THE INTERNATIONAL TELEGRAPH AND TELEPHONE CONSULTATIVE COMMITTEE
(C.C.I.T.T.)

IInd PLENARY ASSEMBLY

NEW DELHI, 8-16 DECEMBER 1960

RED BOOK

VOLUME VI

Telephone Signalling and Switching

RECOMMENDATIONS
(Series Q)

Part 1 — Signalling in the international manual service.

Part 2 — General recommendations relating to signalling in the semi-automatic and automatic services.

Part 3 — Establishment of international accounts in the international automatic service.

Part 4 — Guiding principles for the maintenance of automatic circuits.

Part 5 — Specifications for standard international signalling and switching equipment.

Annexes to Specifications.

QUESTIONS

Questions of Study Group XI (Signalling and switching).

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Published by the
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Each volume contains extracts from contributions received in the 1957-1960 period dealing with the subject of the volume concerned and considered worth publishing owing to their interest.

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(Volume VI of the Red Book)

Volume VI of the C.C.I.T.T. Red Book (New Delhi, 1960),

replaces

Volume V of the C.C.I.F. Green Book (Geneva 1954) which was completed and modified by Volume I bis of the C.C.I.F. Green Book (Geneva, 1956).

INTRODUCTION

1. The Recommendations in Volume VI of the *Red Book* correspond to the Series E C.C.I.T.T. Recommendations (Volume II bis of the *Red Book*) and to the provisions of the *Instructions for the International Telephone Service.*

2. The following expressions, which are in conformity with the I.T.U. *List of Definitions* (see definitions 16.19, 16.20, 17.53 and 17.54), have been used in Volume VI of the *Red 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 C.C.I.T.T. 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.

3. To simplify the wording, and whenever there is no need to conform to the text of other volumes of the *Red Book* or other C.C.I.T.T. publications, the term "Administration " has been adopted as a short form indicating a telephone Administration or, equally, a private telecommunications Agency.

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PART I

SIGNALLING IN THE INTERNATIONAL MANUAL SERVICE

CHAPTER I

RECOMMENDATION Q.1

SIGNAL RECEIVERS FOR MANUAL WORKING

In 1934 (C.C.I.F. *White Book*, Volume III, Xth Plenary Assembly, Budapest, 1934), a signalling current having a frequency of 500 c/s $\pm 2\%$, interrupted at a frequency of 20 c/s $\pm 2\%$, was provisionally chosen for manually-operated circuits used in international communications.

500 c/s was chosen as the frequency to be transmitted, under normal conditions, by carrier terminal equipment and line repeaters. To avoid false signals due to voice currents, it was also considered desirable to interrupt the 500 c/s signalling current at low frequency. The use of a uniform interruption frequency of 20 c/s 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 point or an absolute power level of zero (with a tolerance of ± 1 decibel or ± 0.1 neper) which corresponds to an average power for the interrupted signalling current of 0.5 milliwatt, with a tolerance of ± 1 decibel or ± 0.1 neper.

The power levels specified above were chosen in 1954 (XVIIth C.C.I.F. 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, which must not exceed 2.5 microwatt hours or 9000 microwatt seconds 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 c/s signals are liable to be sent over wide-band carrier systems (coaxial carrier systems) it is desirable, to avoid overloading the repeaters, that the duration of the 500/20 c/s signals sent to line shall not exceed 2 seconds and they should be limited to this value by automatic means.

Since, in general, the *Instructions on the International Telephone Service* (Article 28) require the signalling current sent over an international circuit to have a duration of at least two 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 tha duration at 2 seconds.

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

ANNEX

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

(a) Sending of signals

Power. — The signal transmitter shall supply a sinusoidal current at a frequency of 500 c/s $\pm 2\%$ interrupted at a frequency of 20 c/s$\pm 2\%$.

The effective mean power of the 500/20 c/s current is fixed at 0.5 milliwatt or an absolute power level (ref. 1mW) of -3 decibels or -0.35 neper (with a tolerance of ± 1 decibel or 0.1 neper) 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 c/s signalling current.

(b) Reception of signals

Sensitivity. — The signal receiver shall operate correctly when the 500/20 c/s current at the input to the signal receiver is within the following limits:

$$-0.95+n \leqslant \mathrm{N} \leqslant +0.25+n \text{ neper}$$
$$-8.5+n \leqslant \mathrm{N} \leqslant +2.5+n \text{ decibels}$$

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 leve and include a margin of ± 0.5 neper (± 4.5 decibels) on the nominal absolute power level of the 500/20 c/s 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 c/s guaranteed to within $\pm 2\%$ and at an interrupting frequency of 20 c/s 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 recognised).

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 decibel or 0.035 neper for any frequency effectively transmitted by the circuit.

CHAPTER II

RECOMMENDATION Q.2

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

The directives relating to 500/20 c/s signalling sets are provisional. An Administration or private operating Agency 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 established for the semi-automatic service. 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 completely with clauses 5.2 and 6.2 of the Specifications for automatic equipment depending on whether one-frequency or two-frequency signal receivers are concerned. The general clauses of sections 3.8 and 3.9 of those specifications concerning sensitivity and the insertion of signal receivers should also be observed.

Sending of signals

The frequency and power level of the signalling current must be in accordance with the conditions specified in clauses 5.1 or 6.1 of the Specifications for 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 c/s signalling.

Reception of signals

At the receiving end, provision must be made for a splitting arrangement conforming to the clauses of sections 5.3 or 6.3 of the Specifications for automatic equipment. This splitting arrangement can be either:

— an integral part of the signal receivers,

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

The signalling equipment at the output of the signal receiver and 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 old type 500/20 c/s signal-receiver equipment.

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

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PART 2

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

CHAPTER I

C.C.I.T.T. basic recommendations on international automatic and semi-automatic working

(Geneva, 1954)

RECOMMENDATION Q.5 *

ADVANTAGES OF SEMI-AUTOMATIC WORKING IN THE INTERNATIONAL TELEPHONE SERVICE

The C.C.I.T.T.,

CONSIDERING

1. the large economies in personnel that can result from the introduction of semi-automatic working at the incoming exchange,

2. the very small number of faults due to the equipment used for the international semi-automatic service,

3. the improvement in the efficiency (ratio of chargeable time to total holding time) of circuits using semi-automatic working compared with the efficiency of manual circuits operated on a demand basis,

4. the improvement in the quality of the service given to subscribers due to the reduction in the time of setting up a call,

5. the fact that all types of call—ordinary, preavis, calls requiring an incoming B operator or booking at incoming delay positions—can be set up without difficulty over semi-automatic circuits, so that semi-automatic circuits can be used exclusively on an international relation,

* This Recommendation also appears as Recommendation E. 21 in Series E (Telephone operation) of the C.C.I.T.T. Recommendations.

DRAWS THE ATTENTION of Administrations **

to the advantages of semi-automatic working 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 C.C.I.T.T.,

CONSIDERING

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

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

3. that the change-over from semi-automatic to automatic working may be done without any major modification to the international circuits or to the switching equipment at transit and incoming exchanges;

4. 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;

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

6. 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)

The C.C.I.T.T.,

CONSIDERING

that standardization of the signalling systems to be used for international automatic and semi-automatic working is necessary, to avoid having several different types of equipment serving the various routes from any one exchange,

* This Recommendation also appears as Recommendation E.21*bis* in Series E (Telephone operation) of the C.C.I.T.T. Recommendations.

** or Recognized private operating Agencies.

that the field trials conducted with public traffic in 1953 and 1954 to enable a choice to be made between two different systems proposed for standardization (one-frequency or two-frequency system) indicated that, in the opinion of the operating services, both systems were satisfactory and that no clear evidence was afforded of the superiority of one system over the other,

DESIRING

that the C.C.I.T.T. Recommendation concerning the international signalling system for automatic and semi-automatic working could be generally applied by all administrations,

UNANIMOUSLY RECOMMENDS

that under the conditions shown below, Administrations should use, for international automatic and semi-automatic working, one or other of the two standardized systems specified in Part V of Volume VI of the *Red Book*.

Terminal traffic

The C.C.I.T.T.,

CONSIDERING

that the introduction of automatic and semi-automatic service on an international route, used solely for terminal traffic, requires bilateral agreement only between the administrations of the two countries concerned,

RECOMMENDS

1. that one or other of the two international signalling systems standardized by the C.C.I.T.T. be used on an international route used for terminal traffic;

2. that the choice as to which of the two signalling systems is to be used should be determined by mutual agreement,

CONSIDERING

that where agreement cannot be reached to use the same signalling system for both directions of circuit operation, it would be useful to have a simple rule for reaching an agreement on the signalling system to be used for each direction of operation,

RECOMMENDS

reference to the following rule: " The system to be used in each direction on a route used for terminal traffic will be the system used (or preferred) at the outgoing exchange ", since such a rule has the advantage, by comparison with the inverse rule, that the choice of system would depend on the equipment at the incoming exchange, that, in a number of exchanges, the outgoing exchange (semi-automatic or automatic) can have a single common access to the equipment for all outgoing routes.

Transit traffic

The C.C.I.T.T.,

CONSIDERING

that the introduction of transit working in the automatic and semi-automatic service does not depend solely on agreements between the Administrations of two countries, but on agreements between those of several countries,

that the existence of both signalling systems used together for transit working would give rise to very great difficulties,

HAVING NOTED, IN 1954, when the choice of a standardized signalling system was considered,

that the majority of the countries that preferred the one-frequency system attached only minor importance to transit routings, whereas the majority of countries that considered that transit working was important for the routing of their traffic, and which desired to see a rapid development of transit working, were in favour of the two-frequency system,

UNANIMOUSLY RECOMMENDS

that Administrations should normally use the two-frequency system for transit working.

Note. — In accordance with this recommendation, the transit equipment and the circuits used for transit in the automatic and semi-automatic service should be of the two-frequency type. An exchange at which the outgoing circuits used for terminal traffic are normally of the one-frequency type, can only serve for switching a transit call automatically when, in addition to the one-frequency equipment, two-frequency transit equipment is installed and when a number of two-frequency outgoing circuits are provided on the transit routes.

The volume of transit traffic to be switched through this exchange would therefore have to be sufficient to justify not only the cost of installing the automatic transit equipment but also the existence of two different types of outgoing circuits and the possible reduction in the efficiency of the circuits arising from their division into two distinct groups.

If traffic conditions do not justify such measures, it will nevertheless be possible for the transit traffic to be routed through such an exchange, to obtain some part of the advantages resulting from the use of semi-automatic circuits (elimination of the incoming operator, speedier setting-up of calls). In fact, the operator at the outgoing exchange needs only to route a transit call via the code-11 or code-12 operator at this transit exchange (via a one-frequency or two-frequency automatic circuit) and this latter operator can then set up the call over one of her outgoing one-frequency automatic circuits.

(Q.7)

CHAPTER II

Numbering of subscribers' lines and routing of calls in international automatic and semi-automatic working

RECOMMENDATION Q.10

DEFINITIONS RELATING TO NATIONAL AND INTERNATIONAL NUMBERING SCHEMES

1. international prefix, for access to the international automatic network

A combination of digits to be dialled by a calling subscriber making a call to a subscriber in another country; it provides access to the automatic outgoing international equipment.

Examples of the international prefix are:

00	in Germany, Italy and Switzerland
09	in the Netherlands
010	in Great Britain
91	in Belgium
19	in France

2. international code

A numerical code indicating the required country. In general, one international code has been allotted to each country, but there are exceptions to this in the case of certain very big countries.

3. trunk prefix, for access to the automatic trunk service

A digit or combination of digits to be dialled by a calling subscriber making a call to a subscriber in the same country; it provides access to the outgoing automatic trunk equipment.

Examples of the trunk prefix are:

0	in Germany, Italy, Belgium, Switzerland, Great Britain, the Netherlands, etc.
9	in Spain
16	in France

4. trunk code

A digit or combination of digits (not including the trunk prefix) to be dialled prior to the subscribers " local number " when the calling and called subscribers are in different numbering areas.

The trunk code depends on the country concerned and is composed of:

a) a " regional code " indicating the geographical zone to which the called subscriber belongs, and within which subscribers can call one another by their local numbers:

For example:

in France:

Paris area (Seine, Seine-et-Oise, Seine-et-Marne, Oise):
trunk code 1
Nice area (Alpes-Maritimes):
trunk code 92

in Belgium:

Brussels area: trunk code 2
Namur area: trunk code 81

in Germany or the Netherlands:

The geographical area defined above corresponds to the local network:
Düsseldorf local network: trunk code 211
Amsterdam local network: trunk code 20

in Great Britain:

This definition applies to certain networks such as that of London, the trunk code for which is: 1

etc.

b) a " numbering area code ", followed by an exchange code when the directory entry of the called subscriber does not include the exchange code.

For example:

in certain areas of Great Britain:

Truro: group centre: trunk code TR 3
Perranporth (in the Truro group): TR 372.

5. local number

The number to be dialled by a subscriber to obtain another subscriber in the same network.

The local number is the one given in the directory against the name of the called subscriber.

6. national number

The number formed by all the digits (and shown in telephone directories and on letter-heads) that must generally be dialled by the calling subscriber to obtain another subscriber in the same country.

Two cases arise, depending upon whether published numbers in official directories or on subscribers' letter-heads, show the trunk prefix as included or not in the trunk code.

(a) Trunk prefix published as if included in the trunk code.
In this case, the national number consists of the following sequence:

— the trunk prefix,
— the trunk code,
— the local number.

Examples:

The national number of subscriber 12 34 56 in Brussels is made up as follows: | 0. | 2 | 12 34 56 |

and the national number of subscriber 12 34 56 in Düsseldorf is made up as follows: | 0. | 211 | 12 34 56 |

(b) Trunk prefix not included with the trunk code.
In this case, the national number consists of the following sequence:

— the trunk code,
— the local number.

Examples:

The national number in France (where the trunk prefix is 16), of subscriber SEGur 45 67 is made up as follows: | 1 | SEG 45 67 |

and that of subscriber 12 34 56 in Nice is made up as follows: | 92 | 12 34 56 |

7. significant number

The combination of digits necessary for the selection of a subscriber from a trunk exchange in his own country.

The significant number always consists of:

— the trunk code,
— the subscriber's local number.

The trunk prefix does not form part of the significant number. In countries where this trunk prefix is not included with the trunk code, the significant number is the same as the national number.

8. international number

The number formed by all the digits that must be dialled by the calling subscriber, following the international prefix to obtain a subscriber in another country.

The international number consists of the following sequence:

— the access code of the country required,
— the national number of the called subscriber (Definition 6 above).

Examples:

The international number of subscriber 12 34 56 in Brussels is:	22.0.2 12 34 56
The international number of subscriber SEG 45 67 in Paris is:	33.1.SEG 45 67
The international number of subscriber 12 34 56 in Düsseldorf is:	49.0.211 12 34 56
The international number of subscriber 12 34 in Perranporth (in the Truro group) in Great Britain is:	44.0.TR 372.12 34

RECOMMENDATION Q.11 *

NUMBERING OF SUBSCRIBERS' LINES IN AUTOMATIC AND SEMI-AUTOMATIC INTERNATIONAL WORKING

1. National numbering scheme

1.1 Each telephone Administration*** should give the most careful consideration to the preparation of a national numbering scheme for its own network. This scheme should be designed so that a subscriber is always called by the same number in the trunk service. It should be applicable without exception to all incoming international calls, but may be modified as required in the national service, for instance, for traffic between neighbouring towns or areas.

1.2 Wherever possible, the national numbering scheme of a country should be such that the first, or at most the first two digits following the " trunk prefix " **:

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

(b) indicate the charging area in those countries where there are several, (the first or the first two digits in question are those of the " significant number ") **.

2. Use of figures and letters on dials

2.1 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.

2.2 For fully automatic international service, it is preferable that the national numbering scheme should not involve the use of letters (associated with figures on dials), because in many countries, dials do not bear letters. The use of letters in national

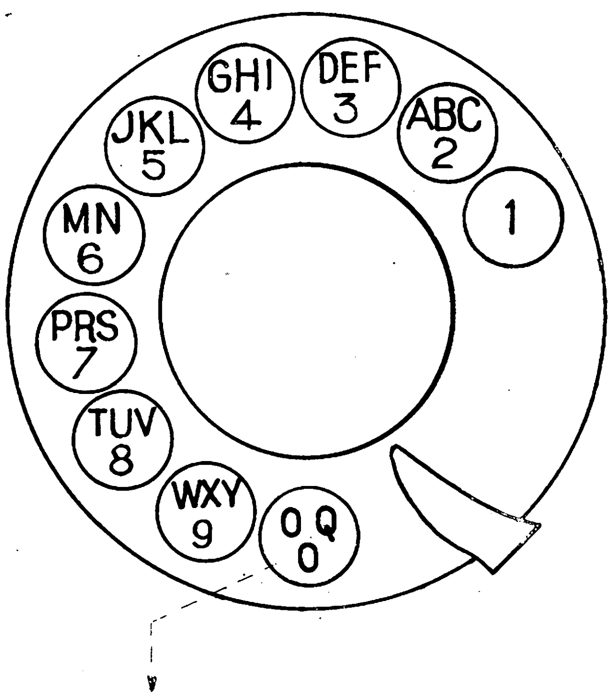
* This Recommendation also appears in the Series E of Recommendations (Telephone operation and tariffs) as Recommendation E 29.

** See the definitions of these expressions in Recommendation Q.10.

*** or Recognized private operating Agencies.

numbering schemes may, however, be necessary for national reasons. For example, countries using letters in their local numbers will naturally use them in their national numbering.

2.3 The dial shown below uses the arrangement of letters and figures employed by the French and United Kingdom Administrations (the latter, however, has only the letter O, associated with figure 0 (zero)). The dials or key-sets *used by international operators for semi-automatic working in Europe* should have this arrangement of letters and figures.



Remark

On most subscribers' dials used by the British Administration, only the letter " O " is associated with the figure " 0 ". However, since October, 1959, new dials also include the letter Q associated with the figure " 0 " with a view to automatic international service.

2.4 For fully automatic international service to countries using dials with letters, it would be helpful, in a country where the dials bear figures only:

(a) to include in the directory a table for converting into figures the letter codes of exchanges in countries with which a fully automatic service is available;

(b) to supply at the time of opening this fully automatic service a booklet of instructions containing the conversion table, to the main subscribers to the international service;

(c) if necessary and on request, to replace dials without letters by dials with letters.

2.5 It would also be desirable, in countries with letter dials, that subscribers with considerable international traffic should be requested to show on their note-paper, below their usual telephone number, the number with the letters converted into figures (i.e. a number with figures only).

2.6 Some examples are annexed, *as documentary information*, to show the association of letters and numbers used on dials in the United States, the U.S.S.R., etc. The inclusion of these examples should not, however, be taken as a C.C.I.T.T. recommendation that such dials are for general use.

3. Access prefixes and codes

3.1 *International prefix* *

International standardization of a code for access to the international network for fully automatic international operation has not been possible since it came up against national numbering schemes that were already in existence. (Such standardization of a code for access to the international automatic network, incidentally, would be of interest only to the few users who, during a journey to a foreign country, desire to dial an international number without the assistance or the explanations of a national of the foreign country.)

3.2 *International code* *

3.2 (1) A list of 2-digit international codes has been prepared by the C.C.I.T.T. for the countries of Europe and the Mediterranean Basin. These international 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.

The list of international codes is given at the end of this Recommendation.

* See definitions in Recommendation Q.10.

3.2 (2) Twenty special codes have been reserved in this list. They may be used in semi-automatic service for routing outgoing calls from an international exchange when there is no analysis of the first digits of the called subscriber's national number (method explained in 1.2) between adjacent countries, to give the most economical routing when operators have dialling access to the international circuits and when the required country has more than one international exchange. They should be used solely for routing traffic over direct routes between two countries.

3.3 *Trunk prefix * and trunk codes **

3.3 (1) The C.C.I.T.T. has considered past and future ways of showing " national numbers " in telephone directories and on letter-heads. Two distinct cases were noted:

— countries where access to the automatic national trunk network is obtained without the subscriber having to receive a second dialling tone;

— cases where a second dialling tone is given after the trunk prefix has been dialled.

In the first case, directories and letter-heads usually show the trunk prefix preceding the " trunk code " representing the numbering area of the called subscriber.

In the second case, however, the trunk prefix does not appear in directories and on letter-heads.

3.3 (2) The C.C.I.T.T. recommends that Administrations ** :

— print their directories so as to show, for example, at the top of the page or in brackets after the name of the local network, those digits that precede the local number in order to form the national number, and that have to be dialled in order to reach a subscriber when the call is made from a telephone in a different numbering area from that of the called subscriber;

— invite subscribers who already have a number in the national numbering scheme allocated to them to show that number in a similar fashion on their letter-heads (with brackets enclosing the figures to be dialled to reach a subscriber in a different numbering area).

Examples of this are as follows:

Case 1:

The " trunk code " for Geneva is 22 and the prefix for access to the automatic trunk network in Switzerland is 0. A Geneva subscriber's number would therefore be shown as: (022) 12 34 56

* See definitions in Recommendation Q.10

** or Recognized private operating Agencies.

Case 2:

For a French subscriber (the " trunk code " for Nice (Alpes-Maritimes) is 92, and the prefix for access to the automatic trunk network in France is 16, but the latter does not have to be printed since there is a second dialling tone): a Nice subscriber's number would therefore be shown as: (92) 12 34 56

3.3 (3) It is recommended by the C.C.I.T.T. that the Administrations* of countries that have not yet adopted the " trunk prefix " for access to their national automatic trunk network, and which do not propose to introduce a second dialling tone after the trunk prefix, should adopt a prefix composed of a single digit, preferably 0.

The reasons for this recommendation are:

a) to ensure that registers will not have to store more than 11 digits for the national number (trunk prefix plus ten digits for the significant number);

b) 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.

In countries where second dialling tone is given after the trunk prefix has been dialled, there is a free choice for the trunk prefix.

3.3 (4) In the automatic international service, following the international prefix and the international code of the country called, the caller should dial the national number of the called subscriber, that is to say, the called subscriber's directory number or the number given on his letter-head.

In accordance with Recommendation 3.3 (2) above, the trunk code for the numbering area to which the called subscriber belongs:

— will normally be preceded by the trunk prefix (0 in most European countries),

— will not be preceded by the trunk prefix when, in the national service of the country called, a second dialling tone is given between the sending of the trunk prefix and the trunk code.

* or Recognized private operating Agencies.

NUMBERING SCHEME

LIST OF CODES FOR AUTOMATIC AND SEMI-AUTOMATIC INTERNATIONAL TRAFFIC IN EUROPE AND THE MEDITERRANEAN BASIN

(International and special codes)

1. Numerical list

A. *Special codes*

00 to 19

B. *International codes*

20	Poland
21	Algeria (France)
22	Belgium
23	Austria
24	—
25	Finland
26	Arabia
27	Cyprus
28	Bulgaria
29	Gibraltar
30	Greece
31	Egypt (United Arab Republic)
32	—
33	France
34	Israel
35	Hungary
36	Turkey
37	Lebanon
38	Norway
39	Italy
40	Libya
41	Jordan
42	Portugal
43	Malta
44	Great Britain
45	—
46	Sweden
47	Rumania
48	Morocco
49	Germany
50	Spain
51	—
52	Ireland
53	—
54	Syria (United Arab Republic)
55	the Netherlands
56	—
57	Czechoslovakia
58	—
59	Albania
60	Luxemburg
61	Denmark
62	Tunisia
63	Yugoslavia
64	Iceland
65	—
66	Switzerland
67	—
68 and 69 70 to 79	U.S.S.R. (European Republics)
80 to 89	Spare codes (in addition to codes 24, 32, 45, 51, 53, 56, 58, 65, 67)
90 to 99	*Intercontinental traffic*

2. List of international codes on a geographical basis

I. — *Western Europe*

Belgium	22
Luxembourg	60
France	33
Great Britain	44
Ireland	52
Spain	50
Portugal	42
Gibraltar	29

II. — *Central Europe*

Austria	23
Hungary	35
Italy	39
Germany	49
Switzerland	66
Czechoslovakia	57
Poland	20

III. — *Northern Europe*

Denmark	61
Finland	25
Norway	38
the Netherlands	55
Sweden	46
Iceland	64

IV. — *Eastern Europe, the Balkans and Asia Minor*

Albania	59
Bulgaria	28
Greece	30
Rumania	47
Yugoslavia	63
Turkey	36
U.S.S.R. (European Republics)	68 and 69 70 to 79

V. *Mediterranean Basin*

Algeria	21
Arabia	26
Cyprus	27
Egypt (United Arab Republic)	31
Israel	34
Jordan	41
Lebanon	37
Libya	40
Malta	43
Morocco	48
Syria (United Arab Republic)	54
Tunisia	62

VI. — *Spare codes*

24, 32, 45, 51, 53, 56, 58, 65, 67 and 80 to 89.

VII. — *Intercontinental traffic*

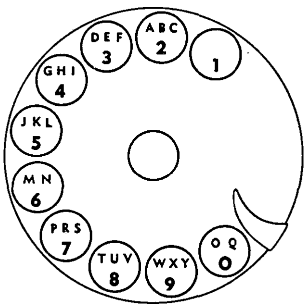
Codes in the series 90 to 99.

ANNEX

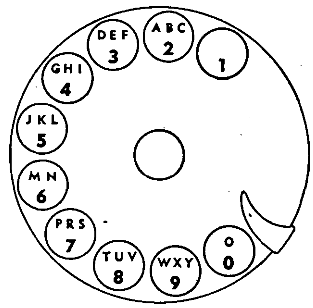
(to Recommendation Q.11)

Dials with letters and numerals, used in various countries

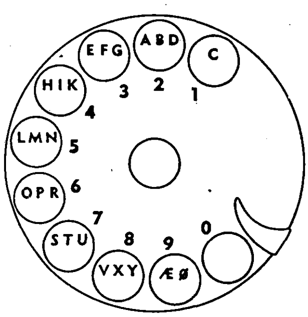
Dials are shown here for information only. Inclusion of figures showing these dials should not be considered as a C.C.I.T.T. recommendation that such dials should be put into general use.



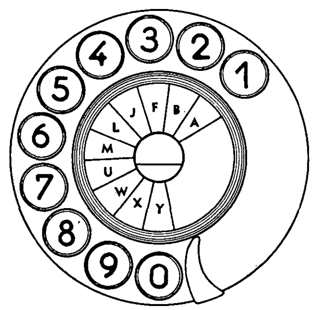
FRANCE
UNITED KINGDOM (new type)



UNITED KINGDOM
(old type)

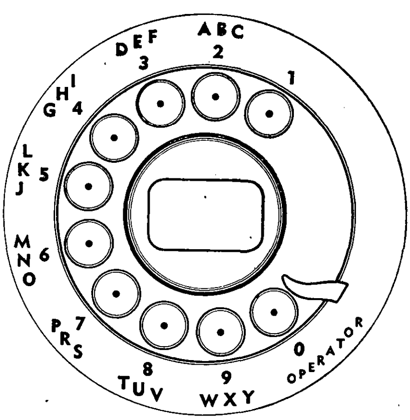


DENMARK

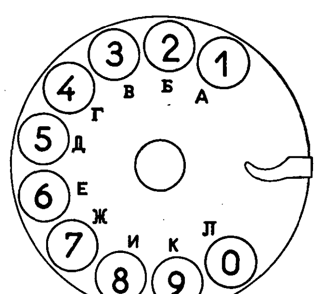


AUSTRALIA

Telephone numbers in the Australian network are being progressively changed from the letter/numeral to the all numeral representation and, when this change is complete, the letters printed on the central card of the dial will no longer be supplied.



U.S.A.



U.S.S.R.

CHAPTER III

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 ALLOWED DURING THE BUSY HOUR

To simplify calculations when plans are being drawn up for carrier systems on cables or radio links, the C.C.I.T.T. has adopted a conventional value to represent the *mean absolute power level* (at a zero relative level point) of

the speech + signalling currents, etc.

transmitted over a given 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 dbm (—1.73 nepers) (mean power = 31.6 microwatts).

This total mean power (about 32 microwatts) is *conventionally* distributed as follows:

— a nominal mean power of 10 microwatts for all *signalling* and *tones;*

— a nominal mean power of 22 microwatts for other currents, namely:

speech currents (including echoes);

carrier leak;

telegraph signals, when the telephone circuit is used to carry voice frequency telegraphy.

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

36 000 microwatt · seconds for one direction of transmission,

72 000 microwatt · seconds for both directions of transmission.

* See Annex 1 to the Specifications of Part V.

Note 1. — No account is taken, in the values of 32 and 22 microwatts, of the power of pilot signals which are assumed to be an integral part of the carrier system not affecting the power transmitted over the telephone channels. It might be noted that for carrier systems now in service, the pilot power can be treated as negligible.

Note 2. — The nominal mean power of 22 microwatts takes account of the " activity factor " of a telephone channel (for one direction of transmission).

Note 3. — Annex at page 291 of Vol. III *bis* of the *Green Book* (Geneva, 1958) contains documents dealing with the volume and power of speech currents transmitted over international telephone circuits.

RECOMMENDATION Q.16

MAXIMUM PERMISSIBLE VALUE FOR THE ABSOLUTE POWER LEVEL (POWER REFERRED TO ONE MILLIWATT) OF A SIGNALLING PULSE

The C.C.I.T.T. 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 below:

TABLE 1

Maximum permissible value of power at a zero relative level point

Signalling frequency c/s	Maximum permissible power for a signal at a zero relative level point (Microwatts)	Corresponding absolute power level	
		Nepers referred to 1 mW	Decibels referred to 1 mW
800	750	−0.11	−1
1200	500	−0.35	−3
1600	400	−0.45	−4
2000	300	−0.57	−5
2400	250	−0.7	−6
2800	150	−0.9	−8
3200	150	−0.9	−8

Note. — 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 (or 0.35 neper) 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:

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

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 break down points when a telephone circuit comprises two or more carrier links. No d.c. 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 d.c. repetition at such points.

3. Easy replacement of a faulty line section : in completely separate channel signalling, replacement of a faulty line section is complicated by the necessity for a separate signalling channel association.

4. Impossibility to set up a trunk connection on a faulty speech path: this can arise with completely separate channel signalling, and to a lesser extent with built-in separate channel signalling.

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 relative to that of a system with a smaller signalling bandwidth. In in-band signalling, realisation of this advantage is limited to those signals not required to be protected against audio signal limitation. The full bandwidth is not available for signalling in out-band and separate channel signalling.

6. The additional cost of a separate signalling channel, and the administrative complication of maintaining records of speech and signalling channel association, do not arise.

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 the advantages (3) and (6) of in-band signalling.

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

Completely separate channel signalling has the advantages (1), (2) and (3) of out-band signalling, and compared with out-band signalling, and built-in separate channel signalling, has the additional advantages:

1. No d.c. repetition is necessary, and no distortion of signals arises, at carrier system break down points when a telephone circuit comprises two or more carrier links.

2. All the signalling equipment can be located at the telephone exchange. When part of the signalling equipment is located at the carrier terminal and part in the telephone exchange, complications arise when the repeater station is remote from the telephone exchange.

C. *Design of systems standardized by the C.C.I.T.T.*

The signalling systems standardized by the C.C.I.T.T. were designed between 1946 and 1949 on the basis of signalling within the speech band.

RECOMMENDATION Q.21

SYSTEMS RECOMMENDED FOR " OUT-BAND " SIGNALLING

When Administrations wish to make mutual agreements to use out-band signalling systems for direct relations not used for transit traffic, the C.C.I.T.T. 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 (ref. 1 mw) at a zero relative level point.)

Type I (discontinuous signals)
Frequency: virtual carrier (zero frequency).
Level: high,
for example −3dbm0 (−0.3 Nm0).

Type II

A.
(discontinuous signals)
Frequency: 3825 c/s
Level: high,
for example about −5 dbm0 (−0.6 Nm0).

B.
(semi-continuous signals)
Frequency: 3825 c/s
Level: low,
for example −20 dbm0 (−2.3 Nm0).

* * *

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 c/s.

Types 2_A *and* 2_B are compatible with only those group and supergroup reference pilots having a displacement from the virtual carrier frequency (zero frequency) of 80 c/s.

ANNEX 2

(to Recommandation 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 (ref. 1 mW) at a zero relative level point.

Mean frequency: 4,4 kc/s ±10 c/s

Level:

— discontinuous signals
 −6 dbm0 (−0.7 Nm0)

— semi-continuous signals
 Value between −20 dbm0 (−2.3 Nm0)
 and −17.4 dbm0 (−2.0 Nm0).

RECOMMENDATION Q.22

FREQUENCIES TO BE USED FOR SIGNALLING WITHIN THE SPEECH BAND

To reduce the liability to signal imitation by speech currents, the frequencies for an in-band signalling system should be chosen from among the frequencies in the band in which speech signal power is lowest, i.e. frequencies above 1500 c/s.

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

C. Protection of " in-band " signalling systems against each other

RECOMMENDATION Q.25

NATIONAL SIGNALLING SYSTEMS. MUTUAL PROTECTION FOR IN-BAND SYSTEMS

1. General

To avoid one " in-band " signalling system interfering with another, it is advisable to limit the length of any part of:

(1) the *international* signal that may be able to pass from the international circuit into the national system (protection of national systems),

(2) the *national* signal that may be able to pass:

(a) from the national signalling system to the international signalling system (protection of the international system),

(b) from one national signalling system to the national signalling system of another country via the international connection that has been set up (protection of national systems).

2. Protection of national systems against international systems

Condition 1.(1) above is met because international signalling systems have a splitting arrangement on each international circuit. The " splitting time " of such systems is therefore specified, it being defined as the maximum time during which any part of the international signal can pass into a national system. The splitting times of standardized systems (see Part V) are:

35 milliseconds in the case of the one-frequency system,
55 milliseconds for the compound signal element in the two-frequency system.

3. Protection of the international against national systems

Condition 1.(2) *(a)* above is generally covered because:

— the value of 60 milliseconds given in the specifications as the minimum recognition time of a line signal (see sections 5.4.2.3 and 6.4.2.3) is in general greater than the splitting time of national systems (see the tables giving the basic characteristics of national signalling systems on pages 40 and 41),

— 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 the national signalling system is greater than 55 milliseconds 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 55 milliseconds.

4. Interference between national signalling systems when they are interconnected via an international circuit

4.1 To ensure protection of national signalling systems one against the other (such protection being defined under 2 *(b)* above) national signalling systems in the audio frequency bands should comply with the following two recommendations:

(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 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 recommendations is to avoid interference, especially under conditions that may exist on international automatic connections.

4.2 Recommendation *(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 this recommendation 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.

4.3 Recommendation *(b)* avoids the false operation of the guard circuit of a signal receiver situated at the distant end of a national circuit.

