes after receipt of the clear-back signal [1], the calling subscriber has not cleared. Clearing of the international connection should preferably be controlled from the point where the charging of the calling subscriber is carried out.

4.3.3 *Clear-forward signal not received by the incoming exchange after sending a clear-back signal* [2]

The incoming circuits at the incoming international exchange should include an arrangement for releasing the national part of the connection if, after sending a clear-back signal, a clear-forward signal is not received within 2 to 3 minutes (provided that a similar arrangement is not already made in the national network of the incoming country). This arrangement avoids indefinite blocking of the national circuits of the country of destination or of the subscriber's line in the case of interruptions of the line or equipment faults.

Such timed supervision may also be applied in semi-automatic service.

Recommendation Q.118 ***bis***

4.4 INDICATION OF CONGESTION CONDITIONS AT TRANSIT EXCHANGES

In the case of congestion at a transit exchange, the following conditions apply:

4.4.1 The busy-flash signal or an equivalent signal shall be returned to indicate that there is equipment congestion in the exchange or that no free outgoing circuit is available. This signal shall be returned within the periods specified.

In semi-automatic and in automatic working, the receipt of this signal by the outgoing exchange will cause the clear-forward signal to be sent so as to release the international connection and will give a suitable indication to the calling subscriber or operator, unless an automatic repeat attempt is made.

4.4.2 In addition, in a transit exchange, when reached by a circuit with System No. 4, connection should be made to a recorded announcement to advise the outgoing operator of the place where the congestion occurred.

In this case the busy-flash signal and the recorded announcement will be used at the outgoing exchange in the manner judged most suitable by the Administration of the country concerned.

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1) In the North American network the corresponding time-out is 13 to 32 seconds.

2) These release arrangements may not be used within some regional networks.

PART VIII

Series Q Recommendations (Q.119)

SPECIFICATIONS OF SIGNALLING SYSTEM No. 3

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SPECIFICATIONS OF SIGNALLING SYSTEM No. 3

Recommendation Q.119

SIGNALLING SYSTEM No. 3

CCITT System No. 3 was studied between 1946 to 1949, subject to field trials from 1949 to 1954, and standardized by the CCIF in 1954 as the "one-frequency system". Detailed specifications for this system were drawn up in 1955 and underwent minor amendments during the revisions made in 1956 to 1960. The study of the system, which is applicable in semi-automatic and automatic working was not carried beyond the stage of terminal traffic operation. It is used only for that purpose on the European continent, and the CCITT therefore decided in 1964 that, in principle, it should not be used in new international connections.

The system uses the frequency 2280 Hz for transmitting line and register signals and provides for one-way circuits only.

The specification of Signalling System No. 3 is described in Part 5 of Volume VI of the *Red Book* (New Delhi, 1960). The clauses which relate specifically to this system (Recommendations Q.76 to Q.79) appear in Chapter V of the *Red Book*.

Section 5.2.3 (Efficiency of the guard circuit) in Volume VI of the *Red Book* should, however, be amended according to a decision of the IIIrd CCITT Plenary Assembly (Geneva, 1964) by inserting the following text between the first and second paragraphs:

"To minimize signal imitation by speech currents it is advisable that the guard circuit be tuned.

To minimize signal interference by low frequency noise it is advisable that the response of the guard circuit falls off towards the lower frequencies and that the sensitivity of the guard circuit at 200 Hz be at least 10 dB less than that at 1000 Hz."

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PART IX

Series Q Recommendations (Q.120 to Q.139)

SPECIFICATIONS OF SIGNALLING SYSTEM No. 4

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SPECIFICATIONS OF SIGNALLING SYSTEM No. 4

Signalling System No. 4 is described and specified in Part IX of Volume VI of the *Green Book* (Geneva, 1973) (Recommendations Q.120 to Q.139).