ANNEX
(to Recommendation Q.25)

INFORMATION RECEIVED ON THE SUBJECT OF NATIONAL VOICE-FREQUENCY SIGNALLING SYSTEMS

TABLE 1
Europe and Mediterranean Basin

	Germany (Federal Republic)		Austria	Belgium	Denmark	Spain	France	Great Britain	
Frequency (c/s)	3000	(2280)*	2280	2280	3000	2500	2000	600-750 separate	2280
Tolerance at the generator terminals (c/s)	±7,5	±6	±3	±5	±6	±3	±6	±3	±6
Frequency variation possible at the entry to the international circuit (c/s)	±15	±15	±7	—	±8	±6	±12	±5	±8
Splitting time (milliseconds)	30	30	30	8	35	10	15 then 35 with attenuated 18 db	140 or 400 320	35
Absolute level of the power of signals at the point of zero relative level	−8	−8	−6	−6	−8	−6	−6	+3	−6
(decibels)	* for narrow band circuits								

	Ireland		Italy	Morocco	Netherlands	Norway	Poland	Sweden	Switzerland	Czechoslovakia	Tunisia	U.S.S.R.		Yugoslavia
Frequency (c/s)	2040/2400 compound	2280	2040/2400 compound	2280	2400-2500 separate	2400	2280	2400 (for 2 wires: 2200 and 2400)	3000	2280	2280 500/20	1200/1600 separate and compound	2100 or 1600	2280
Tolerance at the generator terminals (c/s)	±6	±6	±6	±3	±2	±2	±6	±10	±3	±6	±5	±5	±5	—
Frequency variation possible at the entry to the international circuit (c/s)	—	—	—	±10	±5	—	±8	±15	±6	±15	—	±15	±15	—
Splitting time (milliseconds)	60	35	40/60	25/35	30/55	25	45	35/40	70	150 then 130 with filter	66/34	40 before reply, 150 after reply	50/75	—
Absolute level of the power of signals at the point of zero relative level (decibels)	−9	−6	−9	−6	0	−6	−6	0 (or −6 for coaxial)	−3.5	−6	−6	−4	−6	−6

TABLE 2
Extra-European Countries

	Argentina	Australia	Canada — United States of America
Frequency (c/s)	2040/2400 compound	600-750 separate	2600 (for 2 wires: 2400-2600)
Tolerance at the generator terminals (c/s)	±6	±2.5	±5
Frequency variation possible at the entry to the international circuit (c/s)	±15	—	±15
Splitting time (milliseconds)	60	160/210	35 maximum
Absolute level of the power of signals at the point of zero relative level (decibels)	−9	+3	−8 and after attenuation −20

	Mexico	India	Japan		Pakistan	U.A.R. (Syrian Region)
Frequency (c/s)	(at present 2400-2100) standardisation proposed = 2600	2400	1900-2300 separate	2040-2400 separate	500/20	2040/2400 compound
Tolerance at the generator terminals (c/s)	±5	±2	±5	±2	±2	±6
Frequency variation possible at the entry to the international circuit (c/s)	±15	±10	±20	±20	—	—
Splitting time (milliseconds)	35 maximum	25 filter loss at 2400 → 50 dbm	100-150/80-150	70/11	50	70
Absolute level of the power of signals at the point of zero relative level (decibels)	−8 and after attenuation −20	0	−5/−10	−5	−7	−11±1

D. *Miscellaneous provisions*

RECOMMENDATION Q.26

DIRECT ACCESS TO THE INTERNATIONAL NETWORKS 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 that international exchange which is the outgoing point of the international circuit used, arrangements should be made to transmit over the international circuit, at least the minimum number of signals 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 carry 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 Q.36, Point 2).

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) interruption of the speech circuit, where in-band signalling is used.

It is therefore desirable in practice to reduce delays and interruptions of the speech circuit to the acceptable minimum.

RECOMMENDATION Q.28

RECOMMENDATIONS ON IDENTIFYING 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 identify (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 (cf. Article 224 of the Instructions for the International Telephone Service), and

— measuring the call duration (cf. Recommendations E. 52 *bis*, and Q.35).

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 *. These provisions are set out in detail for C.C.I.T.T. standardized systems in Part V, Chapter II of this present Volume (point C of the remark 2.8.2.).

RECOMMENDATION Q.29

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.g. wipers),

e) d.c. " 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 detrimental to the contacts.

When voice-frequency signals are sent over a transmission path, as it is not possible to use " wetted " 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.30

CAUSES OF NOISE AND MEANS FOR THE REDUCTION OF NOISE IN TELEPHONE EXCHANGES

Circuit noise may be classified as follows:

a) power supply noise,

b) noise generated in the speech circuit,

c) noise induced in the speech circuit.

* 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*

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 mainly originates 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, or 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, springs or resilient mountings to reduce the transmission of vibration;

2.1.3 the proper 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. Arranging design of columns, window sills, radiators and floor to avoid harbouring dust and the use of dust covers on equipment;

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 proper 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 d.c. battery reversals from 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 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 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 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.

The 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, the 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 or retardation coils;

3.2.5 taking the precautions listed under 3.1.

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.

CHAPTER IV

Tones for national signalling systems

A. C.C.I.T.T. Recommendations

RECOMMENDATION Q.31

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

1. General

Administrations are reminded of the advantages of standardizing supervisory tones, so that subscribers and operators may quickly recognize any tone transmitted, of whatever origin.

In considering the degree of possible standardization, the C.C.I.T.T. took account of the various tones already used in Europe, and then set limits for cadence, frequency and level so that in the C.C.I.T.T. view no confusion will be caused when subscribers hear these tones. It was also considered that Administrations and recognized private operating Agencies introducing new tones would find it helpful to know the preferred limits of cadence, frequency and level.

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

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

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

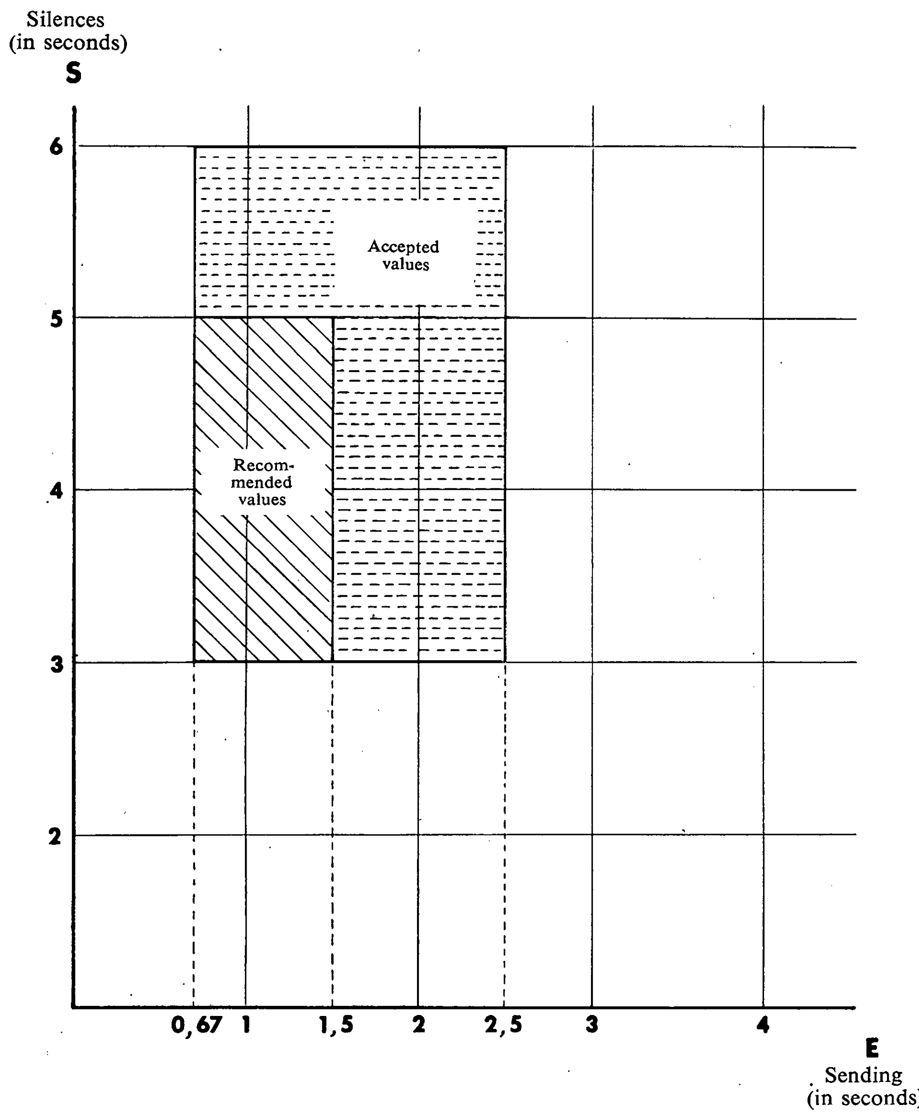
2. Power levels for tones

For international purposes, tone levels have to be defined at a zero relative level point, at the incoming end of the international circuit.

The level of tones so defined must have a nominal value of 10 decibels (−1,1 neper). The recommended limits should be not more than −5 decibels (−0.6 neper) nor less than −15 decibels (1.7 neper) measured with continuous tone.

For the special information tone, a difference in level of 3 decibels (0.3 neper) is tolerable between each of the three frequencies which make up the tone.

RINGING TONE



3. Ringing tone

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

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

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

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

   The diagram on the opposite page shows the recommended and accepted limits for the ringing tone periods.

2. The *recommended* frequency for ringing tone should be between 400 and 450 c/s. The *accepted* frequency should not be less than 340 c/s nor more than 500 c/s, Frequencies between 450 and 500 c/s in the accepted frequency range should. however, be avoided.

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

4. Busy tone

1. Busy tone is a quick period tone in which the tone period is theoretically equal to the silent period.

   The total duration of a complete cycle (tone period E+silent period S) should be between 300 and 1100 milliseconds.

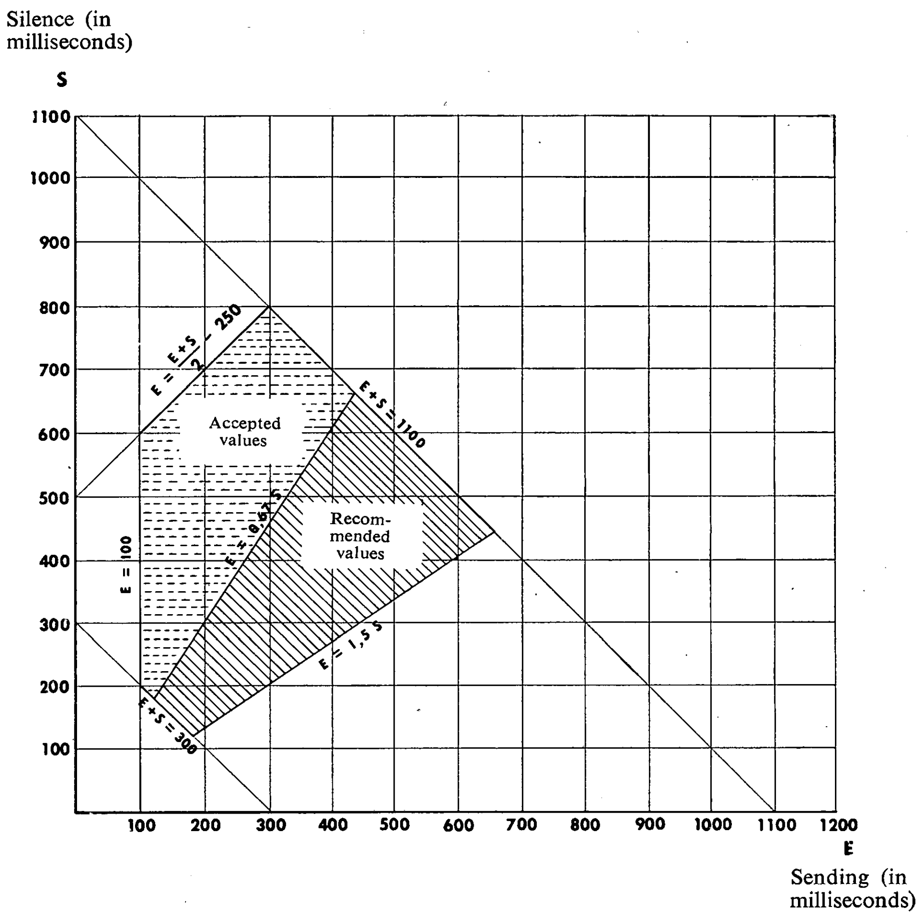
   The ratio $\frac{E}{S}$ of the tone period to the silent period should be between 0.67 and 1.5 (*recommended* values).

   For existing exchanges, or for tones to be used in a special way, it is accepted that the tone period may be 250 milliseconds shorter than the theoretical value $\frac{E+S}{2}$ (which gives $E=\frac{E+S}{2}-250$, that is to say, $E=S-500$ milliseconds).
   In no circumstances should the tone period be shorter than 100 milliseconds.

   The following diagram shows the recommended and accepted areas for the busy tone periods.

2. The *recommended* frequency for the busy tone must be between 400 and 450 c/s. The *accepted* frequency must not be less than 340 nor more than 500 c/s. Frequencies between 450 and 500 c/s in the accepted frequency range should, however, be avoided.

BUSY TONE


Silence (in milliseconds)
S
1100
1000
900
800
700
600
500
400
300
200
100
100
200
300
400
500
600
700
800
900
1000
1100
1200
E
Sending (in milliseconds)
E = (E+S)/2 − 250
E + S = 1100
Accepted values
Recom-mended values
E = 0,67 S
E = 100
E = 1,5 S
E + S = 300

5. Special information tone

1. The special information tone is a *standardized* international tone universally comprehensible and designed to invite the calling subscriber, in international automatic working, to get in touch with an operator in his country when he cannot understand a message orally received.

   The special information tone is provided for special cases, that is to say, all cases in which neither the busy nor the ringing tone can give the required information to the calling subscriber. There are three instances in which it may be used:

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

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

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

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

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

   Silent period. — This lasts for 1000±250 milliseconds.

3. The frequencies used for the three tone signals are:

   950±50 c/s; 1400±50 c/s; 1800±50 c/s,

   sent in that order.

B. Documentary part

TONES ENCOUNTERED IN VARIOUS NATIONAL NETWORKS

On pages 52 to 54 below will be found three tables (Tables 1, 2 and 3) giving data collected by the C.C.I.T.T. from an inquiry about the various tones used in national networks. These tables were brought up to date in January 1961.

On pages 55, 56 and 57 is given a table showing the condition encountered when a call " terminates abnormally ": ceased line, line out of service, changed number.

TABLE 1 — RINGING TONE

COUNTRY	Frequency (c/s)
EUROPEAN COUNTRIES AND MEDITERRANEAN BASIN	
AUSTRIA	450
BELGIUM — Bruxelles-Anvers	450 / 50
BELGIUM — Autres réseaux	450 / 50
DENMARK	450
SPAIN	400
FRANCE — Paris	25/400
FRANCE — Province	25 OR 50 + harmonics
ITALY	450 OR 360
IRELAND	400 / 450
MOROCCO	25 OR 50 + harmonics
NORWAY	400
NETHERLANDS	450 OR 400; 25 + 400
POLAND	400
U.A.R. (Syrian region)	540/ 50
GERMAN FEDERAL REPUBLIC	at present 450 in future
UNITED KINGDOM	400/450
SWEDEN	425
SWITZERLAND	400
CZECHOSLOVAKIA	450
TUNISIA	444
U.S.S.R.	450 ± 50
YUGOSLAVIA	450 + 20
EXTRA-EUROPEAN COUNTRIES	
ARGENTINA	16 ⅔
AUSTRALIA	33 ⅓
CANADA	33 ⅓
CHILE	33 ⅓
CUBA	20
UNITED STATES	420 + 40
INDIA	133 + 16 ⅔; 400 + 16 ⅔
JAPAN	350 + 16 ⅔; 400 + 16 ⅔
PAKISTAN	450; 400 + 16 ⅔

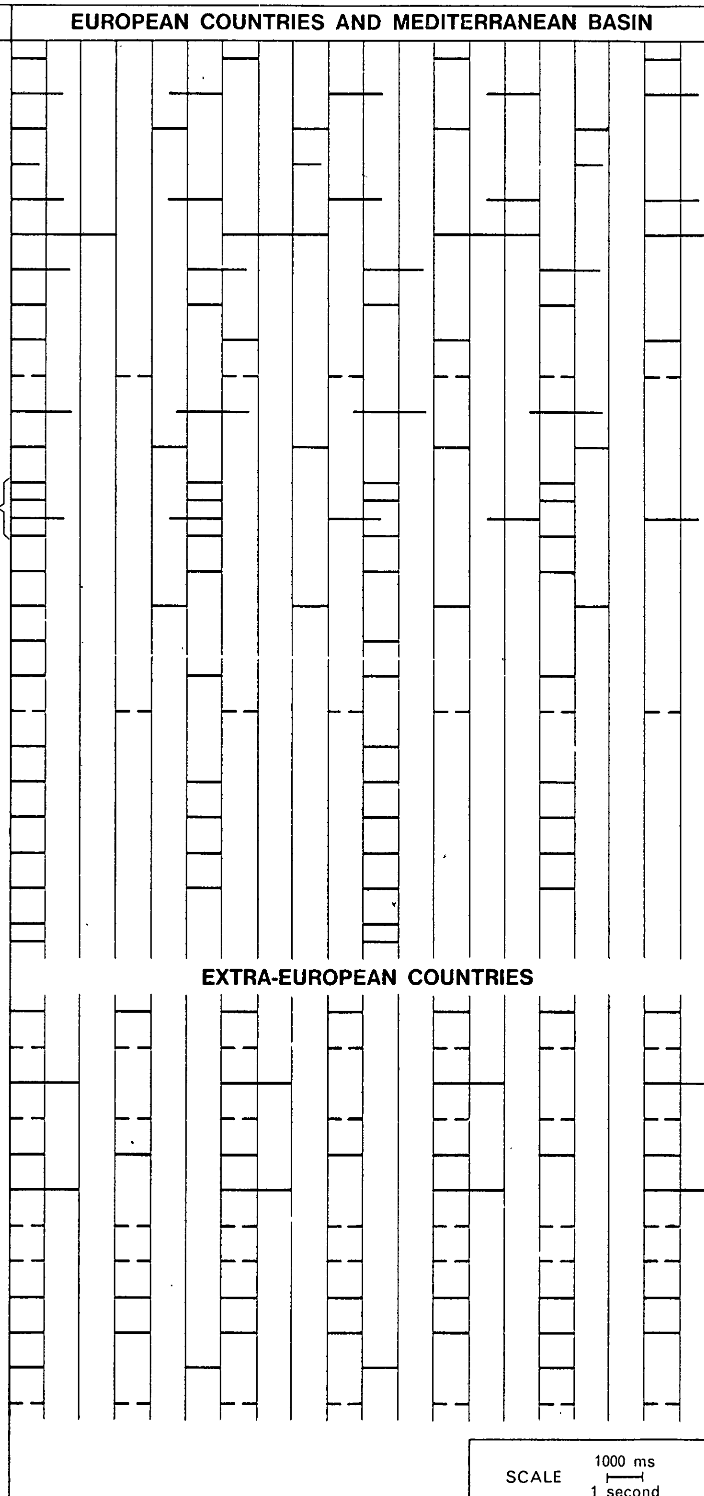


TABLE 2 — BUSY TONE

COUNTRY	Frequency (c/s)	EUROPEAN COUNTRIES AND MEDITERRANEAN BASIN
AUSTRIA	450	
BELGIUM	450	
DENMARK	450	
SPAIN	400	
FRANCE	400 OR 450	
ITALY	450 OR (360)	
IRELAND	400	
MOROCCO	400/450	
NORWAY	400	
NETHERLANDS	450	
POLAND	400	
U.A.R. (Syrian region) ..	150	
GERMAN FEDERAL REPUBLIC	450	
UNITED KINGDOM ...	400	
SWEDEN	425	
SWITZERLAND	400	
CZECHOSLOVAKIA ...	450	
TUNISIA	444	
U.S.S.R.	400±50	
YUGOSLAVIA	450	
		EXTRA-EUROPEAN COUNTRIES
ARGENTINA	400	
AUSTRALIA	400	
CANADA	600 modulated by 120	
CHILE: subscribers ...... / long distance	400	
CUBA	400	
UNITED STATES	600+120	
INDIA	400	
JAPAN	450	
PAKISTAN	450 / 400	

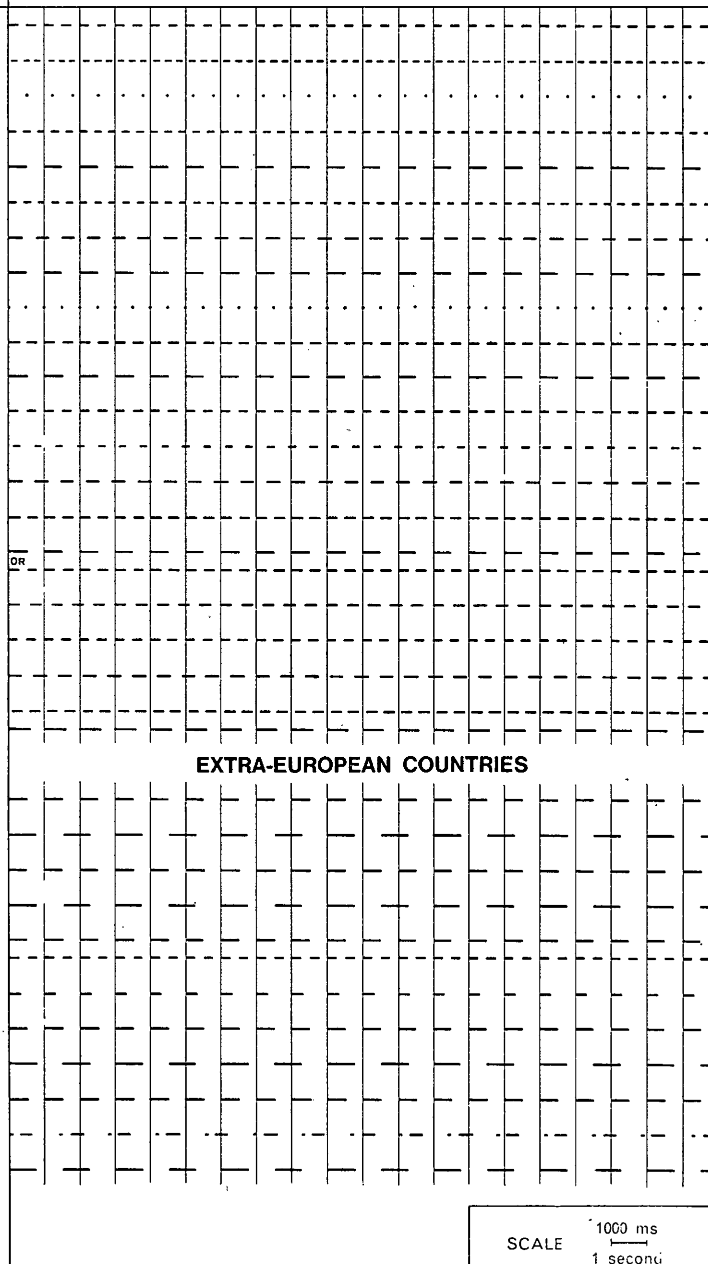
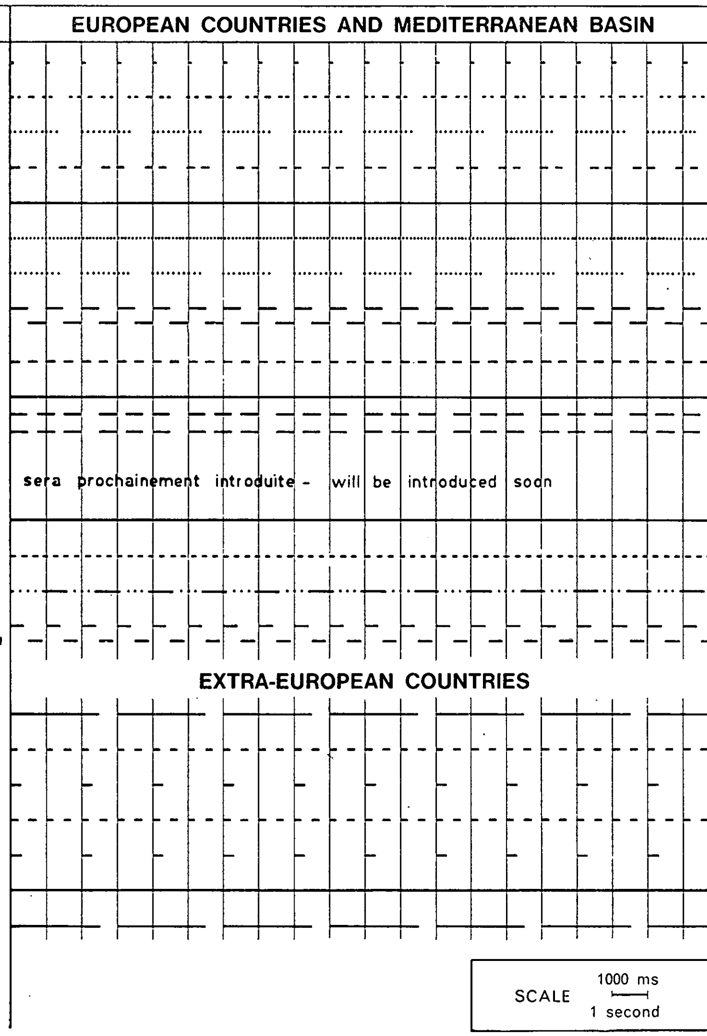


TABLE 3 — **SPECIAL TONE ***
(Reference, information, number unobtainable, engaged tones *

COUNTRY		Frequency (c/s)
BELGIUM	spare level	450
	faulty line	450
DENMARK	information tone	450
SPAIN		400
IRELAND		400
MOROCCO		450
NORWAY		400
NETHERLANDS	Frequence F1...	150/133/130
	Frequence F2...	450/400/260
POLAND		400
U.A.R.	re-call	450
	number unobtainable	150
	barred level	450
GERMAN FEDERAL REPUBLIC		450
UNITED KINGDOM	number unobtainable .	400
	pay tone	400
SWEDEN	re-call tone	425
	congestion tone ..	400 normal level / reduced level
AUSTRALIA	number unobtainable	400
CANADA	reorder	600+120
	no circuit	600+120
UNITED STATES	reorder	600+120
	no circuit	600+120
INDIA	number unobtainable	400
		400



* It may be advantageous to provide the intervention of an assistance operator at the incoming international exchange in the event of receipt of these tones.

The following countries replied to the C.C.I.T.T. enquiry, but have no special tones:

AUSTRIA
FRANCE
ITALY
JAPAN
TUNISIA
U.S.S.R.
YUGOSLAVIA

APPENDIX

(to Recommendation Q.31)

TREATMENT OF CALLS CONSIDERED AS "TERMINATING ABNORMALLY"

Country of destination	Ceased line	Line out of service	Changed number	Line connected to absent subscribers service	Faulty line	Spare numbers (no subscriber)	Spare level or spare code	Congestion in the inland automatic system
Austria	Operator or busy tone	Busy tone	Operator or recorded announcement or busy tone	Operator or recorded announcement	Ringing tone or busy tone	Busy tone		
Belgium	Operator (recorded announcement proposed)		Operator for individual cases; recorded announcement in case of transfer of groups of subscribers	Operator	Special fault tone or, in certain cases, ringing tone	Ringing tone	In principle, no indication; special tone in certain networks. Recorded announcement proposed	Recorded announcement incoming to Brussels. At other points on the trunk network where congestion can be expected, recorded announcement are proposed
Canada	Operator or recorded announcement *			Service usually provided by persons not in the employ of the Telephone Company	Operator or busy tone	Operator or recorded announcement		30 or 120 IPM tone or recorded announcement

* In many cases, the recorded announcement is followed by cut-through to an operator.

<table>
<tr><th>Country of destination</th><th>Ceased line</th><th>Line out of service</th><th>Changed number</th><th>Line connected to absent subscribers service</th><th>Faulty line</th><th>Spare numbers (no subscriber)</th><th>Spare level or spare code</th><th>Congestion in the inland automatic system</th></tr>
<tr><td>Denmark</td><td colspan="3">Information tone or ringing tone, or operator or recorded announcement</td><td>Operator or recorded announcement</td><td>Ringing tone</td><td>Information tone or ringing tone</td><td>Information tone</td><td>Busy tone</td></tr>
<tr><td>France</td><td colspan="3">Operator or recorded announcement</td><td>Operator</td><td>Operator or recorded announcement</td><td colspan="2">Operator or recorded announcement or busy tone</td><td>Busy tone or recorded announcement</td></tr>
<tr><td>Germany (Federal Republic)</td><td colspan="2">Operator or ringing tone (alone, without any other indication)</td><td>Operator or recorded announcement (for transfer of groups of subscribers) or ringing tone (alone, without any other indication)</td><td>Operator</td><td colspan="2">Ringing tone (alone, without any other indication)</td><td colspan="2">Busy tone</td></tr>
<tr><td>India</td><td colspan="2">Number unobtainable tone</td><td>Service not provided</td><td colspan="3">Number unobtainable tone</td><td colspan="2">Busy tone</td></tr>
<tr><td>Ireland</td><td colspan="2">Number unobtainable tone</td><td>Operator</td><td>Service not provided</td><td>—</td><td colspan="2">Number unobtainable tone</td><td>Busy tone</td></tr>
<tr><td>Italy</td><td colspan="2">Busy tone or ringing tone</td><td>Operator or recorded announcement</td><td>Operator</td><td>Busy tone or ringing tone</td><td colspan="3">Busy tone</td></tr>
</table>

Country of destination	Ceased line	Line out of service	Changed number	Line connected to absent subscribers service	Faulty line	Spare numbers (no subscriber)	Spare level or spare code	Congestion in the inland automatic system
Netherlands	Information tone			Operator or information tone	Information tone or ringing tone		Information tone or busy tone	Busy tone
Norway	Information tone or no tone			Operator	Information tone or no tone			No tone
Poland	Special tone			Ringing tone	Special tone			Busy tone
Spain	No tone		Operator or recorded announcement	Service not provided	No indication		Special tone	
Sweden	Operator or re-call tone				Ringing tone or busy tone or no tone	Operator or re-call tone or no tone		Congestion tone or no tone
Switzerland	Operator or recorded announcement			Operator	Ringing tone		Busy tone	
United Kingdom	Operator or number unobtainable tone	Number unobtainable tone	Operator or recorded announcement	Service not provided	Number unobtainable tone			Busy tone or recorded announcement
United States	Operator or recorded announcement *			Service usually provided by persons not in the employ of the Telephone Company	Operator or busy tone	Operator or recorded announcement		30 or 120 IPM or recorded announcement

* In many cases, the recorded announcement is followed by cut-through to an operator.

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PART 3

ESTABLISHMENT OF INTERNATIONAL ACCOUNTS IN THE INTERNATIONAL AUTOMATIC SERVICE

CHAPTER I

ACCOUNTING IN THE INTERNATIONAL AUTOMATIC SERVICE

DEFINITIONS

The following definitions are reproduced from C.C.I.T.T. Recommendation E.1.

. . . .

13. *conversation time (duration of a call)*

The interval between the instant the call is actually established between the calling and the called stations and the instant the calling station gives the clearing signal (or the instant when, although the caller has not replaced his receiver, the call is:

— in manual or semi-automatic service, officially cleared down by an operator;

— in automatic service, cleared down after a time (delay by the action of the called subscriber's clear-back signal).

14. *chargeable duration of a call*

The interval to be taken into consideration in determining the charge for the call.

Note. — The chargeable duration can differ from the call duration (conversation time), since:

a) charging is by indivisible periods;

b) in manual or semi-automatic working, incidents or difficulties that may have occurred during the call can be taken into account in determining the chargeable duration.

15. *holding time of an international circuit*

The time during which the international circuit is used. It includes in particular call duration (conversation time), operating time and the time required for the exchange of service information, etc.

Note. — The term " operating time " is meant to cover the time taken both by operators and switching equipment.

. . . .

RECOMMENDATION Q.35 *

ACCOUNTING SYSTEM IN THE INTERNATIONAL AUTOMATIC TELEPHONE SERVICE

In the international automatic service, the charge for calls will, in general, be automatically registered on subscribers' meters, and Administrations ** will no longer have tickets available for working out the distribution of charges on the basis of the chargeable duration of calls.

Although technically possible, the recording, for international accounts, of the chargeable duration of each effective call would require the installation of new equipment which does not seem justified with the sole object of establishing international accounts. The various systems used for charging subscribers would also result in different chargeable durations for the same traffic.

In these circumstances,

1. The C.C.I.T.T. recommends that accounts between Administrations ** should be drawn up on the basis of the total duration (actual) of calls measured in the international outgoing exchanges on the appropriate meters. A charge in gold francs per minute of actual duration of call, valid in both directions of the relation and applicable solely for international accounts relating to automatic calls, will be fixed by agreement between Administrations.

Exceptions to this general rule may occur in the following cases:

(a) when the Administrations ** concerned agree to dispense with accounts or to adopt lump-sum settlement;

(b) when one or both of the Administrations ** concerned already possess equipment capable of showing the chargeable durations incurred by the subscribers. The accounts prepared on these bases must give the same result as if the call durations had been measured;

c) when simplified code signalling systems are used which make it impossible to assess the call durations without excessive complications, the Administrations ** shall measure the total occupation time of the outgoing circuits. In that case, a correction factor shall be applied to the traffic figures so as to assess, in total actual call duration, the traffic which is to serve as the basis for preparing the accounts. The corrections to be applied should be determined by agreement between the Administrations ** concerned.

2. International accounts for semi-automatic calls shall continue to be based, in accordance with the Telephone Regulations, on the call tickets prepared by the outgoing operators. Hence, in the international outgoing exchange equipment, a distinction should be made, in the preparation of international accounts, between semi-automatic and automatic calls.

In exceptional cases where, with simplified code signalling systems, this distinction is not possible, the Administration ** of the outgoing country should come to an agreement

* This Recommendation appears under No. E.52 *bis* in the series of operation Recommendations.
** or Recognized private operating Agencies.

with the Administration of the incoming country (and, when necessary, with the transit countries) on the arrangements to be made.

3. To take account of the special charging in frontier systems (reduced rates between neighbouring frontier land areas), special arrangements will have to be made to distinguish between frontier automatic calls and other automatic calls. This distinction must be made whenever frontier traffic is routed, entirely or in part (overflow), by long-distance international circuits for which devices for measuring call duration exist.

In derogation of 1.2 of Recommendation E.29, this distinction will generally entail the analysis of other digits than the first, or the first two, of the significant number of the called subscriber and determination of the source of the call, since frontier charges depend on the distance between the outgoing and the incoming frontier areas.

4. Measurements of the call duration on meters shall be made according to country of destination. When the country of destination comprises several charging areas, these measurements will ordinarily be made according to the charging area.

5. The measurement of call durations made by the international outgoing exchange to a given country of destination shall not distinguish between the routes involving different transit countries, provided the traffic is transmitted over direct circuits which constitute the normal route. For international accounting purposes, the total volume of traffic sent by each route is assumed to be proportional to the number of circuits in service on the 15th of each month on each route.

6. From the theoretical point of view, it might seem desirable for the outgoing country to measure the traffic according to route and destination when a transit exchange of another country is used. However, it is left to Administrations* to decide whether:

— metering by route is much more complicated than metering by destination alone;
— metering by route is justified for obtaining the traffic data necessary, as well as for the drawing-up of international accounts;
— the complication of metering by route can be justified by the prospect of setting up automatic transit traffic.

When the Administration* of the outgoing country is not in a position to assess the traffic by route and by destination, it should come to an agreement with the other Administrations* concerned as to the way in which the traffic is assumed to be split up over the various routes.

7. The following special rule shall be permissible to avoid the need for an analysis of routes actually taken by a call beyond a transit exchange when several routes passing through different countries to the destination in question are possible from the transit exchange. The distribution of transit traffic over these different routes shall be taken to be the same as the distribution of traffic originating at the transit exchange for the destination concerned. The distribution between the routes shall be assessed every

* or Recognized private operating Agencies.

6 months by the Administration* of the transit exchange and communicated to the Administration* of the outgoing country.

8. In international accounts the traffic expressed in minutes relating to test calls, service calls and calls terminating at wrong numbers should not be deducted, since the overall duration of these various types of call is very small in relation to the total traffic.

Nevertheless, when the percentage of wrong numbers due to faults in the incoming country's equipment is greatly in excess of what is regarded as a reasonable percentage in a service of good quality, the outgoing country would be entitled to make certain deductions with the agreement of the incoming country.

When free calls are allowed (for example during international telecommunication conferences), deductions may be made in the international accounts by the Administration* of the country on whose territory the conferences are held.

9. The arrangements concerning the acceptance of international accounts as defined in the Telephone Regulations (Chapter XIV - Accounting) shall apply to automatic traffic.

Accounts shall be drawn up monthly but, to avoid errors (which might be serious in the event of the meters being faulty), the call duration meters shall be read every day.