Recommendation Q.120, 1.5.4 "Generation of the number received signal" (page 260 of Volume VI, *Green Book*) should, according to a decision of the VIth Plenary Assembly (Geneva, 1976) be amended to read as follows:

"1.5.4 In semi-automatic working, the incoming register (or associated equipment) after reception of the end-of-pulsing signal acknowledges this numerical signal with an x and then sends back the number-received signals."

In Recommendation.Q.127, 4.4.1(2) (pages 279 and 280 of Volume VI, *Green Book*) the following editorial amendments should be made to the English edition:

- the third line of item 4.4.1(2) should commence:

  "a) 1) with semi-automatic operation if,"

- the fifth line of item 4.4.1(2) should commence:

  "a) 2) with automatic operation if,"

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PART X

Series Q Recommendations (Q.140 to Q.164)

SPECIFICATIONS OF SIGNALLING SYSTEM No. 5

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SPECIFICATIONS OF SIGNALLING SYSTEM No. 5

Signalling System No. 5 is described and specified in Part X of Volume VI of the *Green Book* (Geneva, 1973) (Recommendations Q.140 to Q.164).

According to a decision of the VIth Plenary Assembly (Geneva 1976) the following two paragraphs should be added to 2.1.3.1 e) ii) of Recommendation Q.141 (page 313 of Volume VI, *Green Book*):

"In the case of non-receipt of numerical signals the incoming register should be released 4-9 seconds after the start of sending the proceed-to-send signal (see Table 4 in Annex 2).

In the case of non-receipt of numerical signals the transit register should be released 10-20 seconds after the start of sending the proceed-to-send signal (see Table 6 in Annex 2)."

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PART XX

SUPPLEMENTS TO THE SERIES Q RECOMMENDATIONS

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SUPPLEMENTS TO THE SERIES Q RECOMMENDATIONS

[1] Supplements Nos. 1, 2, 7 and 8 were published in Volume VI of the *Green Book*, Geneva, 1973.
[2] Supplements Nos. 4, 5 and 6 will be found in Volume II.2 of the *Orange Book* and are quoted here just for reference.

Supplement No. 3

INFORMATION RECEIVED ON NATIONAL VOICE-FREQUENCY SIGNALLING SYSTEMS

Country	Frequency (Hz)	Tolerance at the generator terminal (Hz)	Frequency variation possible at the entry to the international circuit (Hz)	Splitting time (milliseconds)	Absolute level of the power of signals at the point of zero relative level (decibels)
Germany [a] (Federal Republic)	3000	± 7.5	± 15	20	−8
[a] In the future the national voice-frequency signalling system will no longer be used	(2280)* * for narrow-band circuits	± 6	± 15	20	−8
Algeria	2000	± 6	± 12	15 then 35 with attenuated 18 dB	−6
Argentina	2040-2400 compound 500	± 6	± 15	60	−9
Australia	600-750 separate 2280	± 5 ± 6	± 15 ± 15	160-210 35	0 −6
Austria	2280	± 6	± 15	30	−6
Bahamas	2600	± 5	± 10	35 maximum	−8 and after attenuation −20
Burundi	3825	± 6	± 15	–	−6
Cameroon	3825		± 15		
Canada	2600	± 5	± 10	35 maximum	−8 and after attenuation −20
Cyprus	3825	± 3	–	–	–
Korea (Rep. of)	3825	± 10	± 10	–	−15
Cuba	2100	± 3	± 10	60	−6
Denmark	3000	± 3	± 8	35	−8
Dominican Rep.	2600				
East African Post and Telecom. Corp. (Kenya, Uganda and Tanzania)	2040-2400	± 6	–	30-40	−9