The degree of accuracy of the call duration measuring apparatus shall be $\pm 2\%$ with a confidence limit of 95%, on the understanding that this result is obtained for a set of measurements covering an adequate number of calls which, in light traffic relations, may lead to acceptance of the fact that $\pm 2\%$ accuracy should be obtained on the overall measurements for a year but not for each of the partial measurements made during that year (monthly measurements, for example, if the monthly interval is retained for the establishment of international accounts).

* or Recognized private operating Agencies.

CHAPTER II

RECOMMENDATION Q.36

BASIC TECHNICAL PROBLEMS CONCERNING THE MEASUREMENT AND RECORDING OF CALL DURATION

1. Recording call duration

1.1 Technically " call duration " is the interval that elapses between:

— the moment when the reply condition is detected at the point where the recording of call durations takes place, and

— the moment when the clear-forward condition is detected at the same point.

It follows that the apparatus used to record call durations of automatic calls must be capable of detecting the two moments mentioned above and of measuring the interval between them.

1.2 When, in application of the provisions of paragraph 1 *(c)* of Recommendation Q.35, an administration using a simplified signalling system has recourse to recording occupation times for the establishment of international accounts, it is necessary to have a conversion factor making it possible to obtain the call duration from the occupation time. The determination of this conversion factor requires fairly close observation. The ratio of occupation time to call duration may not be the same for all the circuits of a single group, so that a fairly large number of circuits must be observed in order to find a reliable conversion factor. Moreover, the occupation time also depends on the availability of switching equipment in the incoming country, as well as the reaction of subscribers when they hear ringing tone, busy tone, etc.; the occupation time for a given call duration may thus be extremely variable.

2. Discrimination between automatic and semi-automatic calls

Since different accounting procedures are to be used for automatic and semi-automatic calls, the recording apparatus must be capable of distinguishing between these two types of calls and must record the call duration of automatic calls only.

Discrimination can be effected by one of the following methods:

a) by connecting the measuring apparatus to a point in the exchange through which only automatic traffic is routed;

b) by recording call durations only on those calls containing the discriminating digit ' 0 ' (see para. 1.3.3.2 of Part V, in which it is specified that the digit 0 shall replace the discriminating digit on automatic calls).

Method *(b)* may be particularly useful when both automatic and semi-automatic calls originate at exchanges within the national network and are routed to the outgoing international exchange over a common group of circuits.

3. Omission of international transit traffic from the records of call durations

All records of call durations will be taken in the outgoing country and will relate to calls originated in this country. It will therefore be necessary, in an international exchange which routes both terminal and international transit traffic, to exclude the call duration of international transit calls passing through the exchange.

It will be difficult to discriminate between originated calls and transit calls on the outgoing international circuits and it may therefore be necessary to segregate this traffic within the exchange and connect the recording apparatus at a point in the exchange where transit traffic is not encountered.

4. Discrimination according to destination

4.1 The records of call durations obtained by the recording apparatus must be related to particular countries of destination and, if required, to the charging areas of the country of destination; and therefore the recording apparatus should be capable of identifying the destination of a call and of associating the measured call duration with this destination.

Note. — For drawing-up of international accounts (apart from frontier areas) it is not necessary to know the origin of the call or the charging area from which it comes. The difference in quotas resulting from different outgoing charging areas in a given country are kept by that country.

4.2 *Incoming country constituting a single charging area*

Where the recording apparatus is connected to a circuit group carrying only terminal traffic, no discrimination is required. Where, however, a circuit group carries traffic to more than one country, discrimination between these countries must be effected from an examination of the international code for the country and/or the type of seizing signal (terminal or transit) which is sent over the international circuits.

4.3 *Incoming country consisting of several charging areas*

If the accounting procedure agreed between two countries demands the production of separate records of call durations for calls made to each charging area in an incoming country, the recording apparatus must be arranged to discriminate between the calls to the different charging areas according to the first one or first two digits of the called station's significant number * (see Recommendation Q.11).

* See the definition of the significant number in Recommendation Q.10 § 7.

4.4 *Special frontier arrangements*

To take account of the special system of charging for frontier relations (reduced charges between neighbouring frontier zones), special steps will have to be taken to discriminate between automatic calls in frontier relations and other automatic calls. This discrimination will be made every time that frontier traffic is routed wholly or partly (overflow) by long-distance international circuits having devices for measuring call duration.

This discrimination will, in general, necessitate:

(a) the analysis of digits other than the first and second of the significant number of the called subscribers, and

(b) the determination of the origin of the calls, since frontier charges depend on the distance between the incoming and outgoing frontier zones.

5. Discriminating according to route and destination

In general there will be little difficulty in determining the route taken by a call on leaving the outgoing international exchange. If the recording apparatus is connected to the international circuits, then of course the recordings obtained will be appropriate to the route in question. If, however, the recording apparatus is connected to a point in the exchange remote from the outgoing circuits and the call to a particular country has the choice of more than one route, then information in respect of the actual route taken by the call must be supplied to the recording apparatus.

When, in the case of transit traffic, the rule in point 6 of Recommendation Q.35 is applied, it is not necessary, at the outgoing international exchange, to provide discrimination between the different routes taken beyond a transit centre.

6. Distribution of traffic in an international exchange for the purpose of measuring call durations

By way of example, a diagram is given hereafter showing how traffic should be distributed in an international exchange so as to take account of the provisions above.

The traffic passing through the international exchange is divided into the following four groups, as shown in the diagram:

(i) international transit traffic,

(ii) automatic traffic (originated locally),

(iii) semi-automatic traffic (originated locally),

(iv) combined automatic and semi-automatic traffic from provincial exchanges.

These groups would employ independent groups of connecting circuits and registers. Only group *(ii)* and possibly group *(iv)* would be involved in measuring call duration.

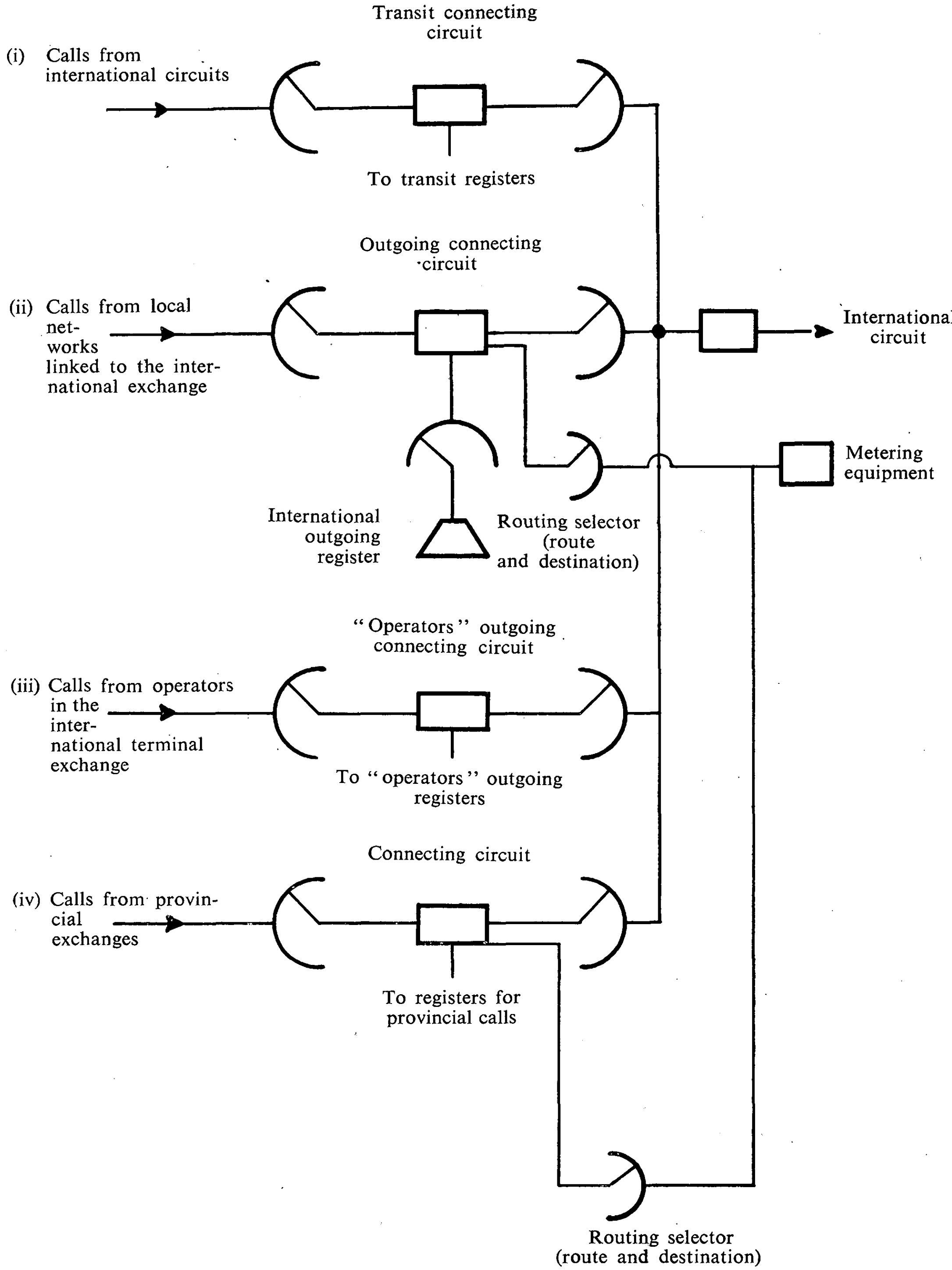

Diagram giving an example of traffic distribution in an international exchange

The following auxiliary equipment is envisaged:

(i) for each connecting circuit in groups *(ii)* and *(iv)*, a selecting device capable of dealing with every possible route and " charging area " destination;

(ii) for each connecting circuit in group *(iv)*, a device to discriminate between semi-automatic and automatic traffic;

(iii) for registers in groups *(ii)* and *(iv)*, an equipment for analysing international codes and able to record two digits of the significant number of the called subscriber in order to discriminate between different areas;

(iv) for registers in group *(iv)*, a device to recognize the language digit and the presence or absence of the discriminating digit and a device in the connecting circuit for making the appropriate discrimination (automatic calls);

(v) a means of recording the call duration for each route and " charging area " destination.

CHAPTER III

RECOMMENDATION Q.37

DEVICES FOR MEASURING AND RECORDING CALL DURATIONS

There are three main methods used for measuring call duration:

1. Use of apparatus of the type which meters the quantity of electricity (ampere-hour meter or coulomb-meter)

This type of meter is permanently connected to the circuits or equipment under observation; for the measurements in question, the current strength in the meter is at all times proportional to the number of circuits or units of equipment in the speech position. With this type of apparatus the accuracy of the measurements depends on:

(a) errors in the meter itself; in any case, in the absence of special arrangements, the accuracy of the latter is not so good for intensities which are only a small fraction of the nominal intensity for which the apparatus is designed;

(b) the accuracy and possibly the variations with time of the resistors inserted in the circuits to be observed;

(c) the ohmic resistance of the connections between the measuring equipment and the circuits to be observed;

(d) voltage variations in the supply battery used.

Obviously, the longer the period of observation, the greater are the chances that partial compensations will occur between the various causes of error. With such apparatus it seems unlikely that more than 2 % accuracy of measurements can be obtained for measurements made over an adequate period of time which includes hours of varying load; measurements made only at times when there is very little traffic might involve a considerably greater error.

2. Use of pulse counting meters

With this method, the circuits or equipment under observation are connected, for the duration of a call, to pulse counting meters which receive pulses from a common timing mechanism at suitable intervals, for example every 6 seconds. The call duration is deduced from the meter readings.

3. Use of a device for periodically scanning circuits or equipment

These devices can be based on either the conventional type of equipment (relays, crossbar switch, etc.) or some form of electronic equipment.

4. Degree of accuracy

With the two last-named methods, the degree of accuracy of measurements depends on:

— the average duration of calls and the law of distribution of durations;

— the number of calls observed;

— the interval between the sending of pulses *(Method 2)* or the scanning interval *(Method 3)*.

It is also possible to assess mathematically, as a function of these factors, the anticipated degree of accuracy. Errors may also arise from the operation of the meter in Method 3, or from accidental variations in the pulsing or scanning interval.

There is no doubt that if the number of calls observed is sufficiently high it is possible, using these methods and without reducing the pulse-sending interval or the scanning interval to such a small value that operation difficulties would arise with classic-type apparatus, to obtain greater accuracy than could be obtained with the method described in paragraph 1.

5. Fault indication

It is recommended that provision should be made for indicating faults in the measuring and recording device. There are two possibilities:

(a) to design the measuring and recording apparatus so that there is permanent check on its operation, with an alarm system to indicate faults;

(b) to provide special equipment to make a routine check of the operation of the measuring equipment.

6. Equipment design

The design of equipment for measuring and recording call durations is left to Administrations. Some design information will be found in the Annex 1 hereafter.

ANNEX

(to Recommendation Q.37)

Measuring call duration

1. The technique to be adopted for recording call durations of automatic traffic will depend on the accounting arrangements agreed between administrations and particularly on whether recordings are to be made:

— by country of destination alone,

— by route and country of destination,

— by route, country of destination and charging area.

In all cases it will be necessary to discriminate between automatic and semi-automatic traffic and possibly transit traffic.

2. Assuming that it is possible to identify automatic calls on the outgoing international circuit and that the circuits carry only terminal traffic, the measurement of call durations could be effected by connecting a measuring and recording device to each international circuit. The disadvantage of this scheme is the large number of recorders to be provided and read daily.

A single recorder could be made to serve a group of international circuits by arranging for the recorder to be connected to each circuit of a group in turn, say every 6 seconds, and for the recorder to operate each time that an international circuit in the answered condition is encountered. The recorder would then show the total call duration of the circuit group.

3. Where transit routings are involved and the recordings are required on the basis of route and country of destination, separate totals of call durations will be required for each country served by the route in question. In other words, it will be necessary to determine the destination of each call and record the call duration on the appropriate recorder.

This may be found to be a complicated process and it may be more convenient to connect the recorder at a point remote from the international circuit, for example at the register access relay set, where information in respect of the destination and routing of the call can be obtained from the outgoing international register. Figure 1 illustrates an arrangement in which switch A is positioned under the control of the register to connect the appropriate route and destination recorder to the register access relay set.

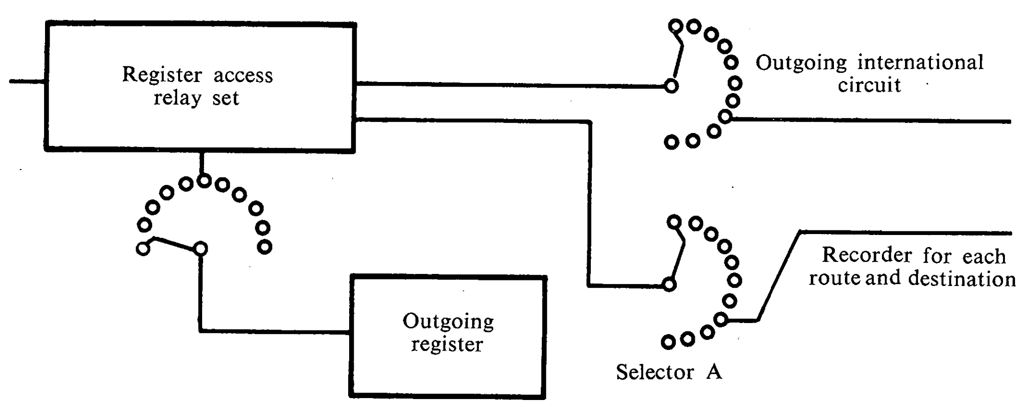

FIGURE 1

The recorder could be an ampere-hour meter or it could consist of a meter and a selector arranged to scan all the register access relay sets which have been connected to this particular route and destination recorder.

4. A similar arrangement to Figure 1 can be employed where recordings are required on the basis of route, country of destination and charging area. The additional complications introduced in determining the charging area mainly concern the outgoing register but it should be noted that a greater number of separate call duration recorders will then be needed.

5. The number of recorders or separate records of call durations is equal to the summation for all destinations, of the product of number of routes by number of charging areas for each

country of destination. The capacity of selector A in Figure 1 must be sufficient to permit access to any recorder and the economics of this scheme will be determined by the number of separate recordings required and the total volume of international traffic originated at the exchange concerned.

6. For a larger number of separate recordings, i.e. in excess of the capacity of the access switch, and a large number of register access relay sets, say 200 or more, Administrations might consider whether it would be cheaper to use electronic methods for recording call durations. In this connection Administrations might take into account the possible future introduction of cheap rates which could double the number of separate records required.

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PART IV

GUIDING PRINCIPLES FOR THE MAINTENANCE OF AUTOMATIC CIRCUITS

CHAPTER I

RECOMMENDATION Q.41

DEFINITIONS FOR MAINTENANCE ORGANIZATION

International line. — Telephone transmission system contained between the test jack panels of the two terminal repeater stations.

International circuit. — The whole of the international line and the outgoing and incoming equipment proper to the line.

Automatic switching equipment. — That part of an international exchange concerned with switching operations for routing the call in the desired direction.

Maintenance. — All the operations concerned with maintaining telephone circuits and automatic switching equipment in a good working condition. (See for this and the following definitions, the diagram on the following page).

Preventive maintenance. — Tests, measurements and adjustment to specific values carried out before the appearance of a fault.

Corrective maintenance. — Tests, measurements and adjustments carried out following a fault.

Determination of the quality of the service. — Tests carried out under normal working conditions to find the percentage incidence of fault failure.

Functional tests. — Tests carried out under normal working conditions to verify that a circuit or a particular part of the equipment functions correctly.

Limit testing. — Tests carried out under conditions more severe than those corresponding to the specific nominal values, to determine the margin of security existing under normal working conditions.

Localization of faults:

The *broad localization* of a fault consists of finding the technical service area in which it exists.

Fault finding consists of determining the faulty part of the equipment.

MAINTENANCE OF AUTOMATIC CIRCUITS

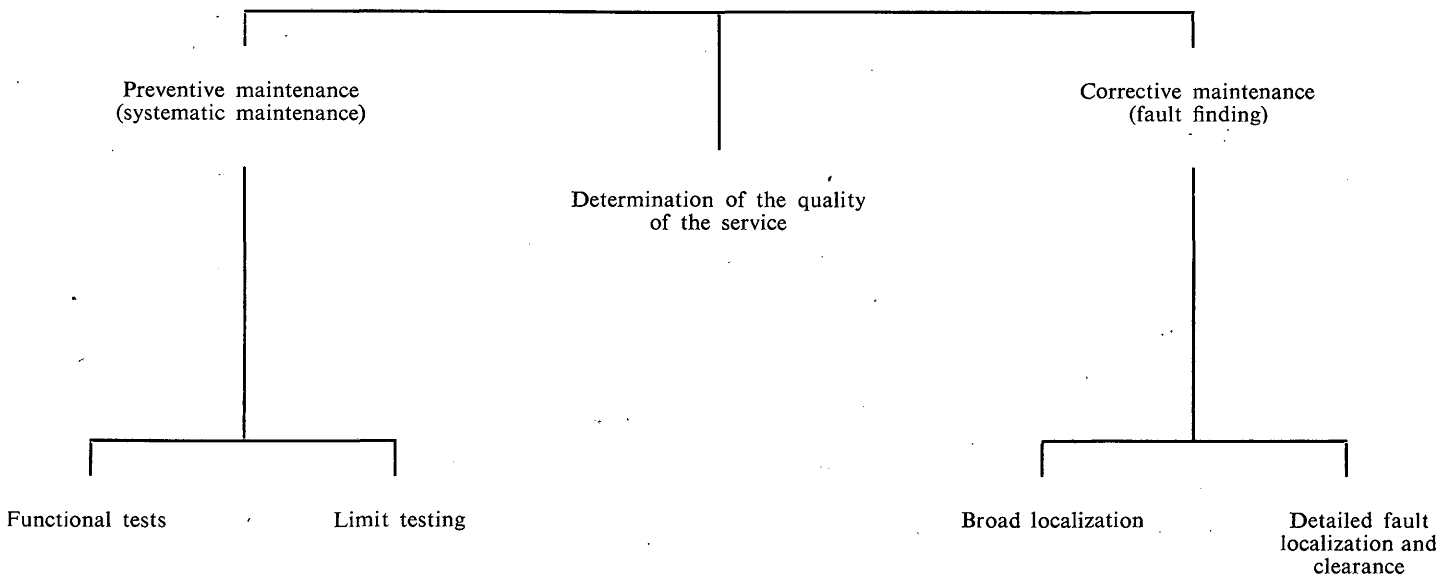


Diagram showing the various operations implied by " maintenance "

CHAPTER II

RECOMMENDATION Q.42

GENERAL MAINTENANCE ORGANIZATION FOR AUTOMATIC CIRCUITS

1. Principles

With international semi-automatic or automatic operation, each Administration shall assume responsibility for the testing and clearance of faults on its outgoing circuits. The other administrations will co-operate in testing and in clearing faults on these circuits at the request of the responsible Administration.

2. International Maintenance Centre (I.M.C.)

2.1 The body which will exercise this responsibility for the outgoing circuits of an international centre is the " International maintenance centre " or in short I.M.C. The person in charge of the international maintenance will be referred to hereafter under the name of " Officer-in-charge of I.M.C." or in short by the expression " officer-in-charge ".

2.2 To carry out the maintenance of outgoing circuits, the International maintenance centre may give directions to the competent services of:

- the international automatic exchange,
- the repeater station.

2.3 The operating services should report all faults affecting the international service to the International maintenance centre and to this centre only.

2.4 The responsibilities of the International maintenance centre are as follows:

2.4.1 to receive all reports of faults on its outgoing international circuits and to conduct tests with a view to the broad localization of faults limited to ascertaining the technical service responsible for their clearance;

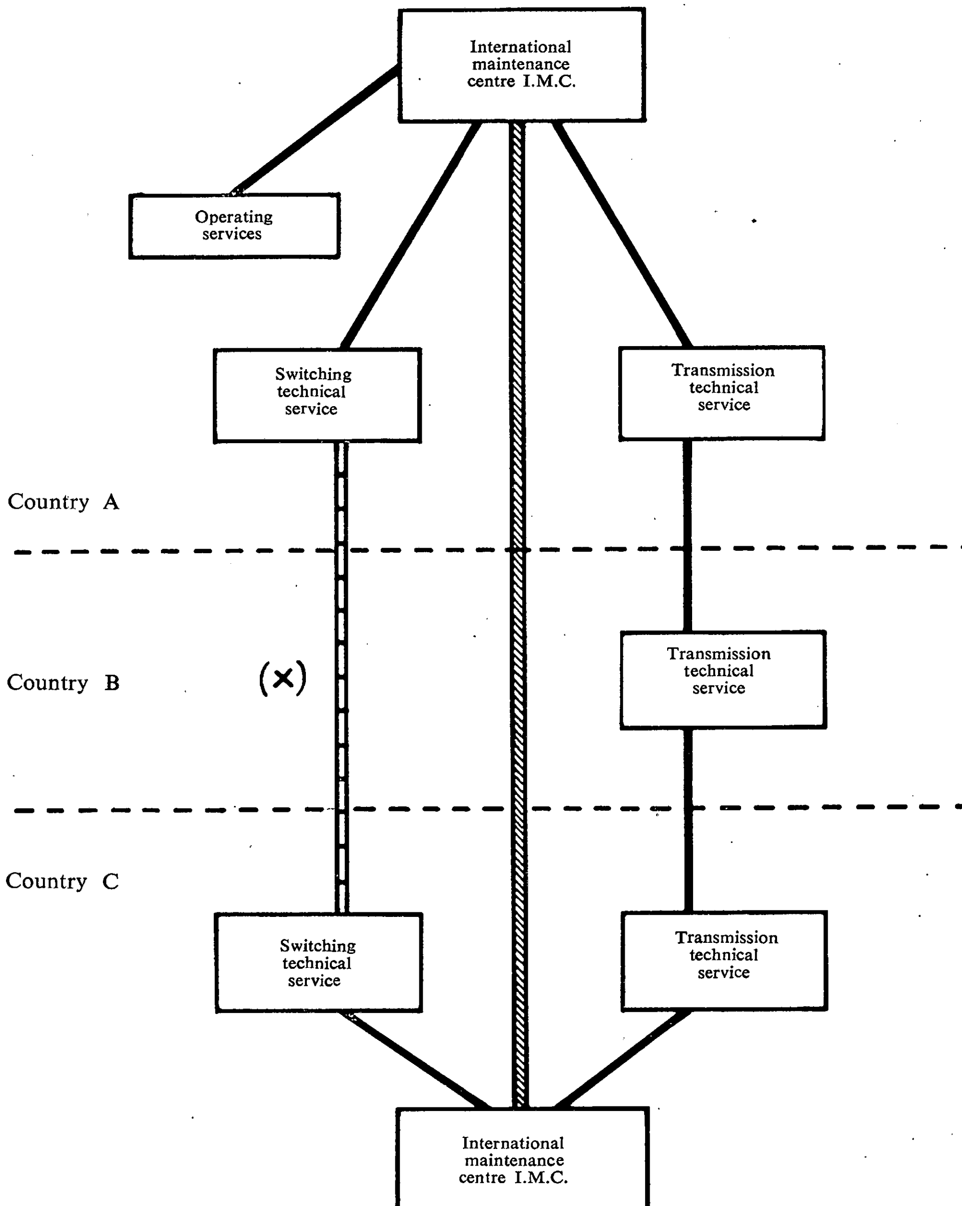
2.4.2 to entrust the clearance of faults to the appropriate technical service as determined by the broad localization;

2.4.3 to ensure that the out-of-service times of its outgoing international circuits (due to faults or other causes) are kept to a minimum compatible with the needs of the service;

2.4.4 to return a circuit to the operating services after having verified its correct functioning;

2.4.5 to keep detailed records of the faults, localizations and clearances with which it has been concerned;

Organization Chart for maintenance of automatic circuits



*The link between switching technical services of different countries is marked by asterisk, because such a link is not considered as indispensable. The staff of international automatic exchanges does not normally need to know foreign languages. However, this link may exist and may be of good service when it does.

2.4.6 to co-operate with the I.M.C.s of other countries in respect of the broad localization of faults on its incoming international circuits and to accept responsibility for the clearance of faults found to exist in or beyond the I.M.C. concerned;

2.4.7 to be advised of the need to put any of its incoming international circuits out of use and to inform the I.M.C. of the outgoing exchange of the fact;

2.4.8 to ensure that the tests prescribed for its outgoing international circuits are carried out at the specified times and that any faults revealed by such tests are dealt with expeditiously;

2.4.9 to ensure that new outgoing international circuits are satisfactory in operation before being brought into service and to co-operate with the I.M.C.s of other countries with any tests which may be necessary on new incoming circuits.

2.5 So as to ensure that the I.M.C.s are operated efficiently, it is desirable that the following conditions should, as far as possible, be applied:

2.5.1 The officers-in-charge (and possibly their direct assistants) should possess a thorough knowledge of the switching equipment with which they will be concerned and have an adequate knowledge of transmission. In addition, these officers should be selected with a view to avoiding language difficulties.

2.5.2 The officers-in-charge should possess sufficient authority to direct the clearance of faults.

2.5.3 The officers-in-charge should be attached to the I.M.C. and should not be diverted from their normal duties by other occupations which may impede the accomplishment of their principal task. These officers should be appointed as soon as there are any automatic circuits in service and their duties should not be subject to frequent change. They should be authorized to establish personal relations with their opposite numbers in other countries.

2.5.4 To facilitate exchange of views on the clearance of faults, the I.M.C. of the outgoing exchange should possess circuit diagrams of the switching equipment installed in the corresponding incoming exchanges together with any other useful information. It is also desirable that the officers-in-charge of the I.M.C. should be able to visit the switching installations of other international exchanges.

3. Control (repeater) station

The repeater station attached to each international exchange should be the control station for the automatic circuits outgoing from this exchange. Consequently, in the case of an international route AB comprising automatic circuits operated in the direction A to B and automatic circuits operated in the direction B to A, there will be a control station at each end A and B of the group of circuits:

— at A for the circuits A to B,

— at B for the circuits B to A.

CHAPTER III

RECOMMENDATION Q.43

PREVENTIVE MAINTENANCE

1. Functional tests

1.1 *Functional tests* are carried out under conditions similar to normal working conditions and their purpose is to verify that a circuit or a particular part of the equipment functions correctly. The test conditions are such that a circuit or item of equipment will not be withdrawn from service as faulty if, apart from the test, it would be considered as satisfactory in service.

1.2 Functional tests are carried out locally, or from one end of an international circuit to the other.

1.3 The tests carried out locally will be left to the discretion of the Administration responsible for the international exchange. The actual tests carried out will depend on the type of equipment concerned and the extent to which alarms and monitoring devices are provided to indicate failures in the setting-up of the calls. Functional tests of common equipment in the international automatic exchange come in this category.

1.4 Overall functional tests on an international circuit are such that they can be made from the outgoing end of the circuit without the co-operation of technical personnel at the incoming end of the circuit.

The tests carried out from end-to-end of a circuit are described in paragraphs 1.4.1, 1.4.2 and 1.4.3.

1.4.1 Verification of satisfactory signal transmission, i.e. checking that a seizing signal is followed by the return of a proceed-to-send signal and that a clear-forward signal is followed by the return of a release-guard signal.

1.4.2 Superficial tests of the transmission conditions, if this is considered useful, by means of a loop test.

The above two tests are simple and so can be carried out quickly and as often as desired, for example, daily.

Signalling tests made by sending seizing and clear-forward signals do not need the provision of any special equipment at the incoming international exchange. On the other hand, the international signalling and switching specifications specify that there must be a loop at the incoming end of an international circuit.

1.4.3 Finally, if any Administration wishes to make functional tests which include the exchange of signals over the international circuit other than those mentioned in 1.4.1 above, use may be made of any test call answering devices existing in the national service of the incoming country. Information concerning the calling numbers of these devices will be communicated to other international exchanges.

2. Limit testing

2.1 The object of these tests is to verify whether a particular type of equipment has the specified operating margins. If necessary, these tests may be followed by the readjustment of the equipment to as near the specified nominal values as is practicable.

2.2 Limit tests of the signalling will, in general, be carried out locally. The frequency of such tests and the test conditions to be applied will be determined by the Administrations concerned.

These tests will be made using, in particular, the calibrated signal generator and the signal measuring apparatus provided under Recommendation Q.95, Chapter VIII of the " International signalling and switching equipment specifications ".

The verification of the adjustment of signal receivers will be carried out locally but, by special agreement between Administrations, this adjustment can be carried out by overall circuit tests when the signal receiver cannot be dissociated from the terminal equipment of the carrier system of which it is an integral part.

The limit signalling tests will not normally be made from end to end of the circuit but it may nevertheless be desirable to be able to make such tests, for example, where technical disagreement arises between the two I.M.C.s concerned.

2.3 This Section 2, on limit testing, does not concern routine maintenance tests made on the line and which are normally followed by a readjustment of the line, for example, to restore it to its planned nominal value of overall loss. Such tests are proper to repeater stations and may be carried out automatically by automatic transmission measuring equipment. A very clear distinction should be made between:

— transmission *measuring* equipment used in the repeater stations;

— automatic transmission *testing* equipment used in the I.M.C.s.

Repeater station tests are carried out in accordance with the Maintenance Instructions in Volume IV of the *Red Book.*

CHAPTER IV

RECOMMENDATION Q.44

CORRECTIVE MAINTENANCE
LOCATION AND CLEARANCE OF FAULTS

1. General

The localization and clearance of faults on automatic circuits will be carried out in accordance with the general rules described in Chapter II above, for the organization of maintenance.

Within the framework of this organization four categories of technical personnel may be called upon for the clearance of faults.

a) The I.M.C. personnel comprising one or more officers-in-charge of maintenance.

b) At the control repeater station, the transmission testing service.

c) At the international automatic exchange, the personnel concerned with the maintenance of the international signalling and switching equipment.

d) In the national automatic exchanges of the incoming country, the personnel concerned with the maintenance of the national switching equipment.

The functions of the maintenance personnel at the international and national automatic exchanges do not call for any particular comment except to say that this staff will not need to know foreign languages.

2. Reporting faults to the I.M.C.

All faults affecting the international service are reported to the "International maintenance centre".

These faults are reported:

— by operators,

— by the maintenance personnel of the international automatic exchange,

— by the repeater station staff,

— by the officers-in-charge of the I.M.C. of an incoming country.

The conditions under which operators will report circuits as faulty will be defined by Administrations.

Fault reports can result from functional tests of the equipment and can also arise from faults revealed during tests of the quality of service if this is the practice followed by an Administration for such tests.

If, at an incoming exchange, there is a fault which affects a major part of the equipment at that exchange and which is liable to impede the flow of traffic, the I.M.C. of the incoming exchange should immediately inform the I.M.C.s of the outgoing exchanges that work into the exchange concerned.

3. Blocking the circuit

Every circuit reported as faulty to the I.M.C. should be blocked on the initiative of the officer-in-charge if this has not already been done. (For example, in the case where automatic blocking is carried out under the conditions described in Recommendation Q.88, Chapter VII of the " Specifications ".)

Every intervention of the maintenance personnel which incurs the blocking of a circuit should be brought to the notice of the outgoing I.M.C. possibly through the incoming I.M.C. or the control station.

The blocking of a circuit by the incoming exchange by means of the blocking signal (one-frequency system) or by the continuous sending of one-frequency (in the two-frequency system) should not exceed a duration of 5 minutes. If the work on the circuit must exceed this duration, the circuit should be withdrawn from service at the outgoing end and the I.M.C. of the incoming exchange should make a request to the outgoing exchange to this effect.

4. Broad localization of faults

The maintenance officer-in-charge of the I.M.C. will first verify whether a fault exists and, if so, will then proceed with the broad localization of the fault. He will determine whether the fault is:

(a) on the international switching equipment at the outgoing exchange,

(b) on the line,

(c) in the incoming country.

In carrying out this localization he will, as far as possible, avoid calling-in the I.M.C. of the incoming country and he will use the means put at his disposal which are described in Chapter VIII of the " Specifications ".

International experience already acquired confirms the excellent results obtained by the use of loop tests in carrying out this broad localization.

5. Priority of fault location tests

As a general rule, fault location tests should have priority over maintenance routine tests of individual circuits.

6. Fault clearance

Faults will be passed:

(a) to the maintenance personnel of the international automatic exchange if the fault is located in the international switching equipment of the outgoing country;

(b) to the control station of the international line if the fault is located in the line. (The control station is situated in the same country as the I.M.C.);

(c) to the I.M.C. of the incoming country if the fault is located in the incoming country. This I.M.C. will in turn pass the fault:

- either to the maintenance personnel of the international automatic exchange,
- or to any other national transmission or switching service concerned.

The I.M.C. personnel may be able to determine that a fault exists in the national network of a foreign country but discretion should be used as to whether or not it will be useful to inform the I.M.C. of this country of such a fault. Normally, no attempt will be made to report faults found to exist in the national network of the incoming country except faults of a persistent nature or those affecting localized areas that are particularly subject to faults.

7. Records of fault clearance

The I.M.C. responsible for an outgoing circuit should, after a fault has been cleared, receive particulars of the cause of the fault, when this has been determined without ambiguity. These particulars should be limited to a few words, for example, in the case of an international automatic exchange (incoming, transit or outgoing):

— automatic switching equipment,

— register,

— incoming or outgoing circuit equipment,

— signal receiver,

or such a report as:

— line fault,

— national network.

This may provide statistics for finding any weak points that may exist in the equipment of an international exchange.

PART 5

SPECIFICATIONS FOR STANDARDIZED INTERNATIONAL SIGNALLING AND SWITCHING EQUIPMENT

CONTENTS

INTRODUCTION

The following C.C.I.T.T. Specifications for standardized international signalling and switching equipment refer to two signalling systems using registers at the two ends of an international circuit and a special code for the transmission of numerical signals.