Country	Frequency (Hz)	Tolerance at the generator terminal (Hz)	Frequency variation possible at the entry to the international circuit (Hz)	Splitting time (milliseconds)	Absolute level of the power of signals at the point of zero relative level (decibels)
Spain	2500	± 3	± 15	10	–6
United States of America	2600	± 5	± 10	35 maximum	–8 and after attenuation –20
France	2280	± 3	± 6	35	–6
Ghana	3825	± 10	–	–	–6
Hungary	2280 3825	± 6 ± 6	± 15 ± 15	25 25	–6 –6 –20
India	2400	± 2	± 10	25 filter loss at 2400 Hz →50 dBm	–10
Ireland	2040-2400 compound 2280	± 6 ± 6	– –	60 35	–9 –6
Israel	3850	± 3	–	–	–5
Italy	2040-2400 separate and compound	± 6	± 15	35	–9
Jamaica	2600 2280	± 5 ± 6	– –	– –	–8 and after attentuation –20
Liberia	3825	± 5	–	–	–6
Madagascar	1000	–	± 20	–	–
Morocco	2280	± 3	± 10	25-35	–6
Mexico	2400	± 5	± 15	35 maximum	–8 and after attenuation –20
Mozambique	2400 500-20 1625 3350 3825	± 6 ± 6	± 15 ± 15	35-40 40-60	–5 –5
Norway	2400	± 2	–	35	–6
New Zealand	600-750 2280	± 3 ± 3	± 3 ± 3	160-210 20-35	–9 –9

Country	Frequency (Hz)	Tolerance at the generator terminal (Hz)	Frequency variation possible at the entry to the international circuit (Hz)	Splitting time (milliseconds)	Absolute level of the power of signals at the point of zero relative level (decibels)
Netherlands	2400-2500 separate	± 2	± 5	30-55	+3.5
Poland	2280	± 6	± 8	45	−6
Portugal	3825	± 5	± 15	30-50	−9
Syria	2040-2400 compound standardization proposed = 2280	± 6	–	70	−11 ± 1
Roumania	3825 or 2280	± 4	–	–	−6
United Kingdom	600-700 separate 2280	± 3 ± 6	– –	140 max. 35 max.	−3 −6
South Africa (Rep. of)	600-750 separate 2280	± 2.5 ± 5	– –	160-210 35 max.	−7 −6
Sweden	2400	± 6	± 11	35-40	−6
Switzerland	3000	± 3	± 6	70	−3.5
Surinam	3825	± 0.8	± 10	–	−18 after attenuation
Czechoslovakia	2280	± 6	± 15	150 then 130 with filter	−6
Thailand	2280	± 6	± 8	35 max.	−6
Tunisia	2400	± 6	± 15	40 max.	−6
U.S.S.R.	1200-1600 separate and compound 2600	± 5 ± 6	± 15 ± 15	40 max. before reply, 150 ± 50 after reply –	−4 changing to −9 after 0.1 sec −7
Yugoslavia	2280	± 6	–	–	−6
Zambia	3825	± 3	± 3	30-50	−20

PART XXI

QUESTIONS ON TELEPHONE SIGNALLING AND SWITCHING ENTRUSTED TO STUDY GROUP XI FOR THE PERIOD 1977-1980

(For the annexes to these Questions, reference should be made to Contribution No. 1 of the period 1977-1980 of Study Group XI.)