* * *

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

The values given below are imperative and must be met under normal service conditions.

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CHAPTER I

GENERAL OPERATING CONSIDERATIONS

RECOMMENDATION Q.51

1.1 FACILITIES PROVIDED IN INTERNATIONAL SEMI-AUTOMATIC WORKING

1.1. (1) The operating methods used in the international semi-automatic service are described in Section III of the Instructions for the International Telephone Service hereinafter referred to as the *Instructions.* These operating methods assume the existence of switching equipment (manual and automatic) involving the following categories of operators:

a) outgoing operators,

b) " code-11 " operators,

c) " code-12 " operators,

d) assistance 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) code-11 operators at the incoming international exchange;

c) code-12 operators, especially a particular code-12 operator at the incoming international exchange;

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

The outgoing operator should be able to recall code-11 and code-12 operators on calls set up via these operators, by sending a forward-transfer signal as defined under 2.12.

1.1. (3) The *code-11 operator* is an incoming operator at the incoming international exchange. She is obtained by dialling a special code-11 signal. This signal is the eleventh of the sixteen combinations provided by the signal code. This operator, called the " incoming " operator in the Instructions, 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) At the incoming international exchange, the *code-12 operator* is, in principle, a delay operator. She is obtained by dialling a special code-12 signal, which is the twelfth of the sixteen combinations provided by the signal code. The code-12 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 group or her position in the group is then indicated by a number which follows the code-12 digits.

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 and signalling points of view, however, the delay operator at the outgoing international exchange recalled 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 recalled.

1.1. (5) *Notes on code-11 and code-12 operators:*

a) Code-11 and code-12 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 digit,* between 1 and 8, sent for *all* semi-automatic calls, is used to obtain operators of a particular language group.

b) It may be the same operator who acts as a code-11 and as a code-12 operator, and even as an assistance operator. She enters a circuit in any of these capacities in response to the appropriate signal.

c) While a code-11 or code-12 operator is being called, the national ringing tone of the incoming country must be sent over the line.

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 when she is required to interpret a national tone signal. Access to an assistance operator at a transit exchange is not possible.

The assistance operator is called by a *forward-transfer signal,* sent by the outgoing operator when, for example, she presses a key on the outgoing position. An assistance operator in a required language group is obtained by the language digit sent during the setting-up of the call. Hence the incoming connecting circuit must store the language digit received.

The outgoing operator receives no supervisory signal 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 enter a circuit as a third party (when she acts as an interpreter between the international outgoing operator and a subscriber or an operator of the incoming country);

b) to enter a circuit on one side only after having isolated the other. She does this, for example, 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.

RECOMMENDATION Q.52

1.2 FACILITIES PROVIDED IN INTERNATIONAL AUTOMATIC WORKING

In international automatic working, the calling subscriber can obtain only such subscribers' numbers as are made up of characters appearing on his dial. Hence, he cannot obtain the incoming international exchange, or the code-11 operators, or the code-12 operators, or an assistance operator. 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 para. 2 and in Recommendation Q.60 para. 2.8.2.*c*).

It is pointless to send a language digit over an international circuit since the calling subscriber does not have to obtain operators speaking a particular language at the incoming international exchange. For all automatic calls, a digit called the " *discriminating digit* " (which is the digit zero) replaces the language digit in the sequence of signals sent. This digit is sent over the international circuit in place of the language digit sent on a semi-automatic call in order to indicate that the call is automatic. 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 Section (2) of Recommendation Q.36;
— enables therefore incoming registers to serve both automatic and semi-automatic service;
— shows the register in the international incoming exchange that there is no end-of-pulsing signal to follow;
— enables the equipment in the incoming international exchange to prevent automatic calls from having access to certain destinations (special services, for example).

RECOMMENDATION Q.53

1.3 NUMBERING USED

1.3.1 *International prefix*

The international prefix (see 3.1 in Recommendation Q.11) in automatic working is used only to give subscribers access to the international automatic network, and is not used in semi-automatic working.

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

1.3.2 *International code*

Under 3.2 in Recommendation Q.11 will be found some information about international codes. The international code is sent in the international outgoing exchange:

— in automatic working, for access to circuits to the country concerned;
— in semi-automatic working:
  — when it is required to give outgoing operators in the outgoing international exchange access to the circuit by means of selectors;
  — in transit working.

RECOMMENDATION Q.54

1.3.3 LANGUAGE DIGIT OR DISCRIMINATING DIGIT

1.3.3.1 *Language digit*

1. The language digit defined under 1.1. (5) decides the *service language* to be used on the circuit, that is to say, the language to be spoken in the incoming international exchange by the code-11, code-12 and assistance operators when they intercept (Article 33 *b* of the *Instructions*).
   The language digit must be sent for *all* semi-automatic calls.
2. The digit to be sent to select the appropriate language is as follows:

   1 = French
   2 = English
   3 = German
   4 = Russian
   5, 6, 7, 8 available to Administrations for selecting a particular language provided by mutual agreement
   9 = reserve (see 1.3.3.2.2.).

3. The sending of the language digit on the international circuit immediately precedes the sending of the significant number; it is the first digit received by the register in the incoming international exchange.
   The language digit is either:
   — sent by the operator to the outgoing register; in this case the operator must send it immediately before the significant number of the called subscriber;
   or:
   — sent automatically by the outgoing register.

1.3.3.2 *Discriminating digits*

1. In all automatic calls, the position in the sequence of pulsing signals occupied by the discriminating digit *0* is that occupied by the language digit in semi-automatic calls (see 1.2 above).
2. The digit *9* in the list of language digits has been kept in reserve for use as an extra discriminating digit if required. Such use should be for a call with

special characteristics, but the digit *9* must not be used merely to take the place of the digit *0* in an automatic call *.

3. Combination *13* in the signal code serves as a discriminating digit in calls to automatic testing equipment (see Section 8.3.3).

4. *N. B. — Point of origin of the discriminating digit 0.*

In all automatic calls:

— the discriminating digit *0* and,

— the significant number **,

must be sent over the international circuit to the incoming exchange by the country at the point of origin of the call.

As regards the point of origin of the discriminating digit *0*, three cases arise:

1. In calls to a country in which the national number includes the trunk prefix ** *0* (which is the case in most of Europe), the national number, dialled by the calling subscriber after the international code, is the same as the sequence of digits to be sent over the international circuit to the incoming international exchange, namely, the discriminating digit *0*, followed by the significant number **.

In this case no translation of the number dialled is necessary.

Example: A subscriber in Germany calls a subscriber in the Netherlands, at Hilversum;

— number dialled by the calling subscriber:

00 55 02950 12345

— number sent to the incoming exchange:

02950 12345

2. In calls to a country in which the national number includes the trunk prefix, this prefix not being *0* (as is the case in Spain), the national number is not the same as the sequence of digits to be sent to the incoming exchange because the trunk prefix is other than the discriminating digit *0*.

In this case, the outgoing country has to ensure that the *9* is translated into *0*.

Example: A subscriber in Germany calls a subscriber in Spain, at Madrid;

— number dialled by the calling subscriber:

00 50 **9** 1 1234567

— number sent to the incoming exchange:

0 1 1234567

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* For example, it might be thought useful to have an additional discriminating digit, when a distinction has to be made between automatic and semi-automatic calls originating in the outgoing country, from ordinary operators in national manual exchanges, and not from international operators. Such a distinction might be necessary because:

— in international accounts, such calls have to be considered as semi-automatic calls not to be metered by the international equipment,

— such calls are not accompanied by an end-of-pulsing signal.

** See the definitions in Recommendation Q.10.

3. In calls to a country in which the national number does not include the trunk prefix, the national number is the same as the significant number (as is the case in France).

In this case, the outgoing country has to arrange for the discrimination digit *0* to be inserted.

Example: A subscriber in Germany calls a subscriber in France, at Paris;

— number dialled by the calling subscriber:
00 33 1 SEG 4567

— number sent to the incoming exchange:
0 1 SEG 4567

The technical arrangements to be made in the outgoing country to meet the required conditions in the above three cases are left to the discretion of individual Administrations.

RECOMMENDATION Q.55

1.3.4 NATIONAL NUMBER

1. In automatic working, the subscriber sends the called subscriber's national number by means of a dial or keyset.

2. In semi-automatic working, the operator sends the significant number * of the called subscriber, by means of a keyset, for example.

3. The outgoing register must be designed to deal with significant numbers * having not more than ten digits. However, Administrations might like to remember, in designing their outgoing registers, that:

   a) the national numbering schemes used in other continents, for example, in North America, may in future provide for as many as twelve digits;

   b) there may in future be national numbers with more digits, so as to provide direct access to private automatic branch exchanges.

RECOMMENDATION Q.56

1.3.5 THE SENDING-FINISHED SIGNAL

In semi-automatic working, when the outgoing operator has finished dialling, she presses a special button on her keyboard or operates a key, so that after the number dialled, a local signal which is called a "*sending-finished*" signal is sent to the outgoing

* See definitions in Recommendation Q.10.

register 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 there is no question of using this signal.

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. This has the same function and shows the incoming register that there are no more digits to be received.

RECOMMENDATION Q.57

1.3.6 SENDING SEQUENCE OF NUMERICAL SIGNALS

The sequence of numerical signals sent from the operator or calling subscriber to an outgoing register is usually as follows. This sequence is the same as the sequence that must be used for corresponding signals sent over the international circuit.

1. Semi-automatic working

a) for a call to a subscriber:

i. the international code [1] *,
ii. the language digit [2],
iii. the significant number [3] of the called subscriber,
iv. the sending-finished signal;

b) for a call to a code-11 operator, or to any code-12 operator:

i. the international code [1],
ii. the language digit [2],
iii. code " 11 " or code " 12 ",
iv. the sending-finished signal;

c) for a specific code-12 operator, or a code-12 operator in a particular group of positions:

i. the international code [1],
ii. the language digit [2],
iii. code " 12 ",
iv. the number of the operator's position (the number given to the operator asked to ring back) or of the group of positions,
v. the sending-finished signal;

* For the reference numbers [1], [2], [3], see the end of this section.

d) for a call to a subscriber connected to a manual exchange obtained by automatic switching via the incoming international exchange:

i. the international code [1]*,
ii. the language digit [2],
iii. the code of the required manual exchange in the national numbering plan,
iv. the sending-finished signal.

2. Automatic working

e) for a call to a subscriber:

i. the international prefix [3],
ii. the international code [1],
iii. the called subscriber's national number [4].

Comments:

1) The international code is not sent on the international circuit in the case of terminal traffic.
As shown in 1.3.2, the operator may not have to dial this code.
2) As shown in 1.3.3.1.3, the operator may not have to send the language digit.
(3) The international prefix will not usually be received by the outgoing international register. Obviously, it will not be sent over the international circuit.
(4) On the international circuit, the outgoing register will send the discriminating digit 0, followed by the significant number.

RECOMMENDATION Q.58

1.4 UNIDIRECTIONAL OPERATION OF CIRCUITS

International circuits for semi-automatic and automatic operation are operated *unidirectionally* so that the equipment in international exchanges can be as simple as possible and so that double connections and lock-ups are avoided.

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* For the reference numbers [1], [2], [3], [4], see the end of this section.

CHAPTER II

RECOMMENDATION Q.60

DEFINITIONS AND FUNCTIONS OF SIGNALS

2.1 **Seizing signal** (sent in the forward direction)

This signal is transmitted at the beginning of a call to initiate circuit operation at the incoming end of an international circuit.

The seizing signal can also perform switching functions and two different types of seizing signal are provided for this purpose, viz:

a) the *terminal seizing signal,* which can be used at the incoming international exchange, to seize equipment used exclusively for switching a call to the called subscriber in the national network of the incoming country;

b) the *transit seizing signal* *, which can be used at the incoming international exchange, to seize equipment for switching the call to another international exchange.

2.2 **Proceed-to-send signal** (sent in the backward direction)

This signal is sent from the incoming end of an international circuit, following the receipt of a seizing signal, to indicate that the equipment is ready to receive the numerical routing information.

(In the two-frequency system, two different proceed-to-send signals are provided:

a) the *terminal proceed-to-send* signal, used to invite the sending of the necessary information for routing the call within the national network of the called country;

b) the *transit proceed-to-send signal* *, used to invite the sending of only those numerical signals necessary for routing the call through the international transit exchange towards the incoming international exchange).

2.3 **Pulsing signal** (sent in the forward direction)

This signal provides an element of information necessary to effect the switching of the call in the desired direction. There is always a succession of pulsing signals sent.

2.4 **End-of-pulsing signal** (sent in the forward direction)

In semi-automatic working, this signal is sent from the international outgoing exchange to show that there are no more pulsing signals to be received. The signal is not sent in automatic working.

* not used in the 1 V.F. system.

2.5 **Number-received signal** (sent in the backward direction)

2.5.1 This signal is sent from the incoming international terminal exchange when the incoming register has recognized that all the digits required for routing the call to the called subscriber have been received.

2.5.2 In semi-automatic working, the number-received signal can also be used to show the outgoing operator that the international switching operations have been completed.

2.5.3 In automatic working, this signal is also essential to show the outgoing register at the outgoing international exchange that it can release, and to set up speech conditions at this exchange. Hence, it is desirable that the signal be sent as soon as possible.

2.5.4 In the automatic service, the incoming register (or associated equipment) recognizes that all the digits of a significant number * have been received:

a) by simply checking the number of digits received in countries where the significant number * is always made up of the same number of digits;

b) in countries where this is not so:

i. by analyzing the first digits in the significant number * to decide how many digits there are in the subscriber's numbers in the particular national numbering zone; or

ii. by using a national end-of-selection signal or national " electrical " ringing-tone signal; or

iii. exceptionally, by observing that five to ten seconds have elapsed since the last digit was received, and that no fresh information has been received; in such circumstances, retransmission to the national network of the last digit received must be prevented until the end of the waiting period which causes the number-received signal to be sent over the international circuit. In this way, it is ensured that no national answer-signal can arrive before the number-received signal has been sent.

2.6 **Busy-flash signal** (sent in the backward direction)

This signal is sent to the outgoing international exchange to show that either the route, or the called subscriber, is busy. The conditions of use of this signal are as follows:

a) An international transit exchange *must* send this signal to indicate that there is congestion at that exchange.

b) An incoming international exchange *must* send this signal if there is congestion at that exchange or on the outgoing routes directly connected to it, but sending the signal is *optional* when there is congestion beyond that exchange (when there

* See definitions in Recommendation Q.10.

is congestion at a point in the national network of the incoming country or when the called subscriber's line is busy). This signal is then optional because there are several countries that do not send it from their national networks.

Note. — In automatic working, the receipt of the busy-flash signal at the outgoing exchange will cause:

— in all cases, an appropriate indication to be given to the calling subscriber; and

— normally, the sending of the clear-forward by the outgoing exchange to release the international connection (except when otherwise arranged, for example, in the case of observations on circuits).

2.7 **Answer signal** (sent in the backward direction)

This signal is sent to the outgoing international exchange to show that the called party has answered the call *.

In semi-automatic working, the signal has a supervisory function.

In automatic working, it is used:

— to start metering the charge to the calling subscriber,

— to start the measurement of call duration for international accounting purposes.

2.8 **Clear-back signal** (sent in the backward direction)

This is sent to the outgoing international exchange to indicate that the called party has cleared. In the semi-automatic service, it performs a supervisory function. It must not permanently release the circuit at the outgoing international exchange.

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, 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.

Notes on the answer and clear-back signals

2.8.1 *Note 1.* — In general, the sequence of answer and clear-back signals that will be sent when the called subscriber depresses and releases the switch-hook of his telephone will be unable to follow the frequency of this operation of the switch-hook, but correct indication of the *final* position of the switch-hook must *always* be given;

— to the outgoing international operator, in semi-automatic operation;

— to the outgoing international equipment, in automatic operation.

* See Recommendation Q.27 for the action to be taken to ensure that answer signals both national and international, are transmitted as quickly as possible.

Note 2. — The "called party" referred to in the definitions of the answer and clear-back signals may be:

— the called subscriber,

— in semi-automatic working, the operator who puts the call through in her own country and who sends an answer signal when she answers the call.

2.8.2 The following is a detailed description of the various possible circumstances in which the answer and clear-back signals are sent.

A. *Called subscriber obtained automatically by the international outgoing operator*

The answer and clear-back signals are sent every time the called subscriber answers or clears.

B. *Called subscriber not obtained automatically by the international outgoing operator*

a) Only one operator involved in the incoming country, without through-supervision via her position:

— (This operator can be a code-11 or code-12 operator or a manual exchange operator obtained automatically from the outgoing international exchange.)

The answer signal is sent when the operator enters the circuit.

The clear-back signal is sent when the operator clears the connection.

b) Only one operator involved in the incoming country, with through-supervision via her position:

— (The operator can be the same as for *(a)* above.)

(Through-supervision can be effected:

— via the cord circuits, the incoming operator intervening to clear down the connection at the end of the call,

— via cordless positions, in which case the connection is released automatically without the intervention of an operator when the called subscriber clears and when the outgoing operator causes the clear-forward signal to be sent.)

The answer signal is sent when the operator enters the circuit.

A clear-back signal is sent when the operator goes out of circuit. This can happen, for example, when the operator hears the ringing tone but does not wait for the called subscriber to reply.

A second answer signal is sent when the called subscriber answers or when the incoming operator again enters the circuit.

The clear-back signal is also sent when the called subscriber clears or when the incoming operator, by mistake, clears the connection before the called subscriber has cleared.

The same signal (answer signal or clear-back signal) must not be sent twice in succession.

c) Two operators involved in the incoming country:

These can be:

— code-11 or code-12 operators at the international exchange, and

— an operator at a national manual exchange.

c.1) There is no through-supervision via the code-11 or code-12 operators' positions at the international exchange. The answer and clear-back signals are sent as described in *(a)* above.

c.2) The code-11 or code-12 operator's position is normally able to provide through-supervision. There are still two cases to consider:

c.2.1) If the whole of the national chain, including the operators' positions, gives through-supervision from the called subscriber, the operating conditions can be as described in *b)* above. An operator intervenes to send an answer signal; her withdrawal causes the sending of a clear-back signal, an answer signal is sent when the called subscriber answers, and a clear-back signal is sent when the called subscriber clears. If an operator clears down the connection in error, before the called party clears, a clear-back signal is sent.

c.2.2) If the whole of the national chain does not give through-supervision from the called subscriber, supervision is extended from the point at which through-supervision ceases.

* * *

In *a)*, *b)*, and *c)* above, it is recommended that the incoming operator should have facilities to recall the outgoing operator by sending a succession of clear-back and answer signals, by means of a special key, for example.

If *automatic service requirements* necessitate the action described under C below, it will inevitably follow that in *semi-automatic working* correct supervision cannot be given, so that the sequence of answer and clear-back signals described above cannot be guaranteed.

C. *Automatic calls*

When direct access by a subscriber to an operator's position in the incoming country cannot be barred, it is essential, to avoid mistakes in charging, not to give the answer signal at the moment this operator replies. Arrangements must be made to ensure that the answer signal is sent when the called subscriber, or paid special service, answers. The answer signal is sent:

— either by an operator (using a key), or
— automatically, by through-supervision.

2.9 **Clear-forward signal** (sent in the forward direction)

1. This signal is sent in the forward direction at the end of a telephone call when:
   a) in semi-automatic working, the operator at the outgoing international exchange withdraws her plug from the jack, or when an equivalent operation is performed;
   b) in automatic working, when the calling subscriber hangs up or otherwise clears (as in the case of a subscriber's installation with extension telephones).

In automatic working, this signal is also sent after receipt of a busy-flash signal by the outgoing international exchange, and when there is forced release of the connection (see paragraphs 7.3.3, 7.3.4 and 7.4).

2. At the end of the clear-forward signal, all switching units held on the call must release at the outgoing, incoming, and transit international exchanges. (The clear-

forward signal must therefore be recognized at an international transit exchange). Each international circuit, however, is guarded against subsequent seizure until the release-guard signal has been received from the incoming end of the international circuit concerned.

3. In a transit exchange, the following arrangements must be made on disconnection:
   a) the GO channel must not be split until the clear-forward signal has completely ceased;
   b) the RETURN channel must be split as soon as possible after recognition of the clear-forward signal;
   c) a clear-forward signal received at the moment a call is established, but before speech conditions have been set up, must be repeated over the outgoing circuit that has been seized.

2.10 **Release-guard signal** (sent in the backward direction)

This signal is sent in the backward direction in response to the clear-forward signal, to indicate that the latter signal has been fully effective in bringing about the release of the switching equipment at the incoming end of an international circuit. It serves to protect an international circuit against subsequent seizure as long as the disconnection operations controlled by reception of the clear-forward signal have not been completed at its incoming end.

2.11 **Blocking signal** (sent in the backward direction)

This signal is sent, when required, to the outgoing end of the circuit to cause engaged conditions to be applied to the outgoing end of the international circuit.

The design of the signalling equipment at the outgoing end of international circuits should be such that the receipt of a blocking signal over a free circuit will cause that circuit to be engaged to operators or automatic equipment which would otherwise have access to it.

2.12 **Forward-transfer signal** (sent in the forward direction)

This signal is sent to the incoming international exchange when the outgoing international exchange operator wants the help of an operator at the incoming international exchange.

The signal will normally serve to bring an assistance operator into circuit if the call is automatically set up at that exchange. When a call is completed via an operator at the incoming international exchange, the signal will cause this incoming operator (code-11 or code-12) to be recalled.

2.13 **Diagram showing signal sequence**

The sequence of signals in semi-automatic and automatic working is shown diagrammatically in Figures 1, 2, and 3 of Annex 2 (see p. 153 *et seq.*).

CHAPTER III

General clauses concerning transmission

RECOMMENDATION Q.61

A. GENERAL CONDITIONS CONCERNING TRANSMISSION

3.1 Use of four-wire circuits

All automatic international telephone circuits have to be four-wire circuits according to C.C.I.F. recommendations for modern type circuits.

3.2 Equivalent of a circuit or of a chain of international circuits

The lining-up, and in some cases, the interconnection of international circuits used for automatic and semi-automatic operation must be such as to satisfy the following conditions:

a) the overall loss in terminal service, measured at 800 c/s between the two-wire ends must have a standard nominal value which, in the present stage of technical development, is 0.8 neper or 7 decibels in each direction of transmission. This value takes into account the insertion loss of the outgoing and incoming switching equipment as well as all attenuation pads inserted in the circuit in terminal service.

Since it may be considered desirable, in the future, to reduce this present standard value of 0.8 neper or 7 decibels, the switching equipment should include some arrangement (attenuation pads) which would enable a change to be made in this value without inconvenience.

b) 4-wire interconnection via transit exchanges of two or three international circuits must be such that the overall loss of the connection made up of those two or three circuits in tandem is of the same standard nominal value as the overall loss of a single circuit in terminal service.

This overall loss is measured in the same way as for a single circuit in terminal service; it takes account of the insertion loss of the transit switching equipment as well as all attenuation pads inserted in the chain of international circuits.

c) the relative levels on this chain of circuits must remain in accordance with the level diagrams of the circuits making up the chain.

* * *

If conditions *(a)*, *(b)* and *(c)* are satisfied, the nominal level of the point at which a signal receiver is connected to an international circuit will always be the same, whether the circuit is used in terminal service or constitutes the second or possibly the third circuit of a chain of several interconnected circuits.

3.3 Method of interconnecting circuits

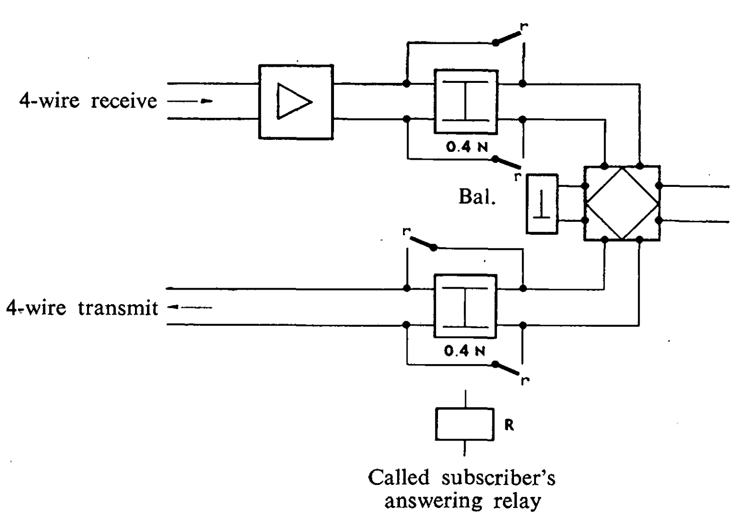
So that reflections, at a connection point between two international four-wire circuits do not interfere with signalling, it is recommended that such interconnected circuits should always be interconnected by direct connection of the line wires. At the interconnection point it is also necessary to take care to disconnect the low-pass filters which may be inserted at the end of an international circuit intended for general use with national extension circuits having a cut-off frequency below 3400 c/s.

This recommendation does not concern the method of interconnecting two national trunk circuits used in international calls. It is for Administrations to make the necessary arrangements for interconnecting such circuits. In the same way, the method of connection between a national circuit and the international circuit can be chosen by the Administrations of each country, provided that the signal receiver is connected to the four-wire end of the international circuit and that the connection with the national network does not give rise to reflections during the time that signals are being transmitted between two registers.

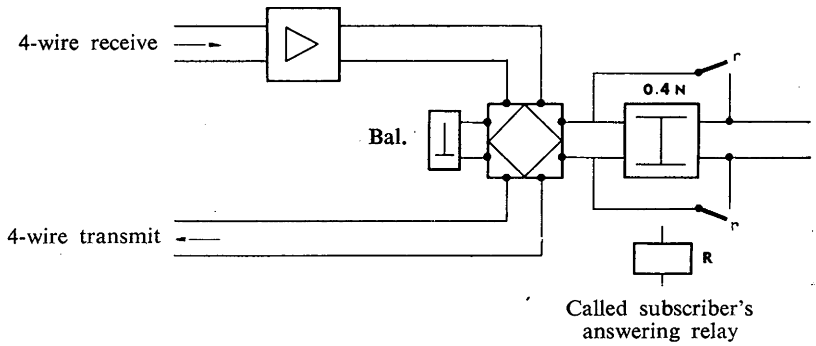
3.4 **Risk of instability**

Arrangements should be made to reduce the risk of singing during the period between the moment when the speech path is established at the incoming international exchange, and the moment the called subscriber answers, and also during the period between the moment when the called subscriber clears and the moment when the circuits are liberated. This result can generally be achieved by one of the following methods:

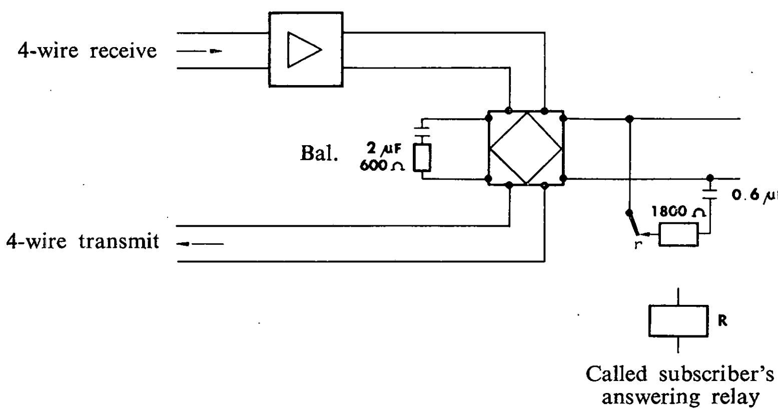
a) the insertion of an attenuator in each direction of the four-wire part of the connection;



b) the insertion of an attenuator in the two-wire part of the connection;



c) the connection of a terminating impedance in parallel with the two-wire side of the connection.



It is recommended that, whatever method is used, it should always be applied at the *incoming* end of an international circuit, each Administration being free to adopt the method it considers most suitable. From experience obtained on manual circuits, it is considered that for the present and for circuits lined-up to an overall loss of 0.8 neper (7 db) between the two-wire ends, it will be sufficient if arrangements are made to increase the stability of circuits by 0.4 neper (3.5 db).

3.5 **Crosstalk introduced within an international exchange**

3.5.1 *Crosstalk between different circuits*

The crosstalk ratio, measured at the test-jack frame, between any two 2-wire connections set-up through an international exchange should not be less than 8 nepers or 70 decibels.

A " two-wire connection " comprises a pair of wires from the test-jack frame, a switching equipment (made up of an incoming equipment, switching apparatus, and an outgoing equipment) and a pair of wires returning to the test-jack frame.

This limit of 8.0 nepers or 70 decibels gives a tolerable transmission impairment on the chain of international and national circuits, and takes account of the fact that there must be at least two international exchanges involved in an international call and that the number of such international exchanges could reach four in the future.

The limit defined above should normally apply to the most unfavourable case, i.e. the case of two connections having parallel routes right through the international exchange. It can be stated that such a case is purely theoretical in fact, since the customary switching arrangements are such that if at one switching stage two connections use adjacent switches, then at the next switching stage these two connections will use switches which are not adjacent.

3.5.2 *Crosstalk between the "go" and "return" paths of a four-wire connection*

The crosstalk ratio between the GO and RETURN paths of a four-wire connection, passing through an international exchange, should not be less than 5.8 nepers (50 decibels).

3.6 Systematic splitting of circuits to protect international and national signalling systems against each other

To avoid one signalling system interfering with another, it is advisable to limit the length of any part of:

1. the *international* signal that may be able to pass from the international circuit into the national system (protection of national systems);
2. the *national* signal that may be able to pass:
   a) from the national signalling system to the international signalling system (protection of the international system),
   b) from one national signalling system to the national signalling system of another country via the international connection that has been set up (protection of national systems).

A splitting arrangement is called for in international signalling systems (see sections 5.3 and 6.3) in order to satisfy condition 1 above. This device also serves to limit the duration of signals on the GO path from returning over the RETURN path by reflection at the termination.

The C.C.I.T.T. has made recommendations about national signalling systems to ensure that Condition 2 above may be satisfied. These recommendations, which do not concern the international signalling system, appear in Recommendation Q.25 paragraph (3).

3.7 Insertion of echo suppressors

3.7.1 When transmission conditions on a particular route require the insertion of an echo suppressor, it must be inserted at a point where it will cause no interference with signalling over the international circuit.

3.7.2 The use of circuits on which echo suppressors are permanently connected should be avoided for automatic and semi-automatic operation.

Any echo suppressor normally connected at the outgoing end of an international circuit should be disconnected when that circuit is used for an international transit connection of which it is the second or third circuit.

3.7.3 Any echo suppressor required on an international circuit should be inserted at the outgoing international exchange. The method for controlling the connection of an echo suppressor at an outgoing international exchange is left to the choice of the Administration responsible for that exchange. A simple method is to leave the control of the insertion of an echo suppressor to the outgoing operator; if automatic alternative routing is used, a study of the routing plan will enable the routes for which echo suppressors will be necessary to be determined in advance, though it may happen that operators will not be able to identify these routings. Another solution is to control the connection of echo suppressors by the outgoing register according to the international code and the route followed by the call.

RECOMMENDATION Q.62

B. CLAUSES COMMON TO SIGNAL RECEIVERS (AND TRANSMITTERS) FOR BOTH 1-FREQUENCY AND 2-FREQUENCY SIGNALLING SYSTEMS

3.8 Signal levels and signal receiver sensitivity

3.8.1 *Standardized transmitted power*

The standardized transmitted power is defined in paragraphs 5.1.2. and 6.1.2. It corresponds 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 during the signalling period, for example, when static modulators are used for signal transmission, should be 50 decibels (5.8 nepers) below signal-level.

3.8.2 *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 variation with time of the overall loss of the international circuits at 800 c/s,
2. the variation with frequency of the overall loss of international circuits, in relation to their nominal value at 800 c/s,
3. the tolerance on the transmitted absolute power level in relation to its nominal value.

To take account of these three variations, a maximum variation of ± 1 neper (± 9 decibels) in relation to the nominal value of this level has been accepted for the absolute level of received signalling currents at the point of connection of the signal receiver.

This margin normally permits tandem connection of two international circuits. It permits the interconnection of three international circuits when the standard deviation of the variations of the overall loss with time of each of these circuits is not greater than 1.5 decibels (0.17 neper) *.

3.8.3 *Maximum sensitivity of the signal receiver*

It is desirable to limit the maximum sensitivity of the signal receiver (see 5.2.2.*b* and 6.2.2.*b*) particularly in view of the fact that the lower limit fixed for the crosstalk ratio between the GO and RETURN paths of a 4-wire circuit is only 4 nepers (35 decibels).

3.9 Connection of the signal transmitter and signal receiver to the circuit

3.9.1 The signal receiver should be connected permanently to the four-wire side of the telephone circuit.

3.9.2 The signal receiver should be protected against disturbing currents (voice currents or possibly noise), coming from 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 signal receiver is connected, these disturbing currents are of such a level that they cannot:

— operate the signal receiver,
— interfere with the reception of signals by operating the guard circuit of the signal receiver.

The supplementary 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 relative level at the distant origin of the circuit);

b) the lowest signal level at the input to the signal receiver, i.e:

$-15 + n$ db in the case of the 1-frequency system (see 5.2.1)

$-18 + n$ db in the case of the 2-frequency system (see 6.2.1)

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 currents might be assumed to be, for example, $+10$ db at a zero relative level point in the direction *opposite* to that of the signals. The nature of the switching noises depends on the national systems used;

* See Recommendation G.123 of Volume III of the *Red Book*.

d) the overall loss of the international circuit when working in terminal service;

e) a safety margin x 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 paragraph *b)*.

The recommendations of Volume III of the *Red Book* concerning international circuits must still be met after the connection of a signal transmitter and a signal receiver (1 or 2 V.F. transmitter or 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 signal transmitters and receivers; an example of a detailed specification concerning these conditions is given in paragraph 3.10.

3.10 Example of detailed specification clauses for signal transmitters and receivers

The following clauses are given solely as an example (see paragraph 3.9); they apply only to 4-terminal signal receivers and to a nominal circuit impedance of 600 ohms.

3.10.1 *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 impedances of the signal receiver, should meet the following condition throughout the 300 to 3400 c/s 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.

3.10.2 *Attenuation*

At 800 c/s, 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:

$$A \pm 0.05 \text{ neper}$$

or

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

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.

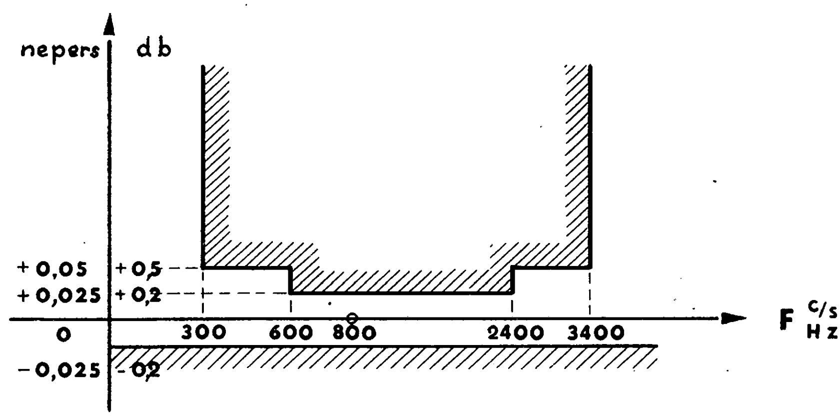
For this measurement the generator will have an e.m.f. of

$$1.55 \; e^n \text{ volts}$$

where n is the *relative* power level (in nepers) at the signal receiver input.