LIST OF QUESTIONS ON TELEPHONE SIGNALLING AND SWITCHING ENTRUSTED TO STUDY GROUP XI FOR THE PERIOD 1977-1980

Question No.	Title	Remarks
1/XI	Digital switching for telephony (64 kbit/s)	The study requires close cooperation with Study Groups II, IV, VII and XVIII
2/XI	Common channel signalling system for integrated digital networks. Message transfer part	The study requires close cooperation with Study Groups VII, X and XVIII
3/XI	Common channel signalling system for digital telephony application	Cooperation with Study Group XVIII is necessary
4/XI	Interworking with mobile telephone systems	The results of the study interest Study Group II and CCIR Study Group 8
5/XI	Interworking between signalling systems	
6/XI	Satellite signalling systems	The results of the study interest Study Group XVI and CCIR Study Group 4
7/XI	Specification and description language (SDL) for SPC telephone exchanges	
8/XI	High-level programming language for SPC telephone exchanges	
9/XI	Man-machine language for SPC telephone exchanges	Other Study Groups should take into account the results of the study since they may be applied on a general basis
10/XI	Automatic switching equipment for use in national networks	The study should be related to the studies under the other Questions of Study Group XI. Account should be taken of the parallel studies being undertaken by GAS 6 and other Study Groups
11/XI	Maintenance methods for common channel signalling systems	The study interests Study Group IV
12/XI	Definitions for switching and signalling in telephony	The study requires cooperation with Study Groups VII and XVIII
13/XI	Updating of Series Q Recommendations	

QUESTION ON TELEPHONE SIGNALLING AND SWITCHING ENTRUSTED TO STUDY GROUP XI FOR THE PERIOD 1977-1980

Question 1/XI – Digital switching for telephony (64 kbit/s)

Considering

a) that digital transmission systems are being introduced widely into telephony networks;

b) that digital switching systems are being planned or introduced into telephony networks;

c) that therefore the introduction of integrated (switching and transmission) digital networks for telephony is expected;

d) that the studies undertaken on digital switching matters during the study period 1973-1976 by Special Study Group D (Question 3/D) and Study Group XI show agreement on the need to achieve an international recommendation on characteristics of digital switching systems (see Annex 1 to this Question).

e) that possible advantages may be gained by digital switching system design in which equipment is developed for use by more than one service (telephony, data, etc.), either in dedicated or service integrated networks;

f) that Study Group XI is the body specifically responsible for telephone switching recommendations, while Study Group XVIII is responsible for aspects of digital switching imposed by integrated digital networks;

what Recommendations should apply for digital switching for telephony taking into account the possibility of other services utilizing the basic switched bit rate of 64 kbit/s?

Note 1. – The possibility of service integration should be taken into account. Close cooperation should be sought with Study Group VII, responsible for data services and Study Group XVIII, responsible for studying service integration in digital networks. (For the subdivision of main responsibilities see Annex 2 to this Question).

Note 2. – Maintenance features will form an inherent part of these studies. Close cooperation with other Study Groups (IV, XVIII, etc.) will be necessary in order to identify the relevant maintenance requirements.

Note 3. – Quality of service aspects also form an inherent part of the studies and close cooperation with Study Group II will be necessary.

Note 4. – The Special Study Group D reply to Question 3a)/D as amended by Study Group XI at their final meeting of the Study Period 1973-1976 is given in Annex 1 to this Question in the form of draft Recommendations.

ANNEXES

(to Question 1/XI)

Annex 1. – Reply to Question 3a)/D, in the study period 1973-1976
Appendix to *Annex 1.* – Phase deviation

Annex 2. – Study Group responsibilities for parameters for international digital exchanges

Question 2/XI – Common channel signalling system for integrated digital networks – Message Transfer Part

Considering

a) that integrated digital switching and digital transmission will be used in the future in national, regional and international networks for various services such as telephony and data;

b) that it has been agreed that a new common channel signalling system is required for use in such networks, optimized for operation over 64 kbit/s digital links;

c) that the system should also be capable of working over analogue links and at lower bit rates;

d) that it has been agreed that the signalling system shall have a functional structure clearly separating:

i) the *message transfer* part – common to all services and applications,

ii) the *user* parts – specified for each service or application individually;

(this division being defined in Annex 1);

e) that there is a desire by Administrations to standardize specifications for common channel signalling for national/regional applications using the basic system specified for international use or options of the system;

f) that a complete and detailed specification of the common channel signalling system is required at the end of the 1977-1980 study period for telephony and data services;

g) that requirements for the application of the system for services other than telephony, as defined by other Study Groups (e.g., Study Groups VII and X) in close cooperation with the studies of Study Group XVIII on an integrated services digital network (ISDN), have to be taken into account;

h) that the system will be suitable also for serving the needs of an ISDN as under study by Study Group XVIII,

what Recommendations should apply for the message transfer part of the common channel signalling system?