3.10.3 *Attenuation distortion*

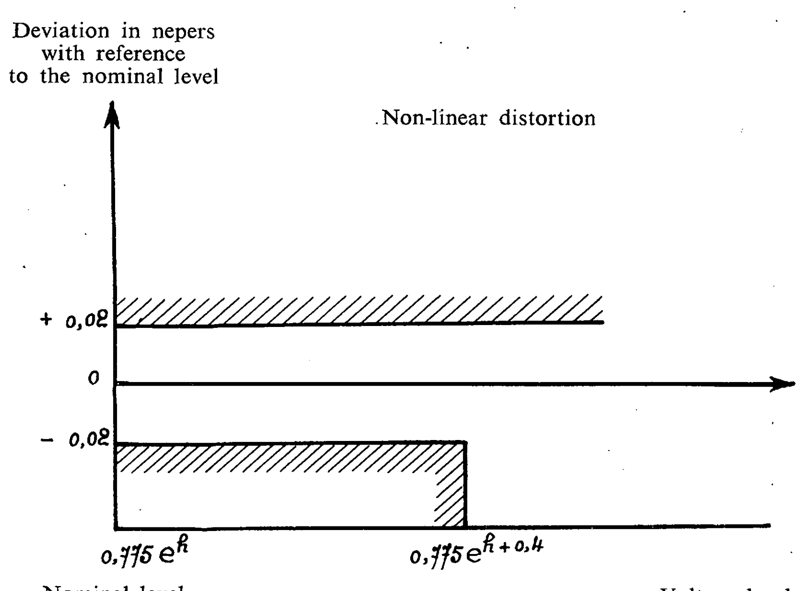
The variation in insertion loss of the signal receiver in the 300-3400 c/s frequency band, measured under the conditions of paragraph 3.10.2 should not exceed the limits shown in the following graph.



3.10.4 *Non-linear distortion*

In the 300-3400 c/s frequency band, the harmonic distortion resulting from the insertion of the signal receiver in the line must be such that the level variation with reference to the nominal level lies within the limits defined by the graph below (h = nominal voltage level, referred to 0.775 V).

The measurement should be made with apparatus having an internal resistance of 600 ohms.



3.10.5 *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 transmitter.

3.10.6 *Crosstalk between adjacent signal receivers*

The crosstalk ratio between two adjacent signal receivers should not be less than 8.5 nepers (74 decibels) in the 300-3400 c/s frequency band.

CHAPTER IV

Miscellaneous clauses common to both 1-frequency and 2-frequency systems

RECOMMENDATION Q.65

4.1 SPEED OF SWITCHING IN AN INTERNATIONAL TERMINAL OR TRANSIT EXCHANGE

4.1. (1) It is recommended that the equipment in international exchanges (terminal or transit) shall have a high switching speed so that the switching time may be as short as possible.

4.1. (2) It is also recommended that the incoming register at the incoming international exchange should begin to set up the national part of the connection as soon as the register has received a sufficient number of digits and without waiting to receive the complete number of the called subscriber;

4.1. (3) At the outgoing international exchange:

— with semi-automatic operation it may be desirable for the outgoing register to start sending numerical signals to line without waiting to receive all the digits of the called subscriber's number. However, this may depend on national conditions.

— with automatic operation, it is evident that the sending of numerical signals must begin without waiting for the receipt of all the digits of the called subscriber's number because the outgoing register will not generally know how many digits there are going to be.

4.1. (4) At incoming and transit exchanges, use can be made of the advantages of continuous hunting (of circuits or common equipment), i.e. economy in the number of outgoing circuits to be provided or improvement in the quality of service for a given number of circuits. However, the return of a busy-flash signal must take place within the following delay times, specified in particular so that the release conditions of registers can be laid down:

— a maximum delay of 5 seconds following the recognition of a seizing signal at an incoming or transit exchange if a free register and/or link circuit is not found,

— a maximum delay of 10 seconds following the receipt, at an incoming exchange, of the information necessary for determining the required route, if a free outgoing circuit is not found,

— a maximum delay of 10 seconds following the receipt of the international code at a transit exchange, if a free outgoing circuit is not found.

RECOMMENDATION Q.66

4.2 RELEASE OF REGISTERS

4.2.1 **Outgoing register**

4.2.1 (1) *Normal release conditions*

The outgoing register shall release in one or the other of the two following cases:

Case 1. — The register has sent forward all the numerical signals and has received a local end-of-sending signal from the outgoing operator indicating that there are no more digits to follow.

Case 2. — The register has received:

- either, a number-received signal from the incoming international exchange indicating that all the digits comprising the complete national number have been received,
- or, a busy-flash signal [except in the case of the two-frequency system where re-routing via an alternative route is employed (see point 4.8), in which case the busy-flash signal initiates re-routing, the outgoing register then releasing at a later stage].

4.2.1 (2) *Abnormal release conditions*

Arrangements should be made at the outgoing exchange for the possibility of releasing the outgoing register when any one of the following conditions arises:

a_1) With semi-automatic operation, if after a delay of 10-20 seconds from the seizure of the register or the receipt of the last digit, no further digit or an end-of-sending signal is received.

a_2) With automatic operation, if after a delay of 15-30 seconds from the seizure of the register or the receipt of the last digit, the register is in one of the following conditions:

- seized, but no further digit received from the calling subscriber,
- incomplete international code received (a single digit),
- correct international code received, but no further digit received from the calling subscriber,
- the last national digit received from the calling subscriber has been sent, but no further digit received from the calling subscriber nor any signal from the international circuit (busy-flash or number-received signal).

In the first two cases, a shorter delay may nevertheless be adopted by certain administrations.

In the last two cases, the release of the outgoing register is made to accompany the release of the international circuit by sending the clear-forward signal.

The method of indicating the above abnormal conditions to the calling subscriber will depend on the practice followed in the various countries: a tone may be sent or, better, a recorded announcement will ask the caller to recommence his call after having checked the number to be dialled.

The delay of 15-30 seconds provided for in the above conditions is considered sufficient to cover the maximum period for receiving a number-received signal under the most unfavourable conditions.

b) International code received for which no routing has been provided.

c) Proceed-to-send signal or busy-flash signal not received within:

— 10 to 20 seconds following the sending of a seizing signal (one-frequency system),

— 10 to 30 seconds following the sending of a seizing signal (two-frequency system),

— 15 to 30 seconds following the sending of the international code digits to a transit centre (two-frequency system, transit traffic).

d) In the two-frequency system, an acknowledgment signal not received within 5 to 10 seconds following the sending of a digit.

e) In the two-frequency system, a third transit proceed-to-send signal received.

In the various cases mentioned above, an appropriate indication should be given to the operator or calling subscriber.

4.2.2 **Transit register** (two-frequency signalling system)

4.2.2 (1) *Normal release conditions*

The transit register shall release as soon as it has completed the whole of the following operations:

a) it has selected an outgoing circuit,

b) it has sent forward a seizing signal.

However, a different procedure may be used, in which the release of the register is delayed until either a proceed-to-send signal or a busy-flash signal is received from the next exchange. It may be judged more convenient to make use of the transit register when it is desired to give an alarm to show that a proceed-to-send signal has not been received. In this case, the circuit should be switched to the speech condition in both directions of transmission immediately following the operations mentioned in *a)* and *b)* above so as to allow the proceed-to-send signal and the following numerical signals to pass through the transit exchange.

If there is outgoing congestion from the transit exchange, the register will release after it has returned a busy-flash signal, and made connection to a recorded announcement.

4.2.2 (2) *Abnormal release conditions*

The transit register will release *without returning any signal* under any one of the following conditions:

a) international code digits not received within 5 to 10 seconds following the sending of a proceed-to-send signal to the outgoing exchange;

b) international code received for which no routing has been provided;

On the other hand, if the release of the transit register is deferred until a proceed-to-send signal is received, in accordance with the alternative method mentioned in paragraph 4.2.2 (1), it will release if a proceed-to-send signal or busy-flash signal is not received within 10 to 30 seconds following the sending of a seizing signal to the next exchange.

4.2.3 **Incoming registers**

4.2.3 (1) *Normal release conditions*

The incoming register will release when all the numerical information necessary to set up the connection in the incoming country has been sent and after a number-received signal has been returned over the international circuit. The register will determine when the complete number has been received under the conditions defined in paragraph 2.5.

If the incoming register finds that there is outgoing congestion from the incoming international exchange, it will release after returning a busy-flash signal.

4.2.3 (2) *Abnormal release conditions*

The incoming register will release if any one of the following three conditions occurs:

a) No further digit received after a delay of 30 to 60 seconds from receipt of last digit and no proof by one of the methods described in paragraph 2.5, that the number received is a complete number.

b) No digits received within 5 to 10 seconds in the two-frequency system or 20 to 40 seconds in the one-frequency system following the return of a proceed-to-send signal.

c) Number received for which no routing exists or incomplete number received followed by an end-of-pulsing signal.

In cases *a)* and *b)* the incoming register in the one-frequency system must return a busy-flash signal before it releases, to indicate that an abnormal condition has occurred at the incoming exchange. This is the only way of informing the outgoing exchange that abnormal conditions have occurred. In the two-frequency system, the return of a signal is unnecessary because the outgoing register remains in circuit and can itself detect any abnormal condition in the establishment of the call.

In case *c)*, before the incoming register releases (in both the one-frequency and two-frequency systems) a number-received signal will be returned, followed, if possible, by a recorded announcement, a number-unobtainable tone or by the intervention of an interception operator.

RECOMMENDATION Q.67

4.3 SWITCHING TO THE SPEECH POSITION

4.3.1 *Outgoing international exchange*

The circuit shall be switched to the speech position when the outgoing register releases (see 4.2.1).

4.3.2 *International transit exchange* (two-frequency system)

The circuit shall be switched to the speech position immediately the transit register has sent the seizing signal (see 4.2.2).

4.3.3 *Incoming international exchange*

The circuit shall be switched to the speech condition immediately the incoming register:

— either has sent the number-received signal and the numerical information to the national network equipment,

— or has sent the busy-flash signal,

— and, if these signals are not sent, when the register releases under abnormal conditions (see 4.2.3 (2)).

RECOMMENDATION Q.68

4.4 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:

— conversion at the incoming international exchange of the national answer signal into the international answer signal, and

— conversion at the outgoing international exchange of the international answer signal into the national answer signal,

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.

RECOMMENDATION Q.69

4.5 DELAY IN THE TRANSMISSION OF LINE SIGNALS

So that surges (transient currents) caused by the opening or closing of direct current circuits connected to the line wires of the switching equipment do not prevent the correct operation of the signal receiver at the other end of the circuit, whether they precede le fonctionnement correct du récepteur de signaux situé à l'autre extrémité du circuit, les dispositions suivantes seront prises à l'émission des signaux à fréquences vocales:

a) Le circuit international sera séparé du côté « centre international », 30 à 50 millisecondes avant le début de l'émission du signal à fréquences vocales sur le circuit international.

b) Le circuit international ne sera raccordé au côté « centre international » que 30 à 50 millisecondes après la fin de l'émission du signal à fréquences vocales sur le circuit international.

AVIS Q.70

ACHEMINEMENTS EN TRANSIT

4.6 INTERDICTION DE CERTAINS ACHEMINEMENTS

Afin d'éviter des acheminements inopportuns qui ne correspondraient pas au « Plan d'acheminement du trafic semi-automatique et automatique en Europe », on pourra éventuellement prévoir au centre de transit des dispositions techniques permettant de vérifier d'où vient l'appel et d'empêcher, grâce à cette donnée, que se produisent des combinaisons fâcheuses d'acheminements.

4.7 INDICATION DES CONDITIONS D'ENCOMBREMENT EN UN CENTRE DE TRANSIT

En cas d'encombrement dans un centre de transit:

1) Le signal d'occupation doit être émis (voir la définition de ce signal sous 2.6) pour indiquer qu'il n'y a aucun circuit sortant libre ou pour indiquer qu'il n'y a pas d'enregistreurs de transit ou de circuits de connexion disponibles. Dans le cas où l'on utilise une recherche continue, ce signal d'occupation doit être envoyé dans les délais maximums spécifiés au point 4.1 (4).

   Ainsi qu'il est mentionné au paragraphe 2.6, en exploitation automatique, la réception au centre de départ du signal d'occupation donnera une indication appropriée à l'abonné demandeur et provoquera l'envoi d'un signal de fin, afin de libérer la connexion internationale (sauf utilisation du réacheminement, voir 4.8.2).

2) Une machine parlante donnera le nom du centre dans lequel l'encombrement est constaté.

   Dans le cas de l'exploitation semi-automatique, le signal d'occupation et l'indication verbale fournie par la machine parlante seront utilisés au centre de départ, suivant les dispositions jugées les plus favorables par l'Administration du pays de départ *.

* Dans le système à 2 fréquences, on peut utiliser des signaux d'invitation à transmettre (de transit ou terminale) pour donner, soit avec des lampes, soit avec des voyants, une indication visuelle du centre où l'encombrement s'est manifesté.

Une Administration qui désire utiliser l'annonce verbale donnée par la machine parlante d'un centre de transit doit évidemment ne pas convertir en une tonalité audible le signal d'occupation qui précède cette annonce verbale.

4.8 ACHEMINEMENT AUTOMATIQUE PAR VOIE DÉTOURNÉE (DÉBORDEMENT) ET RÉACHEMINEMENT

4.8 (1) Pour le cas où, au centre international de départ ou à un centre international de transit, un appel ne réussit pas à trouver un circuit libre sur une voie, on peut prendre des dispositions techniques si on le désire pour détourner automatiquement l'appel sur une autre voie (voie détournée). On désigne cette opération sous le nom de *débordement*.

4.8 (2) Pour le cas où un encombrement se manifeste à un centre de transit intermédiaire, on peut prendre des dispositions, si on le désire, pour détourner automatiquement au centre international de départ, l'appel sur une autre voie (voie détournée). On désigne cette opération sous le nom de *réacheminement*. Le réacheminement d'un appel est provoqué par la réception d'un signal d'occupation au centre international de départ.

Un réacheminement serait sans objet lorsque des conditions d'encombrement sont constatées au centre d'arrivée. Aucun appel ne devra donc être détourné d'une voie directe utilisée exclusivement pour du trafic terminal, vers une voie détournée de transit lorsqu'un signal d'occupation aura été reçu sur un circuit de la voie directe. Afin d'éviter, d'autre part, un réacheminement en cas d'encombrement dans le réseau national du pays d'arrivée, aucun réacheminement n'aura lieu si l'enregistreur de départ reçoit pour un appel écoulé en transit, un signal d'occupation après avoir déjà reçu un signal d'invitation à transmettre terminale.

4.9 INDICATION DE L'ACHEMINEMENT EFFECTIVEMENT SUIVI PAR UN APPEL LORSQUE L'ON UTILISE LA MÉTHODE D'ACHEMINEMENT PAR VOIE DÉTOURNÉE

Lorsqu'il est nécessaire, pour des raisons de taxation, de connaissance du trafic, ou de maintenance, de donner à l'opératrice de départ, à du personnel d'observation ou à du personnel chargé de la maintenance, l'indication de l'acheminement effectivement suivi par un appel dans le cas où l'on utilise des acheminements par voie détournée, on peut prendre des dispositions pour indiquer au moyen de signaux lumineux (lampes ou voyants) la voie (voie de 1er, 2^{e} ou 3^{e} choix) effectivement empruntée *au départ* du centre international de départ.

Dans le système à 2 fréquences, il sera également possible d'effectuer la distinction d'un acheminement comportant un centre de transit et d'un acheminement comportant deux centres de transit, en comptant le nombre et le type des signaux d'invitation à transmettre reçus au centre international de départ. Ces renseignements utilisés en corrélation avec l'indication de la voie de départ choisie au centre de départ permettront de « déterminer » l'acheminement réellement suivi par l'appel.

RECOMMENDATION Q.72

4.10 ARRANGEMENTS TO BE MADE IN TRAFFIC OBSERVATION EQUIPMENT

When designing international signalling and switching equipment, the possibility should be considered of including arrangements (telephone meters, traffic recorders, etc.) for obtaining traffic information, circuit occupancy and the grade of service. This will avoid having to introduce substantial modifications to equipment already in service.

A standardized international arrangement for the collection of information on traffic quantities and distribution has not yet been defined by the C.C.I.T.T., but is currently (1960) under study (see Question 3/XIII).

CHAPTER V

The one-frequency system

RECOMMENDATION Q.76

5.1 SIGNALS SENT TO LINE

5.1.1 *Signalling frequency*

The signalling frequency shall be 2280±6 c/s.

5.1.2 *Absolute power level transmitted*

The absolute power level of the unmodulated signal frequency at a zero relative level point, shall be —0.7 neper (—6 decibels) with a tolerance of ±0.1 neper or ±1 decibel.

The level of the leak current which might be transmitted to line during the signalling period for example, when static modulators are used for signal transmission should be 50 decibels (5.8 nepers) below signal level.

RECOMMENDATION Q.77

5.2 SIGNAL-RECEIVER SPECIFICATION

5.2.1 *Operating limits of the signal receiver*

The signal receiver shall operate in the conditions specified in 5.2.5, to a signal frequency of

2280 ± 15 c/s,

the absolute power level N of the unmodulated signal being such that

$$-1.7+n \leqslant N \leqslant +0.3+n \text{ nepers}$$

or

$$-15+n \leqslant N \leqslant +3+n \text{ decibels}$$

where n is the relative power level at the signal receiver input.

These limits give a margin of ±1 neper (±9 decibels) on the nominal absolute level of the received signal at the input to the signal receiver.

The above tolerances are to allow for variations at the sending end and for variation in line transmission.

5.2.2 *Non-operate conditions for the signal receiver*

a) *Selectivity*

The signal receiver shall not operate to a signal having an absolute power level at the receiving end within the limits specified in paragraph 5.2.1 when the frequency differs by more than 150 c/s from the normal frequency of 2280 c/s.

b) *Maximum sensitivity of the signal receiver*

The signal receiver shall not operate to a signal of 2280 ± 15 c/s, whose absolute power level at the point of connection of the receiver is $(-3-0.7+n)$ nepers or $(-26-6+n)$ decibels, n being the relative power level at this point.

This limit is 3 nepers (26 decibels) below the nominal absolute level of the signal at the input to the signal receiver.

5.2.3 *Efficiency of the guard circuit*

The signal receiver must be protected by a guard circuit against false operation due to speech currents, circuit noise or other currents of miscellaneous origin circulating in the line.

The purpose of the guard circuit is to prevent:

a) signal imitation (signals are imitated if the duration of the resulting direct current pulses at the output of the signal receiver are long enough to be recognized as signals by the switching equipment);

b) operation of the splitting device from interfering with speech.

An indication of the efficiency of the guard circuit is given by the following:

a) during 10 hours of speech, normal voice currents should not, on the average, cause more than one false operation lasting more than 55 milliseconds per 10 hours of conversation (the minimum recognition time of a signal is 60 milliseconds);

b) the number of false splits of the speech path caused by speech currents should not cause an appreciable reduction in the transmission quality of the circuit.

5.2.4 *Guard circuit limits*

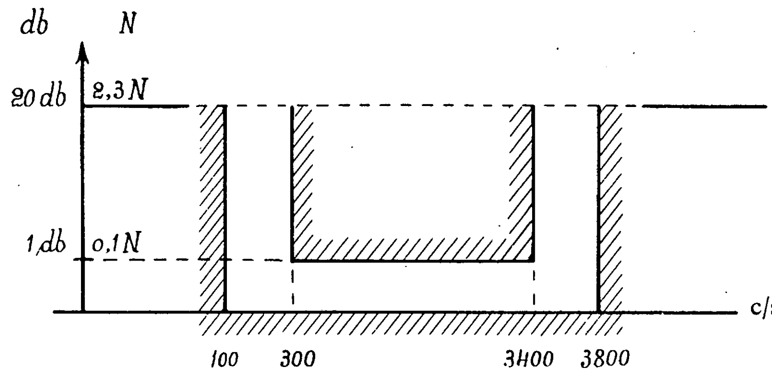
A. *Steady noise*

Considering:

a) that when there is noise on the telephone circuit, a too sensitive guard circuit might give rise to signalling difficulties and, in particular, inhibit the response of the signal receiver,

b) that a psophometric e.m.f. of 2 millivolts, measured at a relative level point of —0.8 neper (or —7 decibels) is *provisionally* allowed as the maximum limit of circuit noise for a single circuit, the psophometric e.m.f. for two circuits in tandem being therefore 3 millivolts.

it is recommended that when the frequency and the level of the signal are within the limits specified in paragraph 5.2.1, the signal receiver should satisfy the conditions indicated in paragraph 5.2.5 (lines *a* and *b*) for the distortion of signals in the presence of a noise having a psophometric e.m.f. of 3 millivolts at a —0.8 neper (—7 decibels) relative level point, the noise being produced by a generator which has a uniform curve of energy output over the frequency spectrum and which is followed by a filter having an attenuation/frequency characteristic within the limits given by the graph below.



B. *Surges*

A guard circuit with a too long hang-over time may cause difficulties in receiving a signal, for example, when it has been immediately preceded by surges and it is therefore recommended that the following condition should be fulfilled:

If a disturbing current, of a frequency corresponding to the maximum sensitivity of the guard circuit, and having an absolute power level of $(-1.15+n)$ neper or $(-10+n)$ decibels, at the relative level point n where the signal receiver is connected, ceases 30 milliseconds before the application of a signal of a frequency and level within the limits defined in paragraph 5.2.1, the lengths of the received signals must remain within the limits specified in paragraph 5.2.5.

5.2.5 *Distortion of received signals*

When the signal frequency and level are within the limits specified in paragraph 5.2.1, the following conditions should be met by an isolated pulse transmitted over the line for at least 40 ms or by a pulse of duration t_1 between 40 and 60 ms, forming one of a train of pulses each of which is separated from the preceding one by an interval of $(100-t_1)$ ms:

1. the delay in the start of a received pulse should be less than 20 ms,
2. the duration of the received pulse should be within ± 8 ms of the original duration, noise as defined in paragraph 5.2.4 being present.

RECOMMENDATION Q.78

5.3 SPLITTING ARRANGEMENT

5.3. (1) To prevent the line signals * of the international signalling system from causing disturbances to national signalling systems, the international circuit should be split (completely cut) at the outgoing and incoming international exchanges when a signal is received to ensure that no fraction of a signal exceeding 35 ms duration may pass out of the international circuit.

This splitting device will also be of advantage to the international signalling system when speech conditions are set up because it will prevent signals from being returned from the GO to the RETURN paths via the termination at the receiving end, so giving rise to false signals at the exchange from which the signal is sent.

The splitting time of 35 ms defined above may possibly be reduced by each Administration concerned in order to help in protecting its national network against the effect of signals coming from the international circuit. It should be noted, however, that a shorter splitting time can lead to an increase in the number of false operations of the splitting device by speech currents and so impair speech transmission.

5.3. (2) The split must be maintained for the duration of the signal but must cease within 25 ms of the direct-current signal which caused the splitting device to operate.

5.2. (3) The splitting of the line must not give rise to surges which might cause interference with signalling over the international or with other signalling systems associated with it in setting up an international call.

RECOMMENDATION Q.79

5.4 SIGNAL CODE

5.4. (1) The signals of the one-frequency system are:

1. signals called " line signals " which serve to control the connection operations and supervisory signals;
2. numerical signals which are arythmic code signals.

5.4.2 *Line signals*

5.4.2. (1) *Line signal code*

The line signal code is given in Table 1.

The symbols used in Table 1 have the following significance:

X short signal element,
XX long signal element,
S silent interval between the elements of the same signal.

* See the definition of "line signals" under 5.4 (1).

1 V.F. SIGNAL CODE

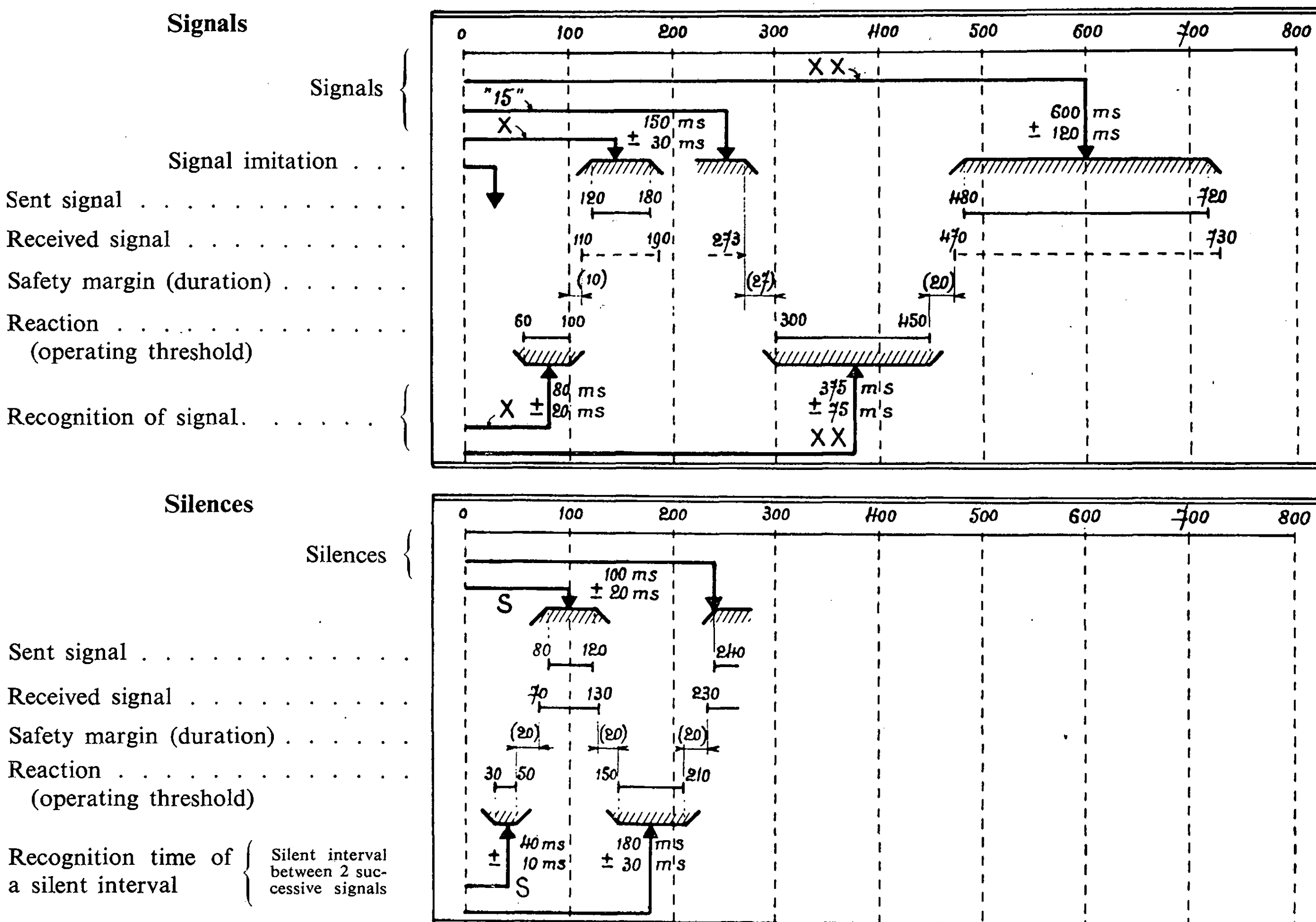


FIGURE 1. — **1 V.F. system: duration of signal elements (line signals)**

5.4.2. (2) *Sending duration of line signal elements*

The elements of each of the voice-frequency line-signals shown in Table 1 have a duration of:

X 150 ± 30 ms
XX 600 ± 120 ms
S 100 ± 20 ms

(The durations of the elements of the X and XX signals are multiples of 50 ms with a tolerance of ± 10 ms.)

Once sending of a signal has begun, it must be sent completely. If two signals have to be sent, one immediately after the other in the same direction, a silent interval must separate the two successive signals. The duration of this interval must not be less than 240 ms but it must not be so long as to cause an unreasonable delay in signalling.

TABLE 1

1 V.F. system signal code
Line signals

List No.	Name of signal	1 V.F. System
	FORWARD SIGNALS	
1	*a)* Terminal seizing signal — *Prise terminale*	**X**
	b) Transit seizing signal — *Prise pour transit international*	**XX**
3	Numerical signals — *Signaux de numérotation*	Arythmic code
4	End-of-pulsing signal — *Fin de numérotation*	Arythmic code
9	Clear-forward signal — *Signal de fin*	**XXSXX**
12	Forward-transfer signal — *Signal d'intervention* . . .	**XSX**
	BACKWARD SIGNALS	
2	Proceed-to-send signal — *Invitation à transmettre* . .	**X**
5	Number-received signal — *Numéro reçu*	**X**
6	Busy-flash signal — *Occupation*	**XX**
7	Answer signal — *Réponse du demandé*	**XSX**
8	Clear-back signal — *Raccrochage du demandé* . . .	**XX**
10	Release-guard signal — *Libération de garde*	**XXSXX**
11	Blocking signal * — *Blocage*	Continuous

* The maintenance instructions given to the maintenance staff stipulate that a circuit may only be blocked for a limited period.

5.4.2. (3) *Recognition time of line signal elements at the receiving end*

At the output of the signal receiver the duration of the direct current signal elements produced by the line signals is determined in terms of the sending duration of the voice-frequency signal elements and the distortion due to the line and to the signal receiver. This distortion is taken to be 10 ms maximum.

The incoming switching equipment must only recognize a signal element after the elapse of a certain time, called the recognition time, from the beginning of the receipt of the direct-current signal so that the risk of recognizing false signals is reduced and so that different signals can be distinguished.

The recognition times of the line signal elements are:

X	80 ± 20 ms
XX	375 ± 75 ms
S	40 ± 10 ms

A silent interval at the receiving end lasting longer than 210 ms should definitely be interpreted as an interval between two successive signals.

In order that a series of numerical signals should not be wrongly interpreted as a clear-forward signal, the equipment which recognizes the long signal XX must recommence the measurement of signal length after any silent interval lasting for 30 ms or more.

5.4.2. (4) Figure 1 shows the following details of the elements of these line signals:

a) the sending duration (transmission at voice frequency over the line);

b) the received duration (direct-current signals at the signal receiver output);

c) the safety margins that allow for equipment not being in adjustment, etc.;

d) the recognition time (operating margin of the incoming switching equipment); this margin is defined between a lower limit t and an upper limit T. The switching equipment must *not* recognize a signal element *before* t, but must *certainly* have recognized it *by the end of the time* T.

5.4.3 *Numerical signals*

5.4.3. (1) *Principle of the arythmic code*

The numerical signal code is shown in Table 2. This code is a binary code of four elements, each element being constituted by either the presence or the absence of the line-signal. These elements must follow each other within a fixed period; this period is marked by a start element (frequency present) and a stop element (frequency absent) between which the 4 characteristic elements of the numerical signals are sent.

The code is in all ways similar to the arythmic code used for telegraph transmission and differs from it only by its lower modulation rate and by the fact that it consists of only 4 elements instead of the 5 used in telegraphy.

TABLE 2

Arythmic Code Signals of the 1.V.F. System

Valeur arithmétique des relais marqueurs excités / Arithmetic value of the marking relays energised		8	4	2	1	
Caractère / Figure	Start	Moments 1	Moments 2	Moments 3	Moments 4	Stop
1	—				—	
2	—			—		
3	—			—	—	
4	—		—			
5	—		—		—	
6	—		—	—		
7	—		—	—	—	
8	—	—				
9	—	—			—	
Digit 0 . . . . . (10)	—	—		—		
Call operator code 11 . (11)	—	—		—	—	
Call operator code 12 . (12)	—	—	—			
Spare code (except for the case foreseen in 1.2.2.) (13)	—	—	—		—	
Spare code . . . (14)	—	—	—	—		
End-of-pulsing . . (15)	—	—	—	—	—	
Spare code . . . (16)	—					
	0	50	100	150	200	250 300
	Millisecondes					Milliseconds

Note. — The relation between the transmitted digits and the different combinations of the arythmic code is arrived at by giving the value of 8,4,2 or 1 to the presence of a positive signal element depending on the moment No. 1, 2, 3 or 4 of the signal in which it occurs.

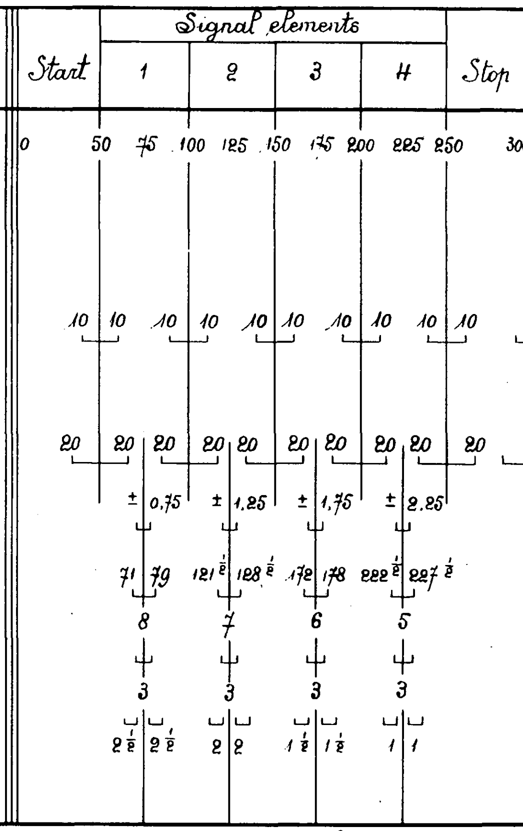
5.4.3. (2) *Clauses relative to the sending of arythmic code signals*

The theoretical duration of the start element, of each of the 4 active elements, and of the stop element is 50 ms (which corresponds to a modulation rate of 20 bauds).

The timing system in the outgoing register must be such that its speed does not differ from the theoretical modulation rate of 20 bauds defined above, by more than 1 %.

FIGURE 2. — **Diagram of tolerances for the arythmic code**

		Tolerance	Margin
a	Characteristic instants		
b	Speed variation (at the sending end)	+- 1%	
c	Transmitter	+- 7,5 ms	
d	At the sending end	+- 10 ms	20%
e	Line + receiver	+- 10 ms	20%
f	At the receiver output	+- 20 ms	
g	Speed variation (at the receiving end)	+- 1%	5(4½)%
h	Period of exploration	min. 5 ms	
i	Duration of exploration	0,5 – 3 ms	3%
j	Security margin	min = 2 × 1 ms	2%



Tolerances: $d = b\ max + c$
$f = d + e$
$h = f - g$
$j = (h - i\ max.) : 2$

Margins % of the unit interval of 50 ms.
g = maximum deviation is 4½ % (rounded up to 5%)
$d + e + g + i + j = 50\,\%$

Notes. — (1) The value indicated under *e* as the maximum distortion caused by the line and receiver together must be considered as a reasonably satisfactory value, and not as the maximum value which may be encountered under the most unfavourable circumstances.

(2) The timing system at the incoming end must be considered as likely to make a new start 279.5 ms after a preceding start. The time available for the preparation of the timing system lies therefore between the instants 270 and 279.5 ms, i.e., it is 9.5 ms.

Beginning with the commencement of the start signal, the beginning or end of sending voice frequency signals over the international circuits must be at the theoretical instants: 50, 100, 150, 200, 250 ms with a tolerance of ± 10 ms; this tolerance takes into account the maximum difference due to speed variation in the timing system and includes a tolerance on the sent signal.

5.4.3. (3) *Clauses relative to the reception of arythmic code signals*

At the incoming end, beginning with the commencement of the start signal on the direct current signalling wire at the output of the receiver, the scanning of the electrical condition on this wire should be made at the theoretical instants: 75, 125, 175, 225 ms.

The scanning time should be between 0.5 and 3 ms.

The timing system in the incoming register is started on receipt of a " start " element and should operate in synchronism with the timing system at the outgoing end; like the latter, it should have a speed which does not differ by more than 1 % from the theoretical modulation rate of 20 bauds.

5.4.3. (4) Figure 2 shows the association of the various tolerances provided for the arythmic code signals.

This figure shows particularly the " scanning period " i.e. the period of time during which scanning should be completed.

5.4.4 *General note on the operation of signalling and switching equipment*

The tolerances defined in Sections 5.4.2 and 5.4.3 concerning the sending duration of signals and their recognition times at the receiving end must be strictly observed in all circumstances and especially under all conditions of battery voltage variation likely to arise in working conditions.