Note. – Annexes 1, 2 and 3 contain the status of the studies on the new common channel signalling system, reached at the end of the period 1973-1976. It should be clearly understood that these results define the starting point for the further studies during the 1977-1980 study period. They should not be regarded as firm positions which do not allow alternatives to be considered, if required. Only if the chosen methods fail to give an acceptable basic signalling system will other methods be studied.

ANNEXES

(to Question 2/XI)

Annex 1. – General aspects for the study of a new CCS system

Annex 2. – Message Transfer Part
Appendix to Annex 2. – New common channel signalling system for digital networks; increase of efficiency of the error control method by preventive cyclic retransmission (source: Federal Republic of Germany)

Annex 3. – Data application requirements on the message transfer part of the common channel signalling system for digital networks
Appendix to Annex 3. – Data signal traffic model; message type and length distribution for national data applications

Question 3/XI – Common channel signalling system for digital telephony application

Considering

a) that integrated digital switching and digital transmission will be used in the future national, regional and international networks for various services such as telephony and data;

b) that it has been agreed that a new common channel signalling system is required for use in such networks, optimized for operation over 64 kbit/s digital links;

c) that the system should also be capable of working over analogue links and at lower bit rates;

d) that it has been agreed that the signalling system shall have a functional structure clearly separating:

i) the *message transfer* part – common to all services and applications,

ii) the *user* parts – specified for each service or application individually;

(these divisions are defined in Annex 1 to Question 2/XI);

e) that there is a desire by Administrations to standardize specifications for common channel signalling for national regional applications using the basic system specified for international use or options of the system;

f) that a complete and detailed specification of the common channel signalling system is required at the end of the 1977-1980 Plenary Period for telephony and data services;

g) that interworking with existing CCITT signalling systems will be necessary;

h) that Recommendations for the common message transfer part will be prepared from studies under Question 2/XI;

i) that it is desirable that the *user* parts as defined for different services and applications are specified in accordance with the commonality approach;

j) that the system will be suitable also for serving the needs of an integrated services digital network as under study by Study Group XVIII,

what Recommendations should apply for the telephony application of the common channel signalling system?

Note. – Annexes 1 and 2 contain the status of the studies on the new common channel signalling system reached at the end of the study period 1973-1976.

It should be clearly understood that these results define the starting point for the further studies during the 1977-1980 study period. They should not be regarded as firm positions which do not allow alternatives to be considered if required. Only if the chosen methods fail to give an acceptable basic signalling system will other methods be studied.

ANNEXES

(to Question 3/XI)

Annex 1. – General aspects for the study of a new CCS system

Annex 2. – Telephony user part

Question 4/XI – Interworking with mobile telephone systems [1)]

(Questions 4/XI, 5/XI and 13/XI are a continuation of Question 10/XI studied in 1973-1976)

Considering

a) that new types of signalling systems working over radio – including satellite – circuits are being used and others are being studied;

b) that mobile units (e.g. ships) are often moving over large distances covered by radio stations – including satellite earth stations – based in several countries;

c) that automatic service to and from such mobile units is desired in relation to the existing international telephone network;

what new Recommendations and extensions to existing Recommendations should be considered?

Note. – The study of this Question interests Study Group II and CCIR Study Group 8.