CHAPTER IV

The two-frequency system

RECOMMENDATION Q.81

6.1 SIGNALS SENT TO LINE

6.1.1 *Signalling frequencies*

The signalling frequencies shall be:

2040±6 c/s (" *x* " frequency) and
2400±6 c/s (" *y* " frequency), these frequencies being applied separately or in combination.

6.1.2 *Absolute power level transmitted*

The absolute power level of the unmodulated signal frequencies at a zero relative level point shall be —1 neper (—9 db) with a tolerance of ±0.1 neper or ±1 db.

These levels also apply to each signal frequency in a signal element made up of a combination of the two frequencies (compound signal element) but the two signalling frequencies making up such a signal must not differ in level by more than 0.05 neper or 0.5 db.

Note. — The level of the leak current which might be transmitted to line during the signalling period, for example when static modulators are used for signal transmission, should be 50 decibels (5.8 nepers) below signal level.

RECOMMENDATION Q.82

6.2 SIGNAL-RECEIVER SPECIFICATION

6.2.1 *Operating limits of the signal receiver*

The signal receiver shall operate in the conditions specified under 6.2.5 to received signals that meet the following three conditions.

a) The signal frequencies shall be within the following limits:

" *x* " frequency: 2040±15 c/s,
" *y* " frequency: 2400±15 c/s.

b) The absolute power level *N* of each unmodulated received signal frequency shall be within the limits

$$-2+n \leqslant N \leqslant n \text{ nepers}$$

or

$$-18+n \leqslant N \leqslant n \text{ decibels}$$

where *n* is the relative power level at the signal receiver input.

These limits give a margin of ± 1 neper (± 9 db) on the nominal absolute level of each received signal at the input to the signal receiver.

c) The absolute level of the two unmodulated signal frequencies may differ from each other, but the received level of the 2400 c/s signal shall not be more than 0.35 neper (3 db) above nor more than 0.7 neper (6 db) below that of the received level of the 2040 c/s signal.

The tolerances given in paragraphs *a)*, *b)* and *c)* above are to allow for variations at the sending end and for variations in line transmission.

6.2.2 *Non-operate conditions for the signal receiver*

a) *Selectivity*

The signal receiver shall not operate to a signal having an absolute power level at the receiving end within the limits specified in paragraph 6.2.1 when the frequency differs by more than 150 c/s from the nominal value of 2040 c/s or of 2400 c/s.

b) *Maximum sensitivity of the signal receiver*

The signal receiver shall not operate to a signal of 2040 ± 15 c/s or 2400 ± 15 c/s whose absolute power level at the point of connection of the receiver is $(-3-1+n)$ nepers or $(-26-9+n)$ db, n being the relative power level at this point.

This limit is 3 nepers (26 decibels) below the nominal absolute level of the signal current at the input to the signal receiver.

6.2.3 *Efficiency of the guard circuit*

The signal receiver must be protected by a guard circuit against false operation due to speech currents, circuit noise or other currents of miscellaneous origin circulating in the line.

The purpose of the guard circuit is to prevent:

a) signal imitation. (Signals are imitated if the duration of the resulting direct current pulses at the output of the signal receiver are long enough to be recognised as signals by the switching equipment),

b) operation of the splitting device from interfering with speech.

An indication of the efficiency of the guard circuit is given by the following:

a) during 10 hours of speech, normal speech currents should not, on the average, cause more than one simultaneous operation of the receiver relays for each of the two signalling frequencies lasting more than 55 ms (the minimum recognition time of a compound signal element is 60 milliseconds),

b) the number of false splits of the speech path caused by speech currents should not cause an appreciable reduction in transmission quality of the circuit.

6.2.4 *Guard circuit limits*

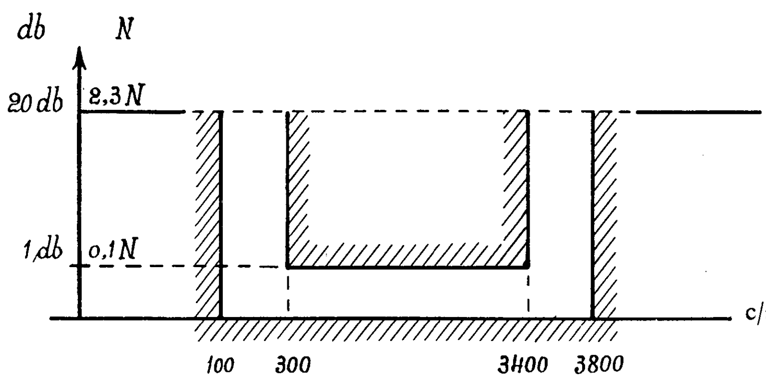
A. *Steady noise*

Considering,

a) that when there is noise on a telephone circuit a too sensitive guard circuit might give rise to signalling difficulties and, in particular, inhibit the response of the signal receiver,

b) that a psophometric e.m.f. of 2 millivolts measured at a relative level point of —0.8 nepers (or —7 db) is provisionally allowed as the maximum limit of circuit noise for a simple circuit, the psophometric e.m.f. for two circuits in tandem being therefore 3 millivolts:

it is recommended that, for either one or two signalling currents each being within the limits of level specified in paragraph 6.2.1, the signal receiver should satisfy the conditions indicated in paragraph 6.2.5 for the distortion of signals in the presence of a noise having a psophometric e.m.f. of 3 millivolts at a —0.8 neper (or —7 db) relative level point, the noise being produced by a generator which has a uniform curve of energy output over the frequency spectrum and which is followed by a filter having an attenuation/frequency characteristic within the limits given in the graph below.



B. *Surges*

A guard circuit with a too long hang-over time may cause difficulties in receiving a signal, for example when it has been immediately preceded by surges, and it is therefore recommended that the following condition should be fulfilled:

If a disturbing current of a frequency corresponding to the maximum sensitivity of the guard circuit and having an absolute power level of $(-1.15+n)$ nepers [or $(-10+n$ db)] at the relative level point n where the receiver is connected, ceases 30 ms before the application of a signal satisfying the limits defined in paragraph 6.2.1, the lengths of the received signals must remain within the limits specified in paragraph 6.2.5.

(Q.82)

6.2.5 *Distortion of received signals*

When the signal frequencies and levels are within the limits specified in paragraph 6.2.1, the following conditions should be met:

1.*a)* the delay in the start of a received pulse consisting of one of the two signalling frequencies should be less than 20 ms,

b) the delay in reproducing the beginning of a signal consisting of a combination of the two frequencies x and y (compound signal) should be less than 20 ms; this delay is defined as the interval between the moment when the beginning of the compound signal arrives at the signal receiver input and the moment of beginning the reproduction of the two frequencies x and y as a direct current signal output of the signal receiver;

2. the change of signal length in the presence of the noise defined in paragraph 6.2.4 should be less than:

a) 5 ms—when the signal receiver receives an *isolated pulse at one frequency only*, with a minimum duration of 25 ms.

b) 8 ms—when the signal receiver receives a *compound pulse* of two frequencies with a minimum duration of 50 ms; this change is defined as the difference between the simultaneous reception of the two received frequencies at the input to the receiver and the simultaneous reproduction of the two components as a direct current signal at the output of the signal receiver;

c) 6 ms—when the signal receiver receives a pulse of current of a *single frequency* with a minimum duration of 80 ms, *preceded by a compound signal element* (separated or not by an interval of silence of 5 ms maximum). Consequently the change in the duration of a signal suffix *, measured from the moment when the prefix ends to the moment when the suffix ends, and taking account of the change in the duration of the prefix signal mentioned under *b)*, will be less than 6+8=14 ms.

RECOMMENDATION Q.83

6.3 SPLITTING ARRANGEMENTS

6.3. (1) To prevent the line signals ** of the international signalling system from causing disturbances to national signalling systems, the international circuit should be split (completely cut) at outgoing and incoming international exchanges when a compound signal is received, to ensure that no fraction of the combination of the two frequencies exceeding 55 ms duration may pass out of the international circuit.

This splitting device will also be of advantage to the international signalling system, when speech conditions are set up, because it will prevent signals from being returned from the " go " path to the " return " path via the termination at the receiving end, so giving rise to false signals at the exchange from which the signal is sent.

The splitting time of 55 ms defined above may be reduced by each Administration concerned, in order to help in protecting its national network against the effect of signals coming from the international circuit. It should be noted, however, that a shorter

* See the definition of prefix and suffix signals under 6.4.2 (1).

** See the definition of " line signals " under 6.4.1.

splitting time can lead to an increase of the number of false operations of the splitting device by speech currents, and so impair speech transmission.

6.3. (2) The split must be maintained for the duration of the signal, but must cease within 25 ms of the end of the direct current signal which caused the splitting device to operate.

For the correct operation of the splitting device, it is necessary to take into account the delay in the reproduction of the compound signal caused by the signal receiver for which the conditions are as described in para. 6.2.5.1 *(b)*.

6.3. (3) The splitting of the line must not give rise to surges which might cause interference with signalling over the international circuit or with other signalling systems associated with it in setting-up an international call.

RECOMMENDATION Q.84

6.4 SIGNAL CODE

6.4.1 The signals of the two-frequency system are:

1. signals called " line signals " which serve to control the connection operations and supervisory signals,

2. signals used for the transmission of numerical information which, for digits and acknowledgement signals, are binary code signals.

6.4.2 **Line signals**

6.4.2 (1) *Line signal code*

The line signal code is given in Table 3.

The use of two frequencies in this code makes it possible to form a characteristic signal in which both frequencies are transmitted simultaneously and which can be used as a preparatory signal element (called a prefix) to the control signal element (called a suffix) having a single frequency.

The two-frequency signal prefix element is much less likely to be imitated by speech currents than a single-frequency element of the same duration and serves to prepare a switching circuit for the reception of the suffix element which follows. The prefix signal element also serves to bring about the splitting of the line to prevent the remaining part of the signal from passing out of the section in which it is intended to be operative.

The symbols used in Table 3 have the following significance:

Prefix signal element P prefix signal constituted by two frequencies x and y

control signal elements or " suffixes "	X	short signal element of the single frequency, x
	Y	short signal element of the single frequency, y
	XX	long signal element of the single frequency, x
	YY	long signal element of the single frequency, y.

TABLE 3

2 V.F. system signal code
Line signals

List No.	Name of signal	2 V.F. System
	FORWARD SIGNALS	
1	*a)* Terminal seizing signal — *Prise terminale*	**PX**
	b) Transit seizing signal — *Prise pour transit international*	**PY**
3	Numerical signals — *Signaux de numérotation*	Binary code
4	End-of-pulsing signal — *Fin de numérotation*	Binary code
9	Clear-forward signal — *Signal de fin*	**PXX**
12	Forward-transfer signal — *Signal d'intervention* . . .	**PYY**
	BACKWARD SIGNALS	
2	Proceed-to-send *Invitation à transmettre* *a)* Terminal — *Terminale*	**X**
	b) International transit — *de transit international*	**Y**
5	Number-received signal — *Numéro reçu*	**P**
6	Busy-flash signal — *Occupation*	**PX**
7	Answer signal — *Réponse du demandé*	**PY**
8	Clear-back signal — *Raccrochage du demandé* . . .	**PX**
10	Release-guard signal — *Libération de garde*	**PYY**
11	Blocking signal * — *Blocage*	**PX**
—	(Unblocking) *(Déblocage)* = use of signal 10 *utilisation du signal 10*	**PYY**

* In addition to the blocking which is provoked by the reception of a blocking signal at the outgoing end of a circuit, the outgoing equipment should be such that a *temporary* condition of " circuit busied " should result at the outgoing end on receiving, on a free circuit, one or other of the frequencies X or Y or both these frequencies. This condition should be maintained for as long as the frequency or frequencies are received. The maintenance instructions given to the maintenance staff stipulate that such an occupation of a circuit should be of short duration.

6.4.2 (2) *Sending duration of line signal elements*

The elements of each of the voice-frequency line signals shown in Table 3 have a duration of:

P	150 ± 30 ms
X and Y	100 ± 20 ms
XX and YY	350 ± 70 ms

(The durations of the signal elements P, X and Y, XX and YY are multiples of 50 ms with a tolerance of ± 10 ms.)

Once the sending of a signal has begun it must be sent completely. If two signals have to be sent one immediately after the other in the same direction, a silent interval must separate the two successive signals. The duration of this interval must not be less than 100 milliseconds but it must not be so long as to cause an unreasonable delay in signalling.

This 100 ms interval must also occur between the sending of a numerical signal including the acknowledgement signal and a subsequent line signal.

Sending of the proceed-to-send or busy-flash signal by an incoming or transit exchange should not take place until 50 ms after the end of the receipt of the corresponding seizing signal. Such a delay will normally result from the operation of equipment (operating times of relays, time of hunting for register).

On sending, there will be no intentional interval of silence between the prefix element and the suffix element of a signal but where such an interval exists its duration at the sending end must not exceed 5 ms.

It can happen, when sending the P prefix element, that the two frequencies will not be sent simultaneously. The interval of time between the moments when each of the two frequencies is sent must not, in this case, exceed 1 ms. In the same way, if the suffix element does not immediately follow the prefix but is separated from it by an interval of silence as explained in the paragraph above, the interval of time between the two instants when the sending of each of the two frequencies ceases shall not exceed 1 ms.

6.4.2 (3) *Recognition time of line signal elements at the receiving end*

At the output of the signal receiver, the duration of the direct current signal elements produced by the line signals is determined in terms of the sending duration of the voice-frequency signal elements and the distortion due to the line and to the signal receiver.

This overall distortion due to the line and the signal receiver is taken to be 10 ms maximum for a prefix-signal element and 15 ms for a suffix-signal element. (The distortion of the suffix-signal element may be greater than that of the prefix-signal element because it depends not only on the distortion of the pulse consisting of a single frequency which is sent as a suffix element, but also on the moment when the other frequency used for the prefix element ceases.)

The incoming switching equipment must only recognise a signal after a certain time, called the recognition time, from the beginning of the receipt of the direct current signal, so that the risk of recognising false signals is reduced and so that signals of different length can be distinguished.

The recognition times of the line signal elements are:

P	80 ± 20 ms
X and Y	40 ± 10 ms
XX and YY	200 ± 40 ms

The incoming switching equipment shall be able to recognize a signal correctly when the prefix and the suffix of this signal are separated by an interval of silence of 15 ms or less.

(Q.84)

6.4.3 *Signaux pour la numérotation*

6.4.3 (1) *Code binaire des signaux de numérotation*

Le code des signaux de numérotation est donné par le tableau 4. Ce code est un code binaire à 4 éléments séparés chaque fois par un intervalle de silence *s*, chacun de ces éléments consistant en l'émission de l'une ou l'autre des fréquences de signalisation.

Les symboles utilisés dans le tableau 4 et dans la figure 4 ont la signification suivante:

x élément court à une seule fréquence *x*
y élément court à une seule fréquence *y*
s élément de silence.

TABLEAU 4

Signaux du code binaire du système à 2 fréquences

Caractère		Combinaison Élément 1	2	3	4
	1	y	y	y	x
	2	y	y	x	y
	3	y	y	x	x
	4	y	x	y	y
	5	y	x	y	x
	6	y	x	x	y
	7	y	x	x	x
	8	x	y	y	y
	9	x	y	y	x
Chiffre 0	**(10)**	x	y	x	y
Appel opératrice code 11	**(11)**	x	y	x	x
Appel opératrice code 12	**(12)**	x	x	y	y
Signal disponible (sauf cas prévu 1.3.3.2.) .	**(13)**	x	x	y	x
Signal disponible	**(14)**	x	x	x	y
Fin de numérotation	**(15)**	x	x	x	x
Signal disponible	**(16)**	y	y	y	y

La correspondance entre les chiffres à transmettre et les différentes combinaisons du code binaire est faite en attribuant à la présence d'un élément *X* la valeur 8, 4, 2 ou 1 suivant que cet élément *X* se trouve constituer le 1er. le 2e, le 3e ou le 4e élément du signal de numérotation.

6.4.3 (2) *Durée à l'émission des éléments de signaux x et y*

La durée à l'émission en ligne comme signaux à fréquences vocales des éléments *x* et *y* doit être de:

$$35 \pm 7 \text{ ms.}$$

La durée à l'émission de l'intervalle de silence *s* entre éléments de signaux d'un même chiffre doit avoir la même valeur de 35 ± 7 ms.

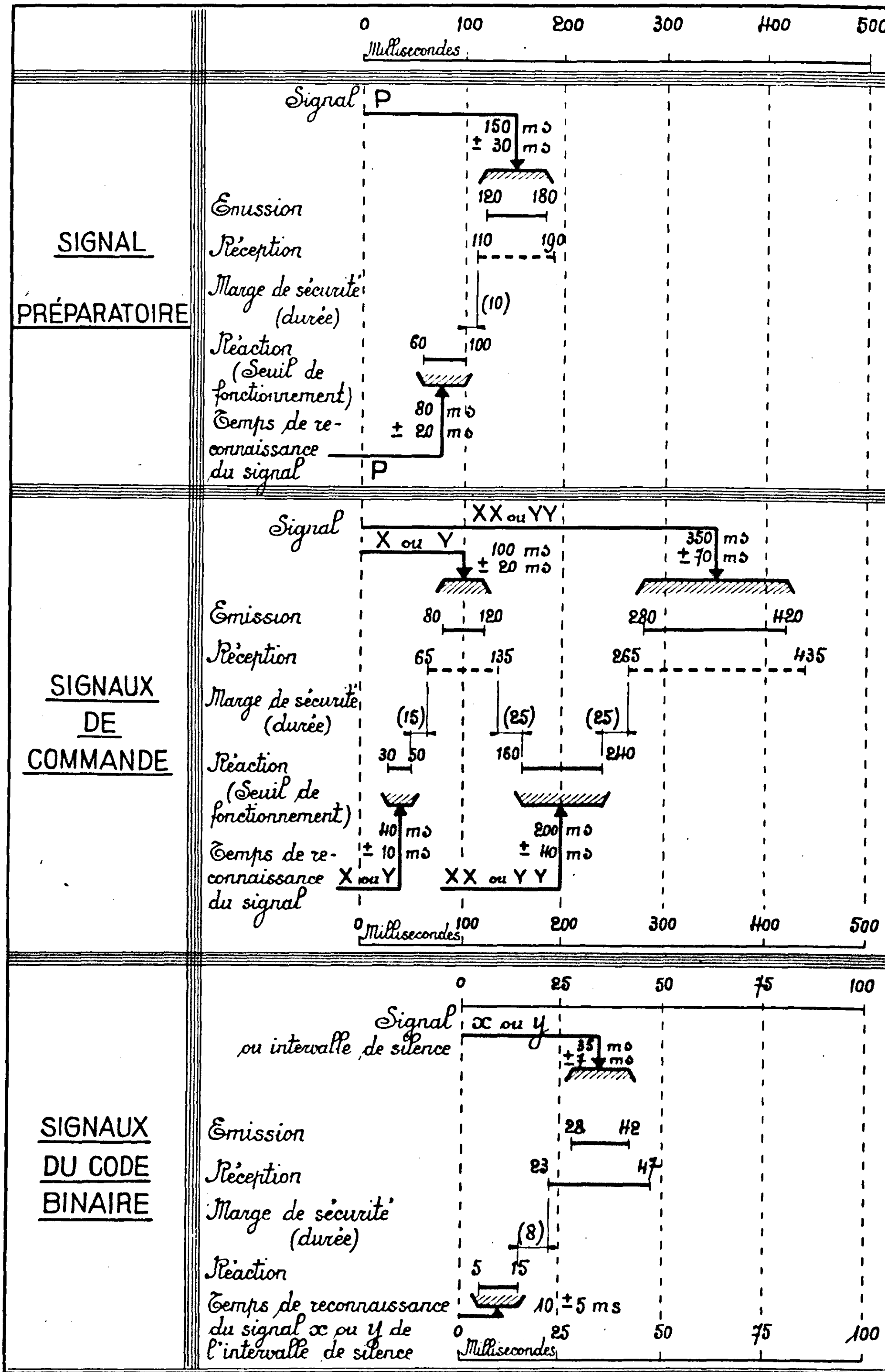
(La durée maximum des éléments de signaux et des intervalles de silence n'est pas un facteur critique dans la conception du système, mais a été spécifiée afin que la vitesse de signalisation ne soit pas anormalement lente).

Système à 2 F

Figures 3 et 4. — Durée des éléments de signaux du système à 2 fréquences

FIGURE 3. — *Signal préparatoire et signaux de commande*

FIGURE 4. — *Signaux du code binaire*



6.4.3 (3) *Recognition time of the x and y elements at the receiving end*

The recognition time by the incoming switching equipment:

a) of the direct-current signal elements x and y,

b) of intervals of silence s

received from the output of the signal receiver, is:

$$10 \pm 5 \text{ ms.}$$

6.4.3 (4) *Acknowledgment signals*

Incoming international and transit exchanges shall return an acknowledgment signal to the outgoing international exchange *at the end of the reception* of the 4th element of a numerical signal.

The acknowledgment signal returned by an incoming international exchange (terminal acknowledgement) shall be constituted by the signal element x defined above.

The acknowledgement signal returned by an international transit exchange (transit acknowledgement) shall be constituted by the signal element y defined above.

At the outgoing international exchange a numerical signal will only be sent if a signal is received from the incoming end acknowledging the receipt of the preceding numerical signal. However, to avoid this procedure delaying the transmission of numerical signals, the sending of numerical signals may begin *as soon as the acknowledgement signal x or y is recognized.*

6.4.4 *Signalling timing diagrams*

Figures 3 and 4 give diagrams showing for line signal elements (Figure 3) and for numerical signal elements x and y (Figure 4):

a) the sending duration transmission at voice frequency over the line;

b) the received duration (direct current signals at the signal receiver output);

c) the safety margins that allow for equipment not being in adjustment, etc.;

d) the recognition time (operating margin) of the incoming switching equipment; this margin is defined between a lower limit t and an upper limit T. The switching equipment must *not* recognize a signal element *before* t but must *certainly* have recognized it *at the end of time* T).

6.4.5 *General note on the operation of signalling and switching equipment*

The tolerances defined in sections 6.4.2 and 6.4.3 concerning the sending duration of signals and their recognition times at the receiving end must be strictly observed in all circumstances and especially under all conditions of battery voltage variation likely to arise in working conditions.

CHAPTER VII

Alarms and arrangements in cases of failures experienced in the switching of a call

RECOMMENDATION Q.86

7.1 INDICATION GIVEN TO THE OUTGOING OPERATOR OR CALLING SUBSCRIBER

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 Annex 3 give details of the signals that are received at the outgoing exchange when abnormal conditions occur in setting-up a call. Each Administration will state how these signals are to be translated into appropriate indications for outgoing operators or calling subscribers.

RECOMMENDATION Q.87

7.2 ALARMS FOR TECHNICAL STAFF AND ARRANGEMENTS IN CASE OF FAULTS. GENERAL ARRANGEMENTS

7.2 (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.

7.2 (2) There will be the usual alarm and fault indication arrangements for such items as blown fuses, disconnected heat coils, failures of power supplies or signalling currents, etc., as provided under the specifications of each Administration.

7.2 (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.

7.2 (4) Des dispositions seront prises pour permettre de suivre la progression d'un appel, en particulier la réception et l'émission des chiffres ou codes numériques successifs. A cet égard, chaque Administration précisera, compte tenu de la pratique habituellement suivie par elle à ce sujet, le détail des dispositions qu'elle désire voir réaliser.

7.2 (5) Des conditions provoquant un encombrement prolongé des centres de transit (comme celui qui risque de survenir en cas de dérangement du deuxième tronçon ou d'un tronçon ultérieur d'une connexion de transit) devraient, dans le cas d'exploitation automatique, être signalées aux Administrations de départ, de manière à ce que des mesures puissent être prises pour restreindre ou supprimer l'accès des appels au centre de transit en question.

Les dispositions précises à prendre par un centre international de départ pour remédier à une telle situation relèvent essentiellement de l'Administration nationale intéressée. Toutefois, au cas où des appels utilisant la voie de transit encombrée débordent d'une voie directe, il ne devrait y avoir aucune difficulté à éviter ce débordement.

Cependant, dans le cas où la voie de trafic encombrée est la seule voie disponible pour les appels automatiques à destination d'un pays déterminé ou dans le cas où le blocage de la voie de transit aboutit à un grave encombrement de la voie directe, deux solutions sont possibles:

a) on peut utiliser une machine parlante pour demander aux abonnés de ne pas rappeler avant un certain temps;

b) les enregistreurs de départ peuvent être prévus pour permettre, en cas de nécessité, l'aiguillage de tous les appels ou d'une certaine proportion d'entre eux sur une position d'opératrice.

Dans le cas où un réacheminement par voie détournée est prévu, cette possibilité de réacheminement doit pouvoir être supprimée si l'on veut éviter des perturbations graves du trafic sur d'autres relations.

Il convient de souligner que les dispositions prises pour assurer l'aiguillage sur des positions d'opératrices, d'appels qui auraient dû normalement être écoulés de façon automatique, doit tenir compte du fait que le nombre des opératrices disponibles pour écouler ce trafic risque d'être très limité.

Des dispositions ayant pour effet à la fois de faire déborder sur des positions d'opératrices des appels destinés à être écoulés normalement par la voie automatique, et de faire intervenir des opératrices d'un centre de transit ne doivent être prises qu'à la diligence des dirigeants des services d'exploitation intéressés.

AVIS Q.88

7.3 DISPOSITIONS PARTICULIÈRES A PRÉVOIR EN CAS D'ANOMALIE DANS LA SUCCESSION DES SIGNAUX

7.3.1 *Blocage d'un circuit sortant*

Sur un circuit sortant, les installations devront donner les possibilités de blocage ci-après. Ces possibilités seront utilisées ou non, suivant les instructions de maintenance qui auront été fixées.

7.3.1 (1) Si après l'envoi d'un signal de prise, un signal d'invitation à transmettre ou un signal d'occupation n'est pas reçu dans un délai de 10 à 30 secondes, le circuit sortant est bloqué et une alarme est donnée.

7.3.1 (2) Dans le système à deux fréquences, le circuit sortant sera bloqué et une alarme sera donnée si aucun signal d'invitation à transmettre ou d'occupation n'est reçu dans un délai de 15 à 30 secondes, après l'envoi vers un centre de transit des chiffres de l'indicatif international.

7.3.1 (3) Si après l'envoi d'un signal de fin, le signal de libération de garde n'est pas reçu dans un délai de 5 à 10 secondes, le circuit sortant est bloqué et une alarme est donnée. A l'extrémité d'arrivée du circuit, le signal de fin doit pouvoir être reconnu en tout temps et même lorsque le circuit est à l'état de repos; un circuit entrant doit donc être agencé de façon à pouvoir reconnaître un signal de fin et à envoyer en retour le signal de libération de garde, même si la réception du signal de fin n'a pas été précédée de la réception du signal de prise.

7.3.2 *Non-réception au centre d'arrivée d'un signal de fin après l'émission du signal de raccrochage*

Si l'émission du signal de reccrochage du demandé n'est pas suivie de la réception d'un signal de fin dans un délai de 2 à 3 minutes, des dispositions seront prises au centre international d'arrivée dans les équipements de circuits entrants afin de libérer la partie nationale de la communication (si une disposition analogue n'est pas déjà normalement prise dans le réseau national du pays d'arrivée). Cette disposition permettra d'éviter qu'en cas d'interruption de ligne ou en cas de dérangement dans les équipements, les circuits nationaux du pays de destination et la ligne de l'abonné demandé restent bloqués indéfiniment.

7.3.3 *Retard au raccrochage du demandeur en service automatique* (dispositions à prendre dans le pays de départ)

Dans le cas de l'exploitation automatique, il conviendra de prendre des dispositions pour libérer la connexion internationale et interrompre la taxation si, après la réception du signal de raccrochage, l'abonné demandeur n'a pas raccroché dans la minute ou les deux minutes qui suivent. La libération de la connexion internationale sera de préférence commandée à partir du point où la taxation du demandeur est effectuée.

7.3.4 *Non-réception au centre de départ d'un signal de réponse à la suite d'un signal de numéro reçu*

Il est recommandé que des dispositions soient prises, soit dans le réseau national du pays de départ, soit au centre international de départ, pour libérer la connexion si un signal de réponse n'est pas reçu dans un délai compris entre 2 et 4 minutes, à partir du moment où l'on sait que la ligne de l'abonné demandé a été atteinte.

Si une Administration adopte une durée plus courte pour cette libération forcée, il existe un risque de libérer prématurément une connexion internationale dans le cas d'appels ne recevant pas de signal de réponse. Si le délai maximum de 4 minutes est dépassé, cela constitue évidemment une immobilisation inutile du circuit international.

(Q.88)

7.3.5 *Abnormal recognition of a release-guard signal at a transit exchange*

In the case where a release-guard signal is recognized at a transit exchange without a clear-forward signal having been recognized, arrangements should be made at the transit exchange to:

— send a blocking signal in the backward direction, to busy the outgoing end of the incoming circuit at the transit exchange,

— immediately release the circuit outgoing from the transit exchange.

This prevents the receipt of the release-guard signal from giving a wrong indication that the circuit to the transit exchange is cleared.

RECOMMENDATION Q.89

7.4 ABNORMAL RELEASE CONDITIONS OF THE OUTGOING REGISTER CAUSING RELEASE OF THE INTERNATIONAL CIRCUIT

In automatic operation the international circuit should be released when the following abnormal conditions arise:

a) if, after receiving a correct international code, the outgoing register receives no further digit within a period of 15 to 30 seconds,

b) if, after having sent the last national digit received from the calling subscriber the outgoing register receives neither a subsequent digit from the calling subscriber nor any signal coming from the international circuit (busy-flash or number-received signal) within a period of 15 to 30 seconds.

The release of the outgoing register under these abnormal conditions is dealt with in paragraph 4.2.1 (2).

RECOMMENDATION Q.90

7.5 MAXIMUM DURATION OF A BLOCKING SIGNAL

When a blocking signal is sent on a circuit, an alarm should be given at the outgoing end of the circuit if the blocking condition persists for more than about 5 minutes.

CHAPTER VIII

Testing arrangements

RECOMMENDATION Q.91

8.1 TEST ACCESS POINTS

8.1. (1) The following three clear subdivisions are made for maintenance purposes:

a) the *international line*, i.e., the telephone transmission system situated between the test racks of two terminal repeater stations;

b) the *international circuit*, i.e., the whole of the international telephone line together with the outgoing and incoming equipment proper to the line;

c) the *automatic switching equipment*, i.e., the part of the international exchange concerned with switching the call in the desired direction.

8.1. (2) Access points must be provided for testing:

— the international line,

— the associated outgoing and incoming equipment proper to this line,

— the switching equipment.

It must be possible to test the telephone line, the outgoing equipment and the incoming equipment separately or in combination with one another.

It must be possible to test the incoming and outgoing equipment in combination with the switching equipment of the exchange concerned. Each access point must enable tests to be made in parallel with the speech wires, and possibly with the signalling wires, without disconnection.

8.1. (3) The automatic transmission measuring devices and the transmission testing devices situated in the repeater stations and in the I.M.C.'s of other countries will be obtainable from the access point defined above by means of the following digit sequences:

a) terminal seizing signal;

b) code 13 replacing the language digit;

c) code 12;

d) digit 0;

e) two digits which will be associated with the type of testing or measuring device required;

(f) end-of-pulsing signal (code 15).

Note. — The allocation of the digits in *(e)* above will enable access to be given to a number of different types of testing or measuring equipment.

Codes 51 to 59 are allocated to automatic transmission measuring devices standardized by the C.C.I.T.T. for international repeater stations. Code 00 is used for access to the automatic testing device in the I.M.C.'s (Recommendation Q.94).

8.1. (4) An equipment enabling observations to be made of all the signals exchanged on the international circuits and which can be connected via the parallel access points mentioned in 8.1. (2) should be provided for international exchanges equipped for automatic switching.

8.1. (5) The following arrangements should be made at these access points:

— the occupation of a circuit will be marked by a visible indication near the access points of the circuit,

— when a circuit is seized from an access point, that circuit will be made inaccessible to selectors and will be marked engaged on the outgoing operators' positions,

— when an incoming circuit is seized from a break jack, a blocking signal must be sent to the corresponding outgoing exchange.

RECOMMENDATION Q.92

8.2 ROUTINE TESTING OF EQUIPMENT (LOCAL MAINTENANCE)

8.2. (1) Routine testers for testing individual items of equipment such as circuit equipment, connecting circuits, operator's line calling equipment, selectors, registers, etc., must be provided in every international exchange equipped for automatic switching. These routine testers will be provided in accordance with the practice followed in each country for the local maintenance of the switching equipment.

8.2. (2) The testing equipment must conform to the following principles:

(a) an item of equipment must not be taken for test until it is free; a signal will show the exchange staff that a piece of apparatus has not been taken for test because it was engaged on a call; it will then be possible to test this piece of apparatus later;

(b) an item of equipment taken for test will be marked engaged for the duration of the test. When an incoming circuit equipment is taken for test, a blocking signal will be sent to the outgoing exchange (see 7.5).

RECOMMENDATION Q.93

8.3 RAPID TESTING EQUIPMENT

8.3.1 *Principles of rapid transmission-testing*

Rapid transmission tests can be made in the following two ways:

(a) The first method consists of a loop measurement of the GO and RETURN paths of an international circuit, these paths being looped at the incoming end of a circuit when it is free.

(b) The second method consists of sending a special code on the international circuit to be tested so as to obtain access to an automatic testing equipment in the incoming exchange.

The first method requires that the incoming end of all circuits should be equipped as described later in paragraph 8.3.2.

The second method assumes the existence of rapid transmission testing equipment in all exchanges between which this method is used. This testing equipment, which can be used irrespective of the type of signalling system employed, must be designed in accordance with paragraph 8.3.3.

Note. — The first method provides overall testing on the GO and RETURN paths without being able to differentiate between the conditions of each of the two directions of transmission. The second method enables separate transmission tests in the two directions. (A situation can occur, however, when it is not possible to determine whether a transmission fault is on the GO path or on the RETURN path of the circuit.) Since the second method requires that for access to the incoming testing apparatus, signals must be passed over the circuit, there is some check of good signalling conditions.

8.3.2 **First method — Loop transmission measurements**

A permanent loop will be connected between the GO and RETURN paths of an international circuit at its incoming end when the circuit is free, so that transmission tests can be made independently of the signalling conditions.

The loop between the GO and RETURN paths shall be connected in such a manner that the level diagrams of each of the two paths will be respected when the circuit is free (loop established); the loop may therefore include an attenuation pad of the required value.

The loop at the incoming end of the international circuit should be disconnected when a seizing signal is received. The loop must be disconnected within 35 ms so as to ensure that the part of a seizing signal which passes round the loop and which is returned to the outgoing end cannot be recognized as a signal.

RECOMMENDATION Q.94

8.3.3 SECOND METHOD — AUTOMATIC TESTING EQUIPMENT

The second method for rapid transmission tests consists of extending the international circuit, by means of a special code, to an automatic testing equipment at the incoming exchange. For the second method, there must be incoming testing equipment at the incoming international exchange and outgoing testing equipment at the outgoing international exchange. This equipment should be designed on an *experimental basis* in accordance with the following conditions:

8.3.3. (1) *Incoming testing equipment*

(1) Connection to incoming testing equipment:

The incoming testing equipment will normally be connected in the 4-wire part of the circuit.

Access to this equipment from an outgoing international exchange will be obtained by sending successively on the international circuit, as provided in 8.1. (3) above:

(a) terminal seizing signal,

(b) code 13 replacing the language digit,

(c) code 12,

(d) three digits 000, the last two being the code for access to the automatic testing equipment . . .

(e) end-of-pulsing signal (code 15).

If the incoming testing equipment is free, the answer signal will be sent 800 to 1200 ms after it is connected.

If the incoming testing apparatus is occupied, a busy-flash signal will be returned.