ANNEX

(to Question 4/XI)

Conclusions reached by Study Group XI in the study period 1973-1976, regarding maritime communications

Question 5/XI – Interworking between signalling systems

(Questions 4/XI, 5/XI and 13/XI are a continuation of Question 10/XI studied in 1973-1976)

Considering

a) that interworking between all CCITT signalling systems has not yet been completely specified;

b) that digital switching and transmission systems may give rise to new interworking problems;

c) that performance of a signalling system may be reduced owing to interworking with another signalling system of different capacity;

d) that improved methods of representing specifications for interworking between CCITT signalling systems are needed;

e) that the possible use of the specification and description language studied under Question 7/XI should be considered;

f) that comprehensive publication of interworking specifications in a separate part of Volume VI seems desirable;

g) that improved methods of representing interworking specifications can be used to analyse and to reconsider the existing interworking specifications;

h) that rules are needed which should be complied with when specifying new signalling systems and which will help to facilitate interworking between existing CCITT signalling systems and new signalling systems,

1. what new interworking specifications and what extensions to existing interworking specifications should be recommended?

2. what methods of presenting interworking specifications should be recommended?

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1) Although this Question is intended to serve studies regarding different types of mobile telephone systems (e.g., land mobile, maritime mobile), it is expected that studies during the 1977-1980 period will concentrate on the maritime mobile system.

ANNEXES

(to Question 5/XI)

Annex 1. – Existing interworking specifications of signalling systems

Annex 2. – Status report on "interworking of signalling systems"
Appendix 1 to Annex 2: Analysis of existing interworking specifications
Appendix 2 to Annex 2: Lists of interworking telephone events resulting from received backward and forward signals of Systems No. 4, No. 5, No. 6 and R2

Annex 3. – Time-outs

Annex 4. – Transfer of no charge information

Annex 5. – Interworking between international and national common channel signalling system

Question 6/XI – Satellite signalling systems

Considering

a) that various methods of future satellite operation can be visualized;

b) that satellite systems need to interwork with the terrestrial part of the international network;

c) that the CCITT has recommended (Note 1) those characteristics of a type (Note 2) of demand assignment (DA) satellite system, which assures that such a system can be successfully incorporated into the international network,

what new, if any, signalling and switching Recommendations are necessary for:

1) use of standardized CCITT signalling systems via satellite;

2) interworking of satellite systems with the international telephone network;

3) utilization of features which can be provided by satellite systems to serve the signalling needs of the international network (Note 3)?

Note 1. – See Recommendation Q.48 and Supplement 8 to Volume VI of the *Green Book*.

Note 2. – The CCITT has so far considered only a DA system having the control at the earth station and not at the CT. See Annex 2 of Supplement 8 to Volume VI of the *Green Book*.

Note 3. – A satellite system may include both pre-assigned and demand-assigned circuits and the demand-assignment signalling system might be used to carry the signalling information for both pre-assigned and demand-assigned circuits.

A type of broadcast operation of common channel signalling serving several small groups of pre-assigned circuits might also be considered. The possibility of signalling in this manner is of interest to countries which – having small groups of circuits to different relations – wish to introduce a signalling system for use on satellite circuits in an economical way and with similar facilities and possibilities as the most modern signalling system.

Note 4. – The results of the study of this Question interest Study Group XVI and CCIR Study Group 4.

ANNEX

(to Question 6/XI)

Possible use of System R2 on satellite links

Question 7/XI – Specification and description language (SDL) for SPC telephone exchanges

(Continuation of Question 7/XI studied in 1973-1976)

Considering

a) that many operating organizations have installed or are planning to install SPC telephone exchanges in their networks;

b) that a general graphical method of presentation of functional specification and functional description for SPC telephone exchanges, namely the SDL, has been recommended;

c) that the SDL presentation should be easy to draw, to modify and to interpret in relation to the needs of the various organizations; and

d) that it should be easy to relate the high-level programming language to the SDL presentation,

what new Recommendations and extensions to the existing Recommendations should be considered, specifically:

1. what model should be adopted to formally describe the SDL?
2. what computer readable version of the SDL, if any, should be adopted
   i) to allow automatic generation of SDL presentations,
   ii) for logic and traffic simulation,
   iii) for automatic generation of high-level language code?
3. what standards should be adopted for pictorial elements and to what extent should their use be recommended (see Recommendation Z.103)?

Note 1. – It is envisaged that the SDL will be applicable to areas other than SPC telephone exchanges.

Note 2. – Other Study Groups should take into account the results of the study of this Question since they may be applied on a general basis.

ANNEXES

(to Question 7/XI)

Annex 1. – Particular problems requiring further study

Annex 2. – Towards the standardization of pictorial elements within state symbols

Annex 3. – Towards the development of a formal model for the SDL

Question 8/XI - High-level programming language for SPC telephone exchanges

(Continuation of Question 8/XI studied in 1968-1972)

Considering

a) that many operating organizations have installed, or are planning to install, SPC telephone exchanges in their networks;

b) the interim answer to Question 8/XI prepared during the 1973-1976 study period in which it was agreed:

i) that it was not possible to recommend any one existing high-level programming language, either modified or unmodified, as the CCITT programming language for SPC telephone exchanges,

ii) that it is decided to develop a new high-level programming language based on the 16 guidelines contained in Annex 1 to this Question,

iii) that the preliminary language proposal discussed in Annex 2 to this Question is a satisfactory basis for further work;

c) that the experience gained by organizations ready and able to evaluate and implement the language proposal is necessary before Recommendations can be made;

d) that there is a requirement to interrelate between the high-level programming language, the specification and description language and the man-machine language, and that this relationship must be considered in the development of the high-level language;

e) that the aim of establishing a common standard terminology over the entire field of telephony and computer sciences should be considered,

what Recommendations should apply for the CCIT high-level programming language for SPC telephone exchanges?

Note 1. – It is envisaged that this study will result in a high-level programming language that will be applicable as well for other services.

Note 2. – Other Study Groups should take into account the results of the study of this Question since they may be applied on a general basis.

ANNEXES

(to Question 8/XI)

Annex 1. – 16 guidelines for the high-level programming language for SPC telephone exchanges

Annex 2. – Excerpt from the draft manual for a CCITT high-level programming language for SPC telephone exchanges

Question 9/XI – Man-machine language for SPC telephone exchanges

(Continuation of Question 9/XI studied in 1973-1976)

Considering

a) that many operating organizations have installed or are planning to install SPC telephone exchanges in their networks;

b) that to facilitate operation, maintenance, installation and testing of switching systems of different types, a common man-machine language is required;

c) that the man-machine language should embrace the needs of international interworking and information interchange at network level and be suitable for man-man international communication for operation and maintenance;

d) that if there is a requirement to interrelate between the high-level programming language, the specification and description language and the man-machine language, this relationship should be considered in the further development of the man-machine language;

e) that there are recommendations concerning CCITT MML syntax, dialogue procedure and terminology;

f) that a preliminary list of functions which it is anticipated will be controlled by means of the MML is contained in Recommendation Z.318.

what new Recommendations should be considered, specifically:

1. what output language syntax and general semantics should be recommended?

2. what relevant functions should be added to the list of functions?

3. what functions should be specified?

4. how should functions, semantics and operational procedures be formally specified?

5. what should be the final form of implementor guide and user's manual?

6. what new mode operating sequences should be recommended (see Recommendation Z.317)?

7. what checks and safeguards should be recommended?

Note 1. – It is envisaged that the CCITT MML will be applicable as well as for other services.

Note 2. – Other Study Groups should take into account the results of the study of this Question since they may be applied on a general basis.