(2) Measuring condition:

When the answer signal has been sent, the incoming testing equipment will pass to the measuring condition, in which the level of the test signal sent by the outgoing testing apparatus will be measured. The passage to the measuring condition will be effected after a period of 600 to 900 ms calculated from the moment when the testing equipment provokes the sending of the answer signal. This delay is necessary to ensure that the noise which may be produced at the moment of the passage of the circuit to the speech conditions will not influence the measuring arrangement.

The measurement of the received signal will be made with an accuracy of ± 1 decibel or ± 0.1 neper.

To provide time for the test signal to become stabilized, there should be a delay of 100 to 150 ms after the operation of the detector circuit, before indications on the level of the test signal are given.

The incoming testing equipment will determine whether the level of the test signal is within the prescribed limits; these limits will be predetermined by an adjustment of the equipment to specified values. These limits will provisionally be ± 4 db or ± 0.5 neper with respect to the nominal level at which the test tone should be received.

(3) Passage to the sending condition:

If the received test signal is within the prescribed limits (deviation of ± 4 db or 0.5 neper from the nominal value) the incoming testing equipment will send a test signal on the RETURN path of the circuit.

This test signal will have a frequency of 800 c/s which is the same as the test frequency sent on the GO path of the circuit by the outgoing testing equipment. The frequency sent should be controlled within ±3%. The test signal sent by the incoming testing equipment will give a power of 1 milliwatt at a zero relative level point of the circuit. The sending level must be maintained to ±0.05 neper.

If there is a failure to receive a clear-back signal, the test signal will be transmitted for a period of 1-2 minutes, the incoming testing equipment will stop transmitting the test signal and a clear-forward signal will be sent. The release of the incoming testing equipment will then be carried out in accordance with the provisions of 7.3.2.

(4) Indication of unsatisfactory transmission on the GO path of the circuit:

If the level of the received test signal is outside the prescribed limits or if the incoming testing equipment does not receive the test signal, a clear-back signal will be returned to the outgoing end. This clear-back signal will be sent 5 seconds after passing to the measuring position and will indicate to the testing officer at the outgoing exchange that the transmission quality of the GO path of the circuit is not up to standard.

8.3.3. (2) *Outgoing testing equipment*

(1) Connection to the outgoing testing equipment:

The outgoing testing equipment will be designed to give automatic sending of the code mentioned under (1) in paragraph 8.3.3. (1) above.

(2) Sending condition:

The receipt of an answer signal sent by the incoming testing equipment will cause the sending of the test signal by the outgoing testing equipment. This test signal will be sent for a period of 500 to 800 ms. To allow the incoming testing equipment to pass into the measuring condition, this test signal should not be sent immediately after the answer signal but should be delayed for a period of at least 700 ms. The test signal will be sent automatically or under the control of the officer making the tests. If the test signal is sent automatically, the delay in sending the test signal following the end of the receipt of the answer signal should be between 700 and 900 ms. If the test signal is sent under the control of the operator, the latter should operate quickly because the clear-back signal can be returned by the incoming testing apparatus after a delay of 5 seconds.

The frequency of the test signal will be 800 c/s ±3%.

The level of the sent test signal will be adjusted to give a power of 1 milliwatt at a zero relative level point of the circuit. The sent level will be accurate to ±0.05 neper.

(3) Passage to the measuring condition:

As soon as the outgoing testing equipment has sent the test signal, it will pass automatically from the sending condition to the measuring condition. In this condition, the level measuring equipment will measure the level of the test signal received from the incoming end. The operator or the automatic device at the outgoing end will check that the level of the received signal is within the prescribed limits.

RECOMMENDATION Q.95

8.4 INSTRUMENTS FOR CHECKING EQUIPMENT AND SIGNALS

8.4.1 *General*

For local checks of correct equipment operation and for readjusting the equipment, international exchanges should have available instruments of the two following types:

(a) calibrated signal generator,

(b) signal measuring apparatus.

These instruments should have the following characteristics:

8.4.2 *Calibrated signal generator*

Duration of sent signals to be adjustable between the extreme limits given in the equipment Specifications, i.e.:

1-frequency system: 25 to 800 ms.

2-frequency system: 3 to 500 ms.

Accuracy required in the duration of sent signals:

(a) signal generator for the 1-frequency system:

— line signals:

the accuracy should be the higher of the two following values:
1 ms error or $\pm 1\%$ of the nominal value of the sent signal.

— numerical signals:

the accuracy should be equal to $\pm 0.4\%$ of the length of the arythmic code signals,

(b) signal generator for the 2-frequency system:

the accuracy should be the higher of the two following values:
1 ms error or $\pm 1\%$ of the nominal value of the sent signal.

Frequency or frequencies of the sent signal to be equal to the nominal value of the signalling frequency or frequencies. The sent frequency shall not differ by more than ± 5 c/s from its nominal value and shall not vary during the time required for testing.

Level of the sent signal(s) to be variable between the extreme limits given in the equipment Specifications and able to be set to a particular fixed value equal to the nominal value as defined in these Specifications.

Tolerances on the reading of the level of the sent signalling frequencies to be ± 0.2 decibel or ± 0.02 neper.

8.4.3 *Signal measuring equipment*

Duration of signals to be measured to be between the extreme limits given in the equipment Specifications, i.e.:

1-frequency system: 25 to 800 ms
2-frequency system: 3 to 500 ms

Accuracy required in the duration of the measured signals:

(a) apparatus for the 1-frequency system:

— line signals:
the accuracy should be the higher of the two following values:
1 ms error or $\pm 1\%$ of the nominal value of the received signal,

— numerical signals:
the accuracy should be equal to $\pm 1\%$ of the length of the arythmic code signals.

(b) apparatus for the 2-frequency system:

the accuracy should be the higher of the two following values:
1 ms error or $\pm 1\%$ of the nominal value of the received signal.

Signal frequency or frequencies to be measured to be between the extreme limits set by the Specifications, the reading being made with an accuracy of ± 1 c/s.

Level of the signalling frequency or frequencies to be measured to be adjustable between the extreme limits set by the Specifications, the reading being made with an accuracy of ± 0.2 decibel or 0.02 neper.

LIST OF ANNEXES
TO THE SPECIFICATIONS

ANNEX I

GUIDING PRINCIPLES FOR THE DESIGN OF STANDARDIZED INTERNATIONAL SIGNALLING AND SWITCHING EQUIPMENT

The C.C.I.T.T. standardized international switching and signalling systems were defined between 1946 and 1949 on the basis of the guiding principles described under points 1 to 5 below. Field trials of the proposed systems were carried out at the time on about thirty international circuits and were controlled by a " Field Trial Committee for international semi-automatic working " (C.E.A.) which was active from 1949 to 1954. From the experience acquired by that Committee, detailed specifications for standardized international equipment were drawn up in 1955.

1. Unidirectional operation of circuits

To enable the equipment to be as simple as possible and to avoid double connections and lock-ups, international automatic or semi-automatic telephone circuits should be operated *in one direction only.*

2. Transmission of signals in the 300/3400 c/s band

The signals employed on international circuits should be transmitted within the band of frequencies used for speech.

3. Maximum permissible power of signals transmitted over international circuits

The maximum permissible power of the signals transmitted over international circuits was defined as follows:

1. The maximum energy which could be transmitted by signals in the course of the busy-hour was limited to 2.5 microwatt hours or 9000 microwatt seconds at a zero relative level point.

2. For cross-talk reasons, the absolute power level for each component of a signal of short duration should not exceed the value for the signal frequency concerned given in Table 1 of Recommendation Q.16.

Attached hereto is some information on the calculations carried out in 1956 relative to the energy of the sum:

— of control signals for international signalling,

— of the national tones which may be transmitted over an international circuit,

in international automatic operation.

4. Choice of frequencies for standardized signalling systems

From 1946 to 1948 in London, Paris and Zurich observations were made on the number of false signals resulting from signal imitation caused by speech currents, when using various signalling frequencies. These observations, as mentioned in Recommendation Q.22, led to the conclusion that signalling frequencies of at least 2000 c/s are necessary to give relative immunity from false signals, if undue increase in signal length is to be avoided.

2600 c/s seemed to be the best choice of frequency at that time and for the foreseeable future, for signalling over international circuits on modern carrier systems. This frequency could not be used at that time, however, because there were many international circuits existing and due to remain in service for a long time, that did not give the C.C.I.F. recommended frequency band.

5. Principles for drawing-up the list of international signals

The principles on which the list of international signals was based are as follows:

1. It was desirable that the number of distinct signals to be transmitted over an international circuit should be kept to a minimum compatible with the basic requirements of an international semi-automatic and automatic service using standard equipment for both terminal and transit working.

2. Outgoing international operators should be able:

(a) to obtain connection to any incoming B-operator at an incoming international exchange;

(b) to obtain connection to *any* delay operator at an international exchange;

(c) to obtain connection to a *particular* delay operator at an international exchange;

(d) on a call already set-up, to call in an operator in the incoming international exchange to speak a particular language (assistance operator).

Report on the energy transmitted by control signals and tones (Geneva, 1956)

1. The problem

In 1956, the C.C.I.F. endeavoured:

(a) to calculate the energy of control signals for international signalling and of national tones which may be transmitted on an international circuit, in automatic working (subscriber-to-subscriber) in the international network;

(b) bearing in mind the limit in Recommendation Q.15 for the overall energy that can be transmitted for signalling on an international circuit, to see whether an increase in the permissible power for control signals and/or a limitation of the sent power of national tones should be proposed;

(c) to indicate to what extent Administrations should be recommended to use the principles established in reply to *(b)* above as the basis for signalling in national network.

2. Operating assumptions

In the calculations, it was assumed from experience in automatic trunk operation in the national networks of various Administrations that in international automatic operation there would be about 20 calls per circuit in the busy hour including:

12 successful calls,

1 call with no reply by the called subscriber, and

7 calls for which the line or the called subscriber was busy.

3. Calculation of control signal energy

With these assumptions, the following figures were obtained:

— a total energy, for both directions of transmission, of 21 000 microwatt × seconds during the busy hour, for a 1-frequency system, and

— a value which is slightly below a half of the above, for 2-frequency systems.

4. Assumptions relative to national tones

The maximum national tone *level* specified, on the basis of the information available in 1956, is −0.2 neper (absolute power level (referred to 1 milliwatt) at a zero relative level point). Moreover, allowances should be made for the fact that an additional attenuation of 0.4 neper is always inserted in the international connection during the period in which tones may be sent. A level of −0.6 neper or a power of 300 microwatts, at a zero relative level point, was therefore considered as a maximum.

As regards the cadences of tones, it was noted that, according to tables 3 and 4 on pages 25 and 26 of the C.C.I.F. *Green Book*, Volume V,

— in almost all cases, the length of the tone period of busy tone is not greater than the length of the silent period,

— for all the countries mentioned (except for Spain and the Paris network), the most unfavourable ringing tone conditions will be a tone period having a duration of one third that of the silent period.

It was finally assumed for the calculation that the duration of connection of the various tones was:

— 10 seconds of ringing tone, in the case of a successful call,

— 60 seconds of ringing tone, if there is no reply,

— 10 seconds of busy tone, under engaged conditions.

5. Calculation of the energy transmitted for the national tones

The calculated total sending duration of tones in the busy hour is shown in the following table:

	Duration of tones per call (in seconds)	No. of calls	Total. duration of tones (in seconds)	Ratio of tone period to silent period	Total sending duration (in seconds).
Successful calls	10	12	120	1/3	30
No reply	60	1	60	1/3	15
Engaged	10	7	70	1/1	35

Total = 80 seconds

Thus, in the busy hour and in the most unfavourable conditions, a total energy of

$$300\ \mu W \times 80\ s. = 24\,000\ \text{microwatt} \times \text{seconds}$$

is obtained.

This is the value for the direction in which the tones are transmitted (backwards, as far as operation is concerned), i.e. it is applicable to both directions of transmission.

In the special case of the Paris network the durations corresponding to the first two lines of the table should be doubled and the total sending duration would be increased to 125 seconds; as the tone level is much lower than −0.6 neper in this case, the maximum value calculated above would not be reached.

6. Energy transmitted in the international service for control signals and national tones

A calculation of the energy of control signals in standardized systems (paragraph 3 above) shows that, when the 1-frequency standardized system is used in the automatic international service, the value to be expected for the combination of both directions of transmission is about 21 000 microwatt × seconds.

In the case of the 2-frequency standardized system, the energy of the control signals is appreciably less.

Hence, if the calculated energy for national tones assuming the most unfavourable conditions, say 24 000 microwatt × seconds, is added to the higher of the two calculated values (i.e. 21 000 microwatt × seconds for the 1-frequency standardized system), a total energy (for the two directions of transmission) of 45 000 microwatt × seconds is obtained, which is much lower than the value of

$$2 \times 36\,000 = 72\,000\ \text{microwatt} \times \text{seconds}$$

defined in Recommendation Q.15.

However, this does not mean that the level of the signalling pulses can be raised, since the choice of this level was based on crosstalk considerations.

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ANNEX 2

Table 1

SIGNALLING SEQUENCES IN TERMINAL SERVICE USING 1 V.F. OR 2 V.F. SIGNALLING SYSTEMS

Table 2

SIGNALLING SEQUENCES IN TRANSIT SERVICE USING THE 2-FREQUENCY SYSTEM

ANNEX 2

TABLE 1. — SIGNALLING SEQUENCES

with the 1 V.F. or 2 V.F. signalling systems * for direct semi-automatic (SA) and automatic (A) operations

Outgoing international terminal exchange		Incoming international terminal exchange
	CALL TO A FREE SUBSCRIBER	
Terminal seizing signal is sent forward	X / PX →	The receipt of this signal causes an incoming terminal register to be connected and when this is ready to receive the digital information a proceed-to-send (terminal) signal is returned.
The receipt of a proceed-to-send signal causes the whole of the digital information to be sent forward SA: Language digit, significant number of the called party followed by the end-of-pulsing signal. A: Discriminating digit, significant number of the called party.	← X / X	
	Arythmic code / Binary code →	The digital information is received in the incoming register. This register then controls the setting-up of the connection within the incoming country to the called party or, on Code 11 or Code 12 calls in semi-automatic operations, routes the call to the manual board.
The register will then release and establish the speech path at the outgoing end of the circuit: SA: after an end-of-pulsing signal is sent A: after the receipt of the number-received signal	← (x = acknowledgment of the reception of a digit)	
SA: an indication is given to the operator that the international selection operations have been accomplished.	← X / P	A number-received signal is returned as soon as the incoming register has determined that it has received a complete number. As soon as the register has sent forward all the information received, it releases and establishes speech conditions at the incoming end of the circuit.
The operator (SA) or the calling subscriber (A) } hears the ringing tone	← ········	The called subscriber, found free, is rung. The ringing tone of the incoming country is sent back.
SA: An answer supervisory signal is given to the controlling operator. A: The charging of the subscriber and the measurement of call duration start.	← XSX / PY	Called party answers—Answer signal is returned.

* The signal quoted above the horizontal line corresponding to the sending of a signal is the 1 V.F. signal. The one below this line is the 2 V.F. signal.

Outgoing international terminal exchange		Incoming international terminal exchange
SA: A clearing supervisory signal is given to the controlling operator. A: After 1-2 min. in the absence of a clear-forward signal the international connection will be released, the charging of the subscriber and the measurement of call duration will be ceased.	← XX / PX	Called party clears — Clear-back signal is returned.
SA: An answer supervisory signal is given to the controlling operator. A: The measuring of the delay of 1-2 min. will be interrupted.	← XSX / PY	Called party re-answers — Answer signal is returned.
SA: Controlling operator clears down the connection. A: The calling subscriber clears: Clear-forward signal is sent.	XXSXX / PXX →	Releases the connection of the incoming exchange and when release is fully effective a release-guard signal is returned.
This signal removes the guard from the outgoing end and frees the circuit for further traffic.	← XXSXX / PYY	

CALL TO A BUSY SUBSCRIBER

The succession of signals is the same as for a call to a free subscriber up to the point of sending the number-received signal.

SA: An indication can be given to the outgoing operator that the international selection operations have been completed.	← X / P	Transmission of the number-received signal and establishment of speech conditions at the incoming end.
		1st case. — The national network of the incoming country can give the busy-flash signal.
SA: A " busy " indication is given to the outgoing operator.	← XX / PX	The national busy-flash signal is detected by the international incoming equipment. The busy-flash signal is sent back.
The operator hears the busy tone. The outgoing operator releases the connection (see above). A: The international connection will be released automatically. The calling subscriber hears the busy tone from the (national or international) outgoing exchange.	←	The busy tone of the incoming country if present is sent back.

ANNEX 2. — **Table 1** (continued)

Outgoing international terminal exchange	Signal	Incoming international terminal exchange
The operator or/and the calling subscriber hears the busy tone, and releases the connection (see above).	◀ ···········	*2nd case.* — The national network of the incoming country cannot give the busy-flash signal. The busy tone of the incoming country is sent back.
	SPECIAL CONDITIONS	
SA: Following a call switched automatically to a subscriber, the controlling operator wishes to bring about the intervention of an assistance operator at the incoming international terminal exchange—A forward-transfer signal is sent.	XSX / PYY ▶	Causes an assistance operator to intervene at the incoming terminal exchange on an established connection completed automatically (no transmission of signals).
SA: Following a call via code 11 or code 12, the controlling operator wishes to recall the incoming operator at the incoming international terminal exchange—A forward-transfer signal is sent.	XSX / PYY ▶	Recalls the incoming operator on calls completed via the manual board at this exchange (no transmission of signals).
This signal causes a guarding condition to be applied to block further traffic.	◀ continuous tone / PX (or continuous tone)	Engineering personnel wish to busy the international circuit at the outgoing end—A blocking signal is sent.
Guarding condition removed on cessation of blocking signal (1 V.F. system).		The guarding condition at the outgoing end is removed when the blocking signal is disconnected (1 V.F. system).
This signal removes the guarding condition at the outgoing end (2 V.F. system).	◀ PYY	A release guard signal is sent when the blocking condition is disconnected at the incoming end (2 V.F. system).

TABLE 2. — 2 V.F. TRANSIT OPERATION SEMI-AUTOMATIC AND AUTOMATIC SERVICE

Assuming an international circuit in the desired direction has been taken, an outgoing register has been associated with the circuit, the digital information has been keyed into this register and in the semi-automatic service that an end-of-sending signal has been received indicating that keying has been completed, the following signalling sequences will occur:

Outgoing international terminal exchange	International transit exchange	International transit exchange	Incoming international terminal exchange
	CALL TO A FREE SUBSCRIBER		
Transit seizing signal sent forward. PY →	Causes transit register to be connected.		
Causes the code digits of the country of destination to be sent forward. ←	Y — Transit proceed-to-send signal is returned.		
Binary code →	Received in the transit register.		
← (y = acknowledgment of a digit)			
	A circuit in the desired direction is taken. If an indirect route is taken a transit seizing signal is sent forward. PY →	Causes transit register to be connected.	
	Transit register releases and speech path through the transit exchange is established.		
←	←	Y — Transit register proceed-to-send signal is returned.	
Causes code digits of the country of destination to be sent forward. →	Binary code →	Received in the transit register.	

ANNEX 2 — *Table 2* (continued)

Outgoing international terminal exchange	International transit exchange	International transit exchange	Incoming international terminal exchange
Causes code digits of the country of destination to be sent forward →	Binary code →	Received in the transit register	
←	← (y = acknowledgment of a digit)	←	
		A circuit in the desired direction is taken. If a direct route is taken a terminal seizing signal is sent forward. PX →	Causes terminal register to be connected.
		Transit register releases and speech path through the transit exchange is established.	
Causes the remaining digital information to be sent: ←	←	←	X Terminal proceed-to-send signal is returned.
SA: Language digit, significant number of the called party followed by the end-of-pulsing signal. A: Discriminating digit, significant number of the called party. →	Binary code →	→	Received in the incoming register.
←	← (x = acknowledgment of a digit)	←	This register controls the setting up of the connection within the incoming country to the called party or, on Code 11 or Code 12 calls, to the manual board. Number-received signal returned when the register has completely received the national number.
The register then releases and establishes the speech path at the outgoing end. SA: An indication is given to the operator that the international selection operations have been accomplished. ← A: Outgoing register releases and establishes speech conditions.	←	←	P

Outgoing international terminal exchange	International transit exchange	International transit exchange	Incoming international terminal exchange
			When it has passed forward all the received digits, the register releases and establishes speech conditions at the incoming end of the circuit. The called subscriber, found free, is rung.
The operator (SA) or the subscriber (A) hears the ringing tone.			The ringing tone of the incoming country is sent back.
SA: An answer supervisory signal given to the controlling operator. A: The charging of the subscriber and the measurement of call duration starts.			PY Called party answers: answer signal returned.
SA: A clear supervisory signal given to the controlling operator. A: After 1-2 min. in the absence of a clear-forward signal the international connection will be released, the charging of the subscriber and the measurement of call duration ceased.			PX Called party clears: clear-back signal returned.
Controlling operator (SA) or the calling subscriber (A) clears. Clear-forward signal sent. PXX	Clears the connection on the cessation of the clear-forward signal. When fully released sends back a release-guard signal.	Clears the connection on the cessation of the clear-forward signal. When fully released sends back a release-guard signal.	Clears down the connection and when this has been completed sends back a release-guard signal.
Removes the guard from the outgoing circuit.	PYY Removes guard conditions from the outgoing circuit.	PYY Removes guard conditions from the outgoing circuit.	PYY

Outgoing international terminal exchange	International transit exchange	International transit exchange	Incoming international terminal exchange
	CALL TO A BUSY SUBSCRIBER The conditions are the same as those described on page 155.		
	SPECIAL CONDITIONS		
SA: Visual or audible indication given to controlling operator. A: Audible indication given to the calling subscriber (or (A and SA) possibly causes an alternative route to be selected when received from a transit centre). ◄	◄ PX Congestion of links, register or outgoing circuits. Busy-flash signal returned followed by a verbal announcement.	◄ PX Congestion of links, register or outgoing circuits. Busy-flash signal returned followed by a verbal announcement.	◄ PX Congestion of links or registers, Busy-flash signal returned. *Note.* — Congestion conditions in the national network may in some cases be indicated by audible tones or verbal announcements.
SA: Following a call switched automatically to a subscriber, the controlling operator wishes to bring about the intervention of an assistance operator at the incoming terminal exchange. Forward-transfer signal sent. PYY ►	►	►	► Causes an assistance operator to intervene on a connection established automatically at this centre (no emission of signals).
SA: Following a call via code 11 or code 12, the controlling operator wishes to recall the incoming operator. Forward-transfer signal sent. PYY ►	►	►	► Recalls the incoming operator on calls completed via the manual board at this exchange (no emission of signals).

ANNEX 3

DESCRIPTION OF THE OPERATIONS CORRESPONDING TO THE VARIOUS NORMAL AND ABNORMAL CONDITIONS WHICH MAY ARISE IN SETTING UP A CALL

ANNEX 3. — *Table 1*

OUTGOING EXCHANGE — NORMAL CONDITIONS

1-and 2-frequency systems

<table>
<tr><th colspan="2" rowspan="3">Conditions</th><th rowspan="3">Subscriber free</th><th colspan="2">Subscriber busy or national congestion</th><th rowspan="3">Congestion outgoing from the incoming exchange</th><th colspan="3">Congestion of common equipment at the exchange</th><th rowspan="3">Congestion outgoing from the transit exchange (2 V.F.) **</th></tr>
<tr><th colspan="2">The busy-flash signal</th><th colspan="2">Incoming</th><th rowspan="2">1st transit centre (2 V.F.)</th></tr>
<tr><th>is not provided</th><th>is provided</th><th>Terminal traffic</th><th>Transit traffic (2 V.F.)</th></tr>
<tr><td rowspan="7">Operations effected</td><td rowspan="2">Release of register</td><td colspan="3">SA — after sending code 15</td><td>SA - after sending code 15 or after reception of busy-flash signal</td><td colspan="2" rowspan="2">After reception of busy-flash signal</td><td colspan="2" rowspan="2">After reception of busy-flash signal *</td></tr>
<tr><td colspan="2">A — after reception of number-received signal</td><td colspan="2">A — after reception of number-received or busy-flash signal</td></tr>
<tr><td>Speech conditions</td><td colspan="2">After release of register</td><td colspan="6">SA — after release of register</td></tr>
<tr><td>Action on the international circuit</td><td colspan="2"></td><td colspan="4">A — Release of the circuit after reception of busy-flash signal</td><td colspan="2">Possibly automatic re-routing</td></tr>
<tr><td>SA - Local signals given to the operator</td><td colspan="2">End of international selection operations</td><td>End of selections, then busy</td><td colspan="3">Busy</td><td colspan="2">Busy or re-routing</td></tr>
<tr><td>A - Transmission of an appropriate indication to the calling subscriber</td><td colspan="2"></td><td colspan="4">Busy tone</td><td colspan="2">Busy tone (possibly *)</td></tr>
<tr><td rowspan="3">Information received on the international circuit</td><td rowspan="2">Signals received</td><td colspan="2" rowspan="2">Number received</td><td rowspan="2">Busy-flash preceded or not by number-received</td><td>Terminal proceed-to-send, then:</td><td></td><td>Transit proceed-to-send, then:</td><td></td><td>Transit proceed-to-send, then:</td></tr>
<tr><td colspan="5">Busy-flash signal</td></tr>
<tr><td>Audible indication received</td><td>Ringing tone</td><td colspan="2">Busy tone</td><td colspan="3"></td><td colspan="2">Name of transit exchange *</td></tr>
<tr><td colspan="2">References</td><td colspan="3">2.5
4.2.1.(1)</td><td colspan="3">2.6
4.2.1.(1)</td><td colspan="2">2.6
4.2.1.(1)
4.7, 4.8</td></tr>
</table>

SA — Semi-automatic service }
A — Automatic service } When there is no specific indication, the clause is applicable to both services.
* — Not applicable if automatic re-routing is provided.
** — Similarly for congestion of the common equipment of a 2nd transit exchange.

ANNEX 3. — *Table 2*

OUTGOING EXCHANGE — ABNORMAL CONDITIONS

1 V.F. System

<table>
<tr><th colspan="2" rowspan="3">Conditions</th><th rowspan="3">The outgoing register receives no more digits</th><th rowspan="3">Registration of an unused international code</th><th rowspan="3">Non-receipt of a backward signal after sending the seizure signal</th><th colspan="3">The outgoing register not having detected an anomaly, the incoming register receives:</th></tr>
<tr><th colspan="2">an incomplete number</th><th rowspan="2">a non-existent national number</th></tr>
<tr><th>not followed by code 15</th><th>followed by code 15</th></tr>
<tr><td rowspan="5">Operations effected</td><td>Release of register</td><td>SA 10-20 seconds
A 15-30 seconds
after seizure or the receipt of last digit</td><td>Immediately the anomaly is recognized</td><td>10-20 seconds after sending the seizure signal</td><td colspan="3">After sending code 15 (SA) or after receipt of the number-received or busy-flash signal (SA and A)</td></tr>
<tr><td>Speech conditions</td><td colspan="3"></td><td colspan="3">After release of the register</td></tr>
<tr><td>Action on the international circuit</td><td>A. Release (if a circuit has been seized)</td><td></td><td>Possible blocking of the circuit</td><td>A. Release after reception of the busy-flash signal</td><td colspan="2"></td></tr>
<tr><td>Local signals given to the operator *</td><td>Faulty call</td><td>Wrong number</td><td>Fault</td><td>Busy</td><td colspan="2">End of international selection operations</td></tr>
<tr><td>Local signals given to the subscriber</td><td colspan="3">Appropriate audible indication</td><td>Busy tone</td><td colspan="2"></td></tr>
<tr><td rowspan="2">Information received on the international circuit</td><td>Signals received</td><td colspan="3"></td><td>Busy-flash</td><td colspan="2">Number received</td></tr>
<tr><td>Tone received</td><td colspan="4"></td><td colspan="2">If possible, national number-unobtainable tone or verbal announcement</td></tr>
<tr><td colspan="2">References</td><td>4.2.1. (2) a</td><td>4.2.1. (2) b</td><td>4.2.1. (2) c</td><td>4.2.3. (2) a and b</td><td colspan="2">4.2.3. (2) c</td></tr>
</table>

* The indications to be given to operators in situations quoted on this line will be determined by each Administration, as this question is a purely national matter.

ANNEX 3. — *Table 3*

OUTGOING EXCHANGE — ABNORMAL CONDITIONS

2 V.F. System

<table>
<tr><th colspan="2" rowspan="2">Conditions</th><th rowspan="2">The outgoing register receives no more digits</th><th rowspan="2">Registration of an unused international code</th><th rowspan="2">Non-receipt of a backward signal after sending the seizure signal</th><th rowspan="2">Non-receipt of an acknowledgment signal after sending a digit</th><th colspan="2">The outgoing register not having detected an abnormality, the incoming register receives</th><th rowspan="2">Non-receipt of a backward signal after sending the international code to a transit exchange</th><th rowspan="2">Receipt of a third transit proceed-to-send signal</th></tr>
<tr><th>an incomplete number followed by code 15 (SA)</th><th>a non-existing national number (SA and A)</th></tr>
<tr><td rowspan="5">Operations effected</td><td>Release of register</td><td>SA 10-20 seconds A 15-30 seconds after seizure or the receipt of the last digit</td><td>Immediately the anomaly is recognized</td><td>10-30 seconds after sending the seizure signal</td><td>5-10 seconds after sending the digit</td><td colspan="2">After sending code 15 (SA) or after receipt of the number-received signal (A)</td><td>15-30 seconds after sending the international code</td><td>After receipt of the third signal</td></tr>
<tr><td>Speech conditions</td><td></td><td></td><td></td><td></td><td colspan="2">After release of the register</td><td></td><td></td></tr>
<tr><td>Action on the international circuit</td><td>A. Release (if a circuit has been seized)</td><td></td><td>Possible blocking of the circuit</td><td></td><td></td><td></td><td>Blocking of the circuit</td><td></td></tr>
<tr><td>Local signals given to the operator *</td><td>Faulty call</td><td>Wrong number</td><td>Fault</td><td>Fault</td><td colspan="2">End of international selection operations</td><td>Fault</td><td>Busy</td></tr>
<tr><td>Local signals given to the subscriber</td><td colspan="8">Appropriate audible indication</td></tr>
<tr><td rowspan="2">Information received on the international circuit</td><td>Signals received</td><td></td><td></td><td></td><td></td><td colspan="2">Number received</td><td></td><td></td></tr>
<tr><td>Tone received</td><td></td><td></td><td></td><td></td><td colspan="2">If possible, national number-unobtainable tone, or verbal announcement</td><td></td><td></td></tr>
<tr><td colspan="2">References</td><td>4.2.1. (2) *a*</td><td>4.2.1. (2) *b*</td><td>4.2.1. (2) *c*</td><td>4.2.1. (2) *d*</td><td colspan="2">4.2.3. (2) *c*</td><td>4.2.1. (2) *c*</td><td>4.2.1. (2) *e*</td></tr>
</table>

* The indications to be given to operators in situations quoted on this line will be determined by each Administration as this question is a purely national matter.

ANNEX 3. — *Table 4*

INCOMING EXCHANGE — NORMAL CONDITIONS
1 V.F. and 2 V.F. systems

Conditions / Operations effected	Called subscriber free	Subscriber busy or national congestion: The incoming exchange cannot recognize the busy condition	Subscriber busy or national congestion: The incoming exchange can recognize the busy condition	Congestion immediately outgoing from the incoming exchange	Congestion of common equipment at the incoming exchange
Release of register	After sending the number-received and the numerical information to the national network equipment			After sending the busy-flash signal	
Speech conditions	After sending the number-received and the numerical information to the national network equipment			After sending the busy-flash signal	
Sending of number-received signal	After recognition of the complete national number			After recognition of the complete national number as the case may be	
Sending of busy-flash signal			After sending number-received signal	0-10 seconds after receipt of the information necessary for determining the route	0-5 seconds after receipt of the seizing signal
Sending of an audible indication	National ringing tone	National busy tone	National busy tone		
References	2.5 4.2.3. (1)	2.5 2.6. b	2.5 2.6. *b*	2.6. b 4.1. (4), 4.2.3. (1)	4.1. (4)

ANNEX 3. — *Table 5*

INCOMING EXCHANGE — ABNORMAL CONDITIONS

1 V. F. and 2 V. F. systems

Conditions / Operations effected	Non-receipt of first digit	Break in the receipt of digits	Receipt of an unused number	Receipt of an incomplete number followed by code 15
Release of register	1 V.F. - 20-40 s. 2 V.F. - 5-10 s. after sending the proceed-to-send signal	30-60 seconds after receipt of the last digit	After sending the number-received signal	
Speech conditions	After release of the register			
Sending number-received signal			After recognition of the anomaly	
Sending busy-flash signal	1 V.F.: immediately before release of the register			
Sending national number-unobtainable tone or a verbal announcement			If possible (after sending number-received signal)	
References	4.2.3. (2) *b*	4.2.3. (2) *a*	4.2.3. (2) *c*	

ANNEX 3. — *Table 6*

TRANSIT EXCHANGE — NORMAL CONDITIONS

2 V.F. System

Conditions / Operations effected	Successful attempt (so far as transit exchange is concerned)	Congestion on switches or on international circuits outgoing from the transit exchange	Congestion on common equipment at the transit exchange
Release of register	After sending seizing signal or after receipt of proceed-to-send signal or busy-flash signal	After sending busy-flash signal	
Speech conditions	After sending the seizing signal	After sending busy-flash signal	
Sending of busy-flash signal		0-10 seconds after receipt of the international code	0-5 seconds after receipt of the seizing signal
Sending of a recorded announcement (name of transit exchange)		After sending the busy-flash signal	
References	4.2.2. (1)	2.6. *a* 4.1. (4), 4.2.2. (1), 4.7	2.6. *a* 4.1. (4), 4.7

ANNEX 3. — *Table 7*

TRANSIT EXCHANGE — ABNORMAL CONDITIONS

2 V.F. System

Conditions / Operations effected	Non-receipt of the international code	Receipt of a unused international code	Non-receipt of a proceed-to-send or a busy-flash signal
Release of register	5-10 seconds after sending the proceed-to-send signal	After recognition of the anomaly	10-30 seconds after sending the seizing signal if the register is still connected
Speech conditions			After sending the seizing signal
Action on the outgoing international circuit			Possible blocking of the outgoing circuit
References	4.2.2. (2) *a*	4.2.2. (2) *b*	4.2.2. (2) 7.3.1. (1)

QUESTIONS

for the period 1961-1964

Questions relative to telephone signalling and switching

entrusted to

Study Group XI

in 1961-1964

Question 1/XI

(continuation of Question 1 studied in 1957/1960)

Considering that

— a clause relating to the maximum psophometric electromotive force which the guard circuit of a signal receiver should take into account, is specified in paragraphs 5.2.4. and 6.2.4. of the Specifications (Rec. Q.77 and Q.82);

— but that line noise may comprise not only a continuous noise of uniform energy spectrum of the type assumed in that clause, but also induced noises, of low frequency and high level, and noise of a transient nature;

— in particular, that a clause of this type could not provide protection against infrequent peaks of noise of short duration, but of large amplitude, such as those which can result from surges arising from switching operations, or from microphonic effects due to the movement of adjacent switches on the switching apparatus racks;

What information exists on the nature, duration, distribution in time, and amplitude, of noises of the transient nature referred to above?

Should the occasion arise, what changes would it be advisable to introduce into the specifications for signalling systems, particularly for the signal receivers, to take account of the points enumerated above?

Note 1. — Annex 1 hereafter gives comments on this question by Study Group 11 during the period 1957-1960.

Note 2. — Annex 2 gives a proposal for the frequency-response-specification of the signal receiver, taking account of low-frequency noise.

(Question 1/XI)

Note 3. — On page 584 of the *Red Book*, Volume I, will be found a study made by the Administration of the Federal Republic of Germany on the nature, duration, time distribution and amplitude distribution of noise of a transient character.