ANNEXES

(to Question 9/XI)

Annex 1. – Summary replies to a questionnaire circulated in 1974 on man-machine language for SPC telephone exchanges

Annex 2. – List of features and ratings

Annex 3. – Work completed on checks and safeguards at the end of the 1973-1976 study period

Annex 4. – Miscellaneous

Annex 5. – Maintenance terminology proposed by AT&T

Annex 6. – Glossary of terms

Question 10/XI – Automatic switching equipment for use in national networks

Because the introduction of newly developed switching systems presents Administrations with an ever increasing number of engineering, staff training, maintenance and other operational considerations, and also

considering

a) the continuous rapid development of new switching technique;

b) that a large amount of switching equipment will be installed in the next few years, especially in areas of low telephone density;

c) that some degree of compatibility in the installed switching equipment is required in the worldwide automatic telephone network;

d) that some degree of compatibility in the installed switching equipment also is desirable to facilitate the training of staff involved in operation and maintenance of the automatic telephone networks;

and also considering

e) the need to relate the study of this Question to the studies being conducted under Questions 1/XI, 2/XI, 3/XI, 5/XI, 6/XI, 7/XI, 8/XI, 9/XI, 11/XI, and 13/XI;

f) the parallel studies on the subject being undertaken by GAS 6 and other Study Groups;

g) that present and anticipated differences in national networks e.g. numbering plan, routing plan, transmission plan, charging arrangements, etc., must be taken into account;

h) that further design and development of switching techniques are expected to continue,

what Recommendations can be made to assist Administrations in the choice and standardization of automatic switching equipment for use in national networks?

Question 11/XI – Maintenance methods for common channel signalling systems

Considering

a) the introduction of common channel signalling systems such as System No. 6;

b) the limited experience gained thus far concerning the maintenance of common channel signalling systems;

c) the failure of a common channel signalling system would affect a large number of speech circuits,

what techniques should be recommended in addition to existing Recommendations for the maintenance of common channel signalling systems and of the common channel in particular?

Note 1. – For System No. 6 signalling system reference is made to Recommendation Q.295.

Note 2. – See (in Annex 1) the proposals presented in the 1973-1976 study period for network maintenance signals for System No. 6.

Note 3. – The study of this Question interests Study Group IV.

ANNEXES

(to Question 11/XI)

Annex 1. – Proposed network maintenance signals for System No. 6 (Question 2/XI of 1973-1976: "Maintenance methods for Signalling System No. 6") and proposed corrections to reasonableness check tables for Signalling System No. 6

Appendix to Annex 1. – Proposed changes to the Signalling System No. 6 specification

Annex 2. – Maintenance methods for Signalling System No. 6

Question 12/XI – Definitions for switching and signalling in telephony

Considering

– the need for uniformity of terminology in all Study Groups studying digital systems;

– the need to rationalize the definition of terms for different switching and signalling systems,

what definitions should be given to terms used for digital switching and signalling for telephony?

Note. – Definitions produced in Study Group XI which are considered to be of common interest to Study Group VII and Study Group XVIII should be sent to the Rapporteurs for Question 15/VII "Definitions of terms concerning public data networks" and Question 7/XVIII "Definitions for digital networks".

ANNEX

(to Question 12/XI)

Terms approved by Study Group XI concerning digital switching

Question 13/XI – Up-dating of Series Q Recommendations

(Questions 4/XI, 5/XI and 13/XI are a continuation of Question 10/XI studied in 1973-1976)

Considering

a) that CCITT signalling systems are generally implemented over a relatively long period after their specification;

b) that field trials and the subsequent operational experience with CCITT signalling systems frequently lead to a modification of the existing Recommendations;

c) that those signalling specifications which result from interworking problems will be updated under Question 5/XI;

d) that continuing study is needed to cover all necessary modifications of the existing Series Q Recommendations,

what revisions or modifications of the existing Series Q Recommendations falling within the responsibility of Study Group XI should be recommended?

ANNEXES

(to Question 13/XI)

Annex 1. – System R2 specifications-provisional draft Chapter VI (Testing and Maintenance)

Annex 2. – Question to Study Group XI, from Study Group XIII concerning the condition for sending the seizing signal

Annex 3. – An item of Signalling System No. 5

Annex 4. – Question put to Study Group XI by the Plan Committee: Possibility of using Signalling System R2 on 3-kHz submarine cable channels

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