Note 4. — SG 12 (succeeded in 1961/1964 by SG XII) pointed out in 1960 that attention should be given to the following point:

It may happen in future that international circuits are equipped with compandors and are of satisfactory quality for speech transmission, whereas the line noise level greatly exceeds the value permitted at present in the specification for signal receivers.

ANNEX 1

(to Question 1/XI)

Comments by Study Group 11 (Brussels, May 1958)

The Joint C.C.I.T.T./C.C.I.R. " Noise " Working Party drew the attention of Study Group 11 to the fact that on a 2500 km circuit on radio relay links, noise may be encountered having the following levels:

a) measured on an instrument with an integrating time of one minute: −40 dbm0 (weighted) during 0.01% of one month;

b) measured on an instrument with an integration time of 5 milliseconds: −30 dbm0 (unweighted) during 0.01 % of a month.

Study Group 11 considers that the design margin of signal receivers is such that signalling errors are unlikely if the mean value of steady uniform random noise is not worse than −40 dbm0.

When the noise level is greater than −30 dbm0 the chance of error is relatively high and would approach a complete failure of signalling. However:

a) the total duration of high noise level given by the " Noise " Working Party, is very short (4,3 minutes per month);

b) the probability that this noise will all occur in a single continuous period seems very low. In the great majority of cases this noise will be distributed in a random manner over one day or one month.

Under these conditions only a few of the circuits on the radio relay link will have their signalling affected and the total incidence of these signalling faults can be considered acceptable, when comparison is made with other cases in which setting up a call is prevented (congestion of circuits or equipment involving a loss probability of 1% to 3%).

Study Group 11 did not have time during its Brussels meeting to give more detailed consideration to the question of modifying the noise clauses for signal receivers.

It was in particular unable to examine the effect of noise voltages having a high absolute value but whose psophometric value stays within permissible limits because of their (low) frequency. (Annex II hereafter contains a proposal by Teléfonos de Mexico relative to the frequency response of the signal receiver, taking into account low frequency noise).

ANNEX 2

(to Question 1/XI)

Proposal by Teléfonos de Mexico
concerning specification of the frequency response of the signal receiver, to take into account noise at low frequencies (noise with strong psophometric weighting)

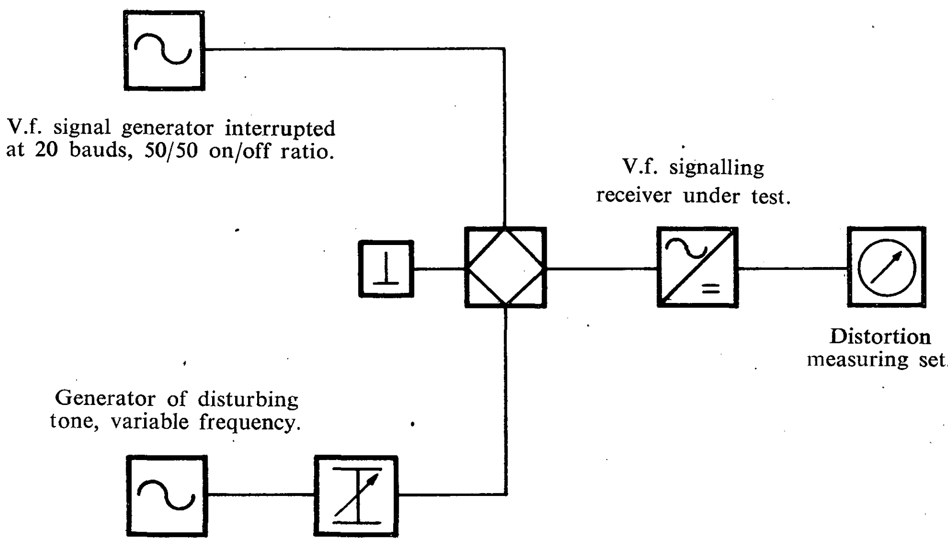


FIGURE 1. — *Possible method of testing guard-circuit performance for a single disturbing tone.*

The signal receiver guard circuit can operate under the influence of noise impulses whose frequency components have a large absolute value even though their psophometric value remains within the permissible limits defined by the Recommendations.

Recommendation G. 222 now sets a limit on unweighted impulse disturbance (in a 2500 km reference circuit, measured with 5 milliseconds integration time) at −30 dbm0 for 99.99% of the time. Good practice should ensure that disturbances within the exchanges or on local lines do not appreciably degrade this limit during signalling.

In principle one can consider introducing some kind of limitation on the frequency response curve of the guard circuit (the curve being defined by the sensitivity of the signal receiver to disturbance at different frequencies).

It is suggested that measurements could be made for different frequencies with equipment as shown in Figure 1, the level of the disturbing tone being adjusted at each frequency so that it results in, say, 5% distortion. The signal level should take various values within the operating range of the receiver. The results could be plotted in the form of curves showing absolute sensitivity to the disturbing tone (in dbm0 or Nm0). These curves could be required to lie under some limit to be defined as a result of tests. Perhaps the entire protection need not be provided by the signalling receiver alone, as very low frequencies are normally greatly attenuated in transmission.

It is considered that a specification in this form giving adequate protection against disturbance of the type in question could be based on such measurements. This protection would not be difficult to check; for a given design a single check might suffice once for all.

Administrations migth be asked to submit results obtained using this technique of measurement on those types of signalling receivers actually in use, and stating whether such receivers have been found satisfactory or are subject to interference. A detailed recommendation could be prepared from these results.

Question 2/XI

(continuation of Question 2 studied in 1957/1960)

What *clauses should be provided in the specification* of automatic exchanges to ensure that noise on the transmission channel of an international connection does not exceed a permissible value?

When determining these clauses, account should be taken of the conditions for telephone connections over general network circuits on which data transmission is carried out.

Note 1. — Question 2 relates to both national and international exchanges.

Note 2. — Proposed arrangements for reducing noise to a minimum are defined in Recommendation Q.30 in Volume VI of the *Red Book.*

Question 3/XI

(New question)

Considering that paragraph 3.5.1 of Recommendation Q.61 of Volume VI of the *Red Book* specifies that cross-talk between any two 2-wire connections in an international exchange should not be worse than 8 nepers or 70 decibels;

— and considering that paragraph 3.5.2 of Recommendation Q.61 states that the cross talk ratio between the "go" and "return" paths of a 4-wire connection in an international exchange should not be worse than 5.8 nepers or 50 decibels;

1. Is it desirable to place an upper limit on the psophometric voltage which should be permitted in an international exchange?

2. Is it desirable to specify such an upper limit for general noise and also for noise produced by interference from an adjacent selector and if so what limits should be recommended?

3. How should the values be measured?

(Question 3/XI)

Question 4/XI

(New question)

Taking into account:

— the question 1/XIII concerning the operating conditions and requirements for international operation, having regard to the expected rapid extension of semi-automatic and automatic operation on a world-wide basis,

— the fact that the characteristics of a number of the circuits provided for these services differ appreciably from those considered in establishing the present C.C.I.T.T. standard signalling and switching system specifications.

What changes and/or additions, if any, are necessary to these specifications to produce the most suitable signalling and switching arrangements?

Question 5/XI

(New question)

For the " New switching plan from the transmission point of view " being examined by the C.C.I.T.T., it is anticipated that some form of echo suppressor will be needed for the longer international connections:

— either for all connections on the group of circuits under consideration;

— or only for those connections with a certain percentage of subscribers in the country under consideration.

For a few connections it can happen that two (or more) circuits each necessitating echo suppressors will be switched together and technical considerations may make it desirable to reduce the number of echo suppressors.

What arrangements can be made, in these circumstances, in signalling and switching equipments, to permit the insertion or removal of echo suppressors when required by the transmission conditions?

Note 1. — Concise information on the new transmission plan envisaged by the C.C.I.T.T. is given in the Annex to Question 6/XI.

Note 2. — Annex 1 to Q. 5/XI describes the use of echo suppressors foreseen in 1960 by SSG 1/2 according to the new transmission plan.

Annex 2 to Q. 5/XI embodies a note by the Chile Telephone Company and the UK Administration regarding the use of echo suppressors on continental connections.

ANNEX 1

(to Question 5/XI)

Use of echo suppressors foreseen by Sub-Group 1/2 according to the new transmission plan

(taken from the report by SSG 1/2 approved by SG 1 and the IInd Plenary Assembly)

. . . . . .

6. Echo effects

. . . . . .

6.2 *Ways of avoiding troublesome echoes*

For the time being, Sub-Group 1/2 has reached the following conclusions:

a) There is no general need for echo suppressors in national networks. They may be required, however, for the inland service in large countries.

b) Echo suppressors will nearly always be necessary on intercontinental circuits of more than 2500 km.

c) The nominal overall loss of certain long continental circuits may be increased so as to avoid the use of echo suppressors (the full text of paragraph 6.2 *c)* is given in Annex 1 to Question 6/XI).

d) The Sub-Group considered a study (given in Annex 2 to Question 5/XI hereafter) of echo suppressors which might be necessary on circuits between Great Britain and various European countries when the rules envisaged are applied.

It might be advisable, later, to see whether the rule given in paragraph *c)* above could be made a little more flexible in borderline cases, it being understood that the total overall loss of the chain of 4-wire circuits should never exceed the value laid down for an intercontinental call.

6.3 *Types of echo suppressor*

The preferred type of echo suppressor is a far-end operated, differential, half echo suppressor. The design should be such that the suppressed signal is always connected to the differential device, thereby providing a break-in facility.

. . . . . .

6.4 *Insertion and removal of echo suppressors*

It is undesirable to have more than one echo suppressor on a complete connection; it is therefore advantageous to remove two half echo suppressors situated at an intermediate point on a connection *.

. . . . . .

It should be pointed out that in some cases echo suppressors are necessary for the operation of the circuit itself, quite apart from the subscribers' tolerance to echo. This is the case for circuits equipped with TASI or similar systems. If intercontinental circuits of this type have to be interconnected, it might be necessary to retain all the echo suppressors.

* Some Administrations may prefer to insert half echo suppressors by switching, according to requirements.

ANNEX 2

(to Question 5/XI)

Use of echo suppressors on continental connections

(Note from Chile Telephone Company and United Kingdom Administration)

Recommendation G. 121 envisages either that echo suppressors will be permanently connected to those circuits over which calls requiring echo suppression may be routed or that echo suppressors will be switched into circuit according to the length of the connection, as determined from the country code, the called number information and the distance from the originating group centre to the originating international centre.

The best solution will to some extent depend on the proportion of calls which are likely, in practice, to require echo suppression. An arrangement dependent on examining the routing of each international call is unlikely to be justified if few calls require echo suppressors.

In order to assess the extent to which echo suppressors are likely to be needed an analysis has been made of the traffic originating in the United Kingdom to other countries of the Europe and Mediterranean Basin Network. The study has been confined to those relations using metallic lines or line of sight radio relay links. High velocity plant throughout has been assumed.

The transmission plan for the U.K. is assumed to be of the pattern 3.5+0+0+0 db; to take the most unfavourable condition from the point of view of echo, the plans of all the other countries are assumed to be of the pattern 2.0+0.5+0.5+0.5 db.

The need or otherwise for an echo suppressor has been determined by recourse to the curve shown in Recommendation G.121, which is based on a mean echo balance return loss of 11 db (standard deviation: 3 db) and the American Telephone and Telegraph Company's mean threshold of objection to echo published in 1956.

Two classes of connection have been considered. One in which the connection is between subscribers in the immediate areas surrounding the terminal centres and the other where the call is routed over the longest possible national four-wire extension (each extension assumed to be over three national circuits). The losses of the international circuits were assumed to be at first 0.5 db per circuit and then 0.5 db per 500 km (or part thereof) to see if an echo suppressor could be dispensed with thereby.

The results are given in Table 1, from which it will be seen that in some cases, for example London-Budapest, an echo suppressor would be needed on calls extended into each country if the international circuit is operated at 0.5 db but not if it were operated at 0.5 db/500 km (compare columns F and H).

In other cases, for example London-Warsaw, applying the rule does not obviate the need for an echo suppressor. In this particular case, if an extra 0.5 db loss is added somewhere in the four-wire chain no echo suppressor would be needed.

Significance of the Column Headings in the Table

A = Distance of centre from London — km.

B = Longest national 4W extension — km. The longest national extension from London is 1000 km.

C = Length of connection with the two longest national connections (A+B+1000 km).

D = Number of circuits or direct routes. IT=transit via one intermediate centre.

TABLE 1

(of Annex 2 to Question 5/XI)

Analysis of need for echo suppressors on continental telephone calls originating in the United Kingdom

Country	Terminal centre	A km	B km	C km	D ccts	E db	E E/s ?	F db	F E/s ?	G db	G E/s ?	H db	H E/s ?	Note
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Albania														No service
Algeria	Alger	2030	700	3730	1T	6½	yes	8	yes	8	no	9½	yes	Note 1
	Oran	2300	650	3950		6½	yes	8	yes	8	no	9½	yes	
Austria	Wien	1630	640	3270	1T	6½	no	8	yes	8	no	9	no	
Belgium	Bruxelles . . .	360	180	1540	40	6	no	7½	no	—	—	—	—	
Bulgaria . . .	Sofia	3140	480	4620	1T	6½	yes	8	yes	9	no	10½	yes	
Czechoslovakia .	Praha	1300	680	2980	direct	6	no	7½	yes	7	no	8½	no	
Denmark . . .	København . .	1340	460	2800	14	6	no	7½	yes	7	no	8½	no	
Egypt	Cairo				direct									H.F. Radio
Finland	Helsinki	2300	1130	4430	1T	6½	yes	8	yes	8	no	9½	yes	Note 1
France	Paris	450	900	2350	100	6	no	7½	no	—	—	—	—	
Germany. . . .	Berlin	1230	290	2520	direct	6	no	7½	no	—	—	—	—	
	Düsseldorf . . .	610	250	1860	80	6	no	7½	no	—	—	—	—	
	Frankfurt . . .	850	400	2250		6	no	7½	no	—	—	—	—	
	Hamburg . . .	1010	200	2210		6	no	7½	no	—	—	—	—	
Greece	Athinai	3115	900	5015	direct	6	yes	7½	yes	9	no	10½	yes	
Hungary	Budapest . . .	1910	290	3200	direct	6	yes	7½	yes	7½	no	9	no	
Iceland	Reykjavik . . .	2500	850	4350	direct	6	yes	7½	yes	8	no	9½	yes	
Ireland	Dublin.	550	340	1890	direct	6	no	7½	no	—	—	—	—	
Israel	Tel Aviv . . .													H.F. Radio
Italy	Milano	1300	400	2700	24	6	no	7½	yes	7	no	8½	no	
	Roma	1840	1000	3840		6	no	7½	yes	7½	no	9	yes	Note 2
Lebanon . . .	Beirut													H.F. Radio
Libya	Tripoli													H.F. Radio

Table 1. — (continued)

Country	Terminal centre	A km	B km	C km	D ccts	E		F		G		H		Note
						db	E/s?	db	E/s?	db	E/s?	db	E/s?	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Luxemburg	Luxembourg	570	70	1640	direct	6	no	7½	no	—	—	—	—	
Malta	Valetta	2840	50	3890	1T	6½	yes	8	yes	8½	no	10	no	
Morocco	Rabat	3000	750	4750	1T	6½	yes	8	yes	9	no	10½	yes	
Netherlands	Amsterdam	500	250	1750	60	6	no	7½	no	—	—	—	—	
	Rotterdam	450	170	1620		6	no	7½	no	—	—	—	—	
Norway	Oslo	1800	2070	4870	9	6	no	7½	yes	7½	no	9	yes	
Poland	Warszawa	1810	500	3310	5	6	no	7½	yes	7½	no	9	yes	Note 1
Portugal	Lisboa	2580	460	4040	direct	6	yes	7½	yes	8½	no	10	yes	
Rumania	Bucuresti	2760	600	4360	direct	6	yes	7½	yes	8½	no	10	yes	
Spain	Madrid	2000	700	3700	8	6	yes	7½	yes	7½	no	9	yes	Note 2
Sweden	Stockholm	1850	1150	4000	19	6	no	7½	yes	7½	no	9	yes	
Switzerland	Basel	905	80	1985	40	6	no	7½	no	—	—	—	—	
	Bern	975	150	2125		6	no	7½	no	—	—	—	—	
	Zürich	1000	220	2220		6	no	7½	no	—	—	—	—	
Syria	Damachk													H.F. Radio
Tunisia	Tunis	2780	600	4380	1T	6½	yes	8	yes	8½	no	10	yes	
Turkey	Ankara	3420	1180	5600	1T	6½	yes	8	yes	9½	no	11	yes	Estimated six calls only a day by 1962
U.R.S.S.	Moskva	3050	?	?	direct	6	yes	7½	?	9	no	10½	?	Note 3
Yugoslavia	Beograd	2190	600	3790	1T	6½	yes	8	yes	8	no	9½	yes	Note 1

Note 1. — Echo suppressors would not be required if an extra 0.5 db loss were added to the 4-wire chain.

Note 2. — Echo suppressors would not be required if an extra 1.0 db loss were added to the 4-wire chain.

Note 3. — The 10½ db between 2 W terminals equivalent for the chain of trunk circuits would permit of a national extension from Moskva only 150 km long without necessitating an echo suppressor; this assumes a 1000 km national extension in UK.

E = Loss in db between 2W terminals. Is an echo suppressor needed? The international circuits are operated at 0.5 db per circuit. Calls between local areas of terminal centres.

F = Loss in db between 2W terminals. Is an echo suppressor needed? The international circuits are operated at 0.5 db per circuit. Calls involving longest national extension.

G = Loss in db between 2W terminals. Is an echo suppressor needed? The international circuits are operated at 0.5 db/500 km. Calls between local areas of terminal centres.

H = Loss in db between 2W terminals. Is an echo suppressor needed? The international circuits are operated at 0.5 db/500 km. Calls over longest national extensions.

Question 6/XI

(New question)

With reference to the " New switching plan from the tiansmission point of view " being examined by the C.C.I.T.T., it is expected that the routing through two international exchanges will often be essential for international connections and it is difficult to assume that requirements for more than two international transit exchanges will never arise.

The plan envisages a small transmission loss in the four-wire path for each international circuit and as a consequence the relative level at the point of insertion of the international signalling receiver will vary for different connections.

Are the limits which are available with the C.C.I.T.T. standard 2 V.F. signalling system adequate to permit this additional attenuation on the four-wire path of the circuit?

Note. — Concise information on the new transmission plan is given in the annex below.

ANNEX 1

(to Question 6/XI)

New transmission plan studied by S.S.G. 1/2 in 1960

(taken from the report by Sub-Group 1/2 approved by SG 1 and the IInd plenary Assembly)

. . . . . .

2. Variation of equivalent as a function of time

2.1 *National circuits*

The Sub-Group proposes to issue the following recommendation with regard to the " New switching plan from the transmission point of view " (see under 4 hereafter). The standard deviation of variations of equivalent as a function of time should not exceed 0.23 neper (2 decibels) for a chain of four national circuits with 4-wire interconnection including the associated switching equipment. The general principle given in the first sub-paragraph of paragraph 4.1 applies to this recommendation.

It should be possible to satisfy this recommendation in the near future, particularly by the use of automatic regulation by group pilots. Slightly better values are to be expected in a more distant future.

2.2 *International circuits*

According to information supplied by SG 4, it is reasonable to assume that the introduction of group and supergroup pilots and the use of automatic regulators will improve transmission conditions; a standard deviation of 1.5 db for a 1000 km circuit can, in fact, be expected a few years hence.

2.3 *Very long intercontinental circuits*

Information already received on this point may be summed up as follows:

a) Values measured by the French Administration on five circuits between Paris and New York.

1. The adjustment deviation with respect to nominal equivalent is between (+0.06 and −0.02 neper +0.52 and −0.17 db).

2. Standard deviation of variations of equivalent for all the circuits is:

0.78 db (0.092 N) for the direction New York-Paris,
1.25 db (0.144 N) for the other direction.

Note. — These figures refer to favourable cases in which there is no demodulation to audio frequency between the two extremities of the circuits; there was an automatic regulator in Paris (but not in New York) for each group.

b) Values measured by the UK Administration

Circuits	Mean deviation from nominal		Standard deviation	
	db	N	db	N
London to White Plains	−0.37	−0.04	1.03	0.117
White Plains to London	0	0	0.65	0.075
London to Montreal	+0.38	+0.04	1.47	0.169
Montreal to London	+1.73	+0.2	1.13	0.13

Note. — The maintenance practices adopted on the routes differed.

. . . . . .

4. Principles of a new switching plan from the transmission point of view

4.1 *Introduction*

The plan described below was drawn up with the object of making use, in the internationa service, of the advantages offered by 4-wire switching. However, the recommendations contained in this plan may be considered as having been met if an equivalent performance is obtained at the international exchange by the use of other techniques than those described.

(Question 6/XI)

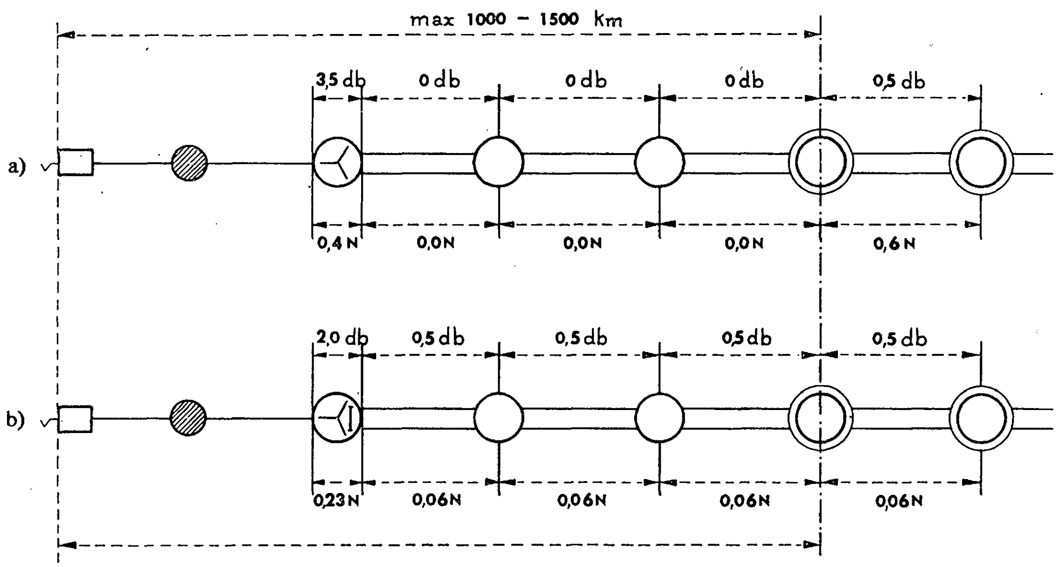


FIGURE 1. — *Distribution of overall loss within a country of average size for an international call.*

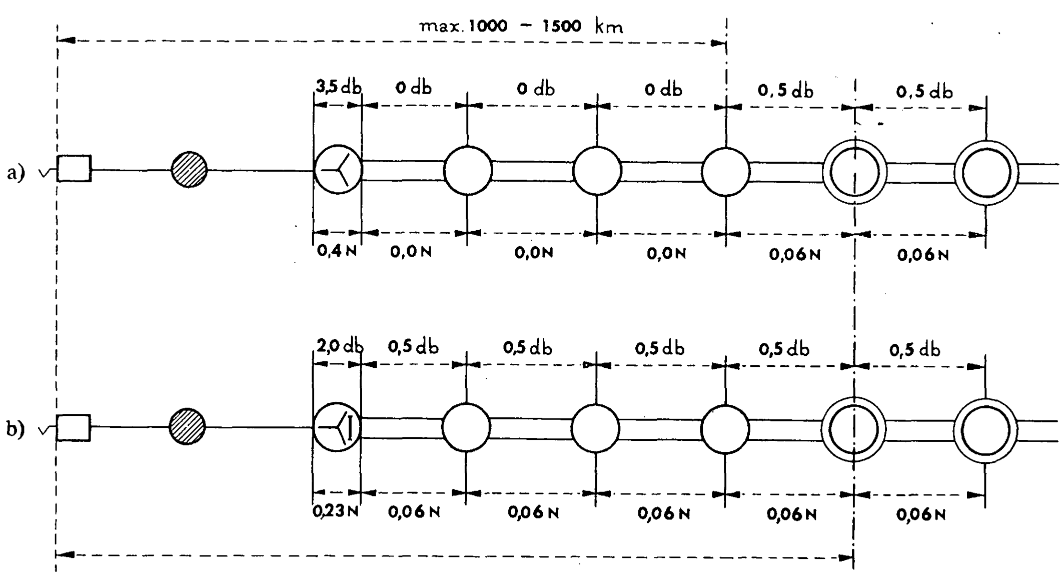


FIGURE 2. — *Distribution of overall loss within a large country for an international call.*

(Question 6/XI)

Throughout the paragraphs below, it is understood:

a) that the intercontinental circuits shorter than, or equal to, 2500 km are considered as ordinary international circuits;

b) that short trans-frontier circuits are not covered by this plan and should be the subject of agreements between the administrations concerned.

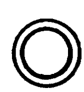
4.2 *Distribution of equivalents in an international connection*

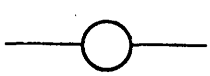
The case of a single, international circuit, used only for terminal traffic between two countries, has already been dealt with in the reply by Sub-Group 1/2 to Question 10 (see paragraph B-b of Recommendation G. 131). The Sub-Group proposes the following provisional draft recommendation for the general conditions which will be encountered in coming years, with the spread of automatic operation and 4-wire switching.

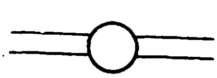
A country in which the maximum distance between an international exchange and a subscriber who can be reached from that exchange is not more than about 1000 km, or, exceptionally 1500 km, is considered as a country of " average size ". In such a country, a maximum of three national circuits can be interconnected on a 4-wire basis between each other and to international circuits and as indicated in Figure 1 (a), such circuits will have a nominal overall loss of 0 decibel between the 4-wire terminals in the transit position; the attenuation of 3.5 db (0.4 N), introduced by the terminating set in the national network at the end of the 4-wire chain is to be included in the reference equivalent of the national system. Any other plan for the distribution of overall loss which leads to the same results as far as limits for performance and considerations of stability are concerned, is likewise permissible; Figure 1 (b) gives one of the possible variants, by way of example.

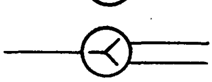
To ensure the stability of the chain of national and international 4-wire circuits, the international circuits (including the intercontinental circuits) should have a nominal overall loss of 0.5 db or 0.06 neper, between the 4-wire terminals, in the transit position, and should have as

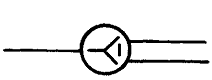
Key to figures 1 and 2

 Subscriber's set  Local exchange  International exchange

 2 wires switching exchange

 4 wires switching exchange

 Exchange with terminating unit *

 Exchange with terminating unit and switchable pad

* A switchable pad may also be introduced at that point to compensate for losses in the 2-wire side, it being understood that return loss conditions are still satisfactory.

little attenuation distortion as possible; the latter objective may be attained either by means of appropriate terminal carrier equipment, or by the use of correctors fitted to the circuits. In some cases, there may be reason to adopt higher overall losses, to avoid echoes (see para. 6.2 *c)*.

There is no strict limit to the total number of circuits which may be used for an international connection. However, there should be as few as possible so as to obtain good transmission. The attention of the Plan Committee is drawn to this point.

In large countries, a fourth and possibly a fifth *national* circuit may be introduced into the 4-wire chain, provided it has the overall loss and characteristics recommended for an international circuit. Figure 2 represents equivalent distributions of overall loss which may be applied in this case.

. . . . . .

Note. — SG XI is advised that the nominal relative level at the receiving end of the international 4-wire chain (on the 2-wire side) will be

$$-\ (7+0.5\ n)\ \text{db or}\ -\ (0.8+0.06\ n)\ \text{neper.}$$

n being the number of international or intercontinental circuits (increased by 2 or 4 if one of the extreme countries, or both of them, are large), the maximum length of the chain of circuits being about 20 000 to 25 000 km.

These formulae should be modified if the overall loss of some circuits is increased in order to avoid echoes (see para. 6.2 *c)*. The values concerned are the nominal values, to which should be added, if necessary, any variations in time of the overall loss of national and international circuits.

. . . . . .

6.2 *Avoidance of troublesome echoes*

. . . . . .

c) (Provisional recommendation). To avoid the extensive use of echo suppressors, long international circuits used for calls within a continent may be adjusted to an overall loss based on their length according to the rule:

up to 500 km	0.5 db
500 to 1000 km	1.0 db

and 0.5 db for each additional 500 km or part thereof.

Question 7/XI

(New question)

In view of the fact that certain transit exchanges can be connected by two or more incoming international exchanges in a distant country, what should be done to ensure the economical and efficient routing of calls in such transit exchanges?

Note. — This problem arises, for example, at the Zürich transit exchange, which is connected to both Milano and Roma. Since the single international code provided for Italy cannot provide discrimination between the two routes, it has been supposed that the distinction would be made in the transit exchange, according to the first digit of the national number. To this end, for a two-frequency system, the transit register would send the terminal proceed-to-send signal and would receive the national number from the outgoing register. It would then select an outgoing circuit after analysing the first digits in the national number. Finally, it would retransmit the national number, after receipt of the terminal proceed-to-send signal from the incoming exchange.

It seems unlikely that this procedure would affect the outgoing exchange. Conditions would be changed at the transit exchange, however, especially as regards releasing the transit register and switching the circuit to the speech condition.

There may well be other methods of solving the problem, more in accordance with the original design of the two-frequency system, in which the numerical signals are transmitted from one end of the connection to the other.

Question 8/XI

(New question)

Considering the provisions of Article 13, paragraphs 177, 178 and 179 of the International Telecommunication Convention, Geneva, 1959,

What guiding principles can be established to assist Administrations in the comprehension, examination and analysis of the problems associated with the development of national telephone switching networks and the determination of the suitable equipment, taking into account the various local, interlocal and international aspects concerned?

Which general recommendations can be given with regard to special items such as the accommodation for the equipment, power plant, air conditioning, etc... ?

Annex

(to Question 8/XI)

Comments of Mr. E. R. Banks, Chairman of the working party entrusted with the study of the question

Scope of the question and proposed method for obtaining a solution

The question has been phrased in general terms and covers potentially the whole field of knowledge relating to switching network design and switching system and exchange selection and integration. However, it is not considered that the question includes questions of transmission design which can be dealt with separately.

I interpret the purpose of the question as being to provide information which will assist new and developing countries in their studies of the problems associated with the introduction of switching networks and automatic switching systems. It is not intended, and it would not be possible, to provide particular solutions to the various problems in this field, it is rather intended that a series of recommendations should be formulated which will enable an administration to draw on the accumulated knowledge and experience gained in the development of other networks, when planning for their own purposes. Further the recommendations would enable administrations to consider all the related aspects which must be associated with the consideration of suitable switching equipment for application in a network. It is considered that such recommendations would enable the administrations to assess fully the potentialities of available switching equipments and, in this regard, it is considered that this will be beneficial not only to the Administrations but also to the manufacturers of switching equipment.

These recommendations will be general in nature and therefore could be supplemented with appendices which give more specific information on particular subjects. Examples would be typical numbering schemes or switching plans, basic information on methods of assessing subscriber's growth and telephone demand. I envisage that these appendices would fulfil the dual purpose of providing examples, as in the case of numbering schemes and also referring to other literature and published information on a subject, as in the case of traffic reading methods and subscriber's growth.

Plan for study

A study of the question would appear to divide itself into three main categories:

A — Basic planning,

B — Switching system and exchange selection,

C — Associated aspects of installation and operation.

A. — Basic planning

In this category I would include methods of developing a numbering plan, a charging plan and the location and ordering of switching centres.

B. — Switching system and exchange selection

In general the recommendations under this heading would assist an Administration in providing adequate information to enable manufacturers to offer equipment for the particular project and would include criteria against which the Administration could evaluate the various offers of equipment it received. To some extent it is necessary to resolve problems under category A before proceeding with category B, however I consider that it is possible to deal with this Section making due allowance for A without necessarily completing the study of A first. The two subsections in this category would then cover the following general ground:

a) Information which it is necessary to assemble and supply to a contractor in order to obtain a quotation and information which is sufficient to allow a full assessment of the potentialities of the plant.

b) The criteria which should be used for assessing the most suitable switching equipment for adoption on the basis of the tenders. In this regard I consider there are a variety of conditions which will have a bearing on the particular criteria used for such a selection of a switching system and that we must provide, not only a set of general criteria, but also relate these to the various conditions which it is possible to envisage. For instance:

1) Whether a complete system is required, that is local, rural and trunk exchanges, or

2) Whether only a single exchange type is required, for instance large city or small rural.

3) Whether the equipment selected is to be manufactured locally or not.

4) The nature of the existing plant in the network and the stage of development of the network.

5) The availability of trained personnel and whether these personnel would be used for installation of the exchange.

C. — Associated aspects of installation and operation

In the final category I group recommendations regarding building design, installation practices, power plant and air conditioning requirements and, in general, the subjects on which considerable experience has been gained which is not generally readily available.

* * *

Of these three categories above, I consider that categories B and C should be studied first since, from discussions, it would appear that there is a more general demand for information under these sections.

Administrations are invited to submit their comments on the proposals as outlined above and to submit information relating to the particular subjects under study.

SUMMARY OF QUESTIONS SET FOR STUDY GROUP XI

No. of Question	Brief description	Comments
1/XI	Noise causing operation of the signal receiver.	Continuation of Question 1, studied in 1957/1960.
2/XI	Clauses specifying limitation of noise through an automatic exchange.	Continuation, with amended wording, of Question 2, studied in 1957/1960.
3/XI	Noise through an international exchange.	Wording to be compared with the wording of Question 2.
4/XI	Signalling for international operation.	
5/XI	Insertion and removal or disablement of echo suppressors.	
6/XI	Effects of the new transmission plan on the operation of the signal receiver in the 2 V.F. system.	
7/XI	Routing of calls in an international transit exchange connected to two international exchanges in the same country of destination.	
8/XI	Basic specification clauses for the supply of automatic exchanges (Technical Assistance).	

(Question 8/XI)

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Questions about automatic telephone switching

entrusted to

Study Group XIII

in 1961-1964

Question 1/XIII

(New question)

Having regard to the expected extension of semi-automatic and fully automatic telephone operation to intercontinental operation on a world-wide basis,

Are the operating facilities and requirements for international operation, as are published in Volume VI of the C.C.I.T.T. *Red Book* the most suitable for such world-wide application?

If not, what changes are necessary?

Question 2/XIII

(New question)

Considering that the semi-automatic and automatic service will be extended to intercontinental connections in the coming years,

1. How should the international numbering scheme which appears in Volume VI of the *Red Book* (as an annex * to Rec. Q.11) be amended to cater for this extension?

2. What are the most suitable arrangements for a world-wide numbering scheme? In the preparation of this scheme, allowance should be made especially for:

a) future development of the various numbering schemes which exist in the different regions of the world,

b) the desirability of reducing the number of digits to be dialled by subscribers to the minimum,

c) the desirability of avoiding basic changes in the international codes already used in certain regions of the world in accordance with C.C.I.T.T. recommendations.

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* Also appears in Recommendation E.29 (Vol. II *bis* of the *Red Book*).

(Question 2/XIII)

Notes. — Annexes 1 to 6 below contain the replies given to a C.C.I.T.T. Note inviting administrations to make suggestions for the wording of this question.

ANNEXES

Establishment of a world-wide numbering scheme

Annex 1

(to Question 2/XIII)

Suggestions submitted by the Netherlands Administration

For the wording of the Question relative to intercontinental codes, the following two systems could be taken into account:

a) the international code may consist of 3 digits, the first of which would indicate an important group of countries, e.g. a continent, with up to 100 countries in principle. This method leads to the use of a 3-digit number also for traffic between countries in the same group;

b) the traffic in a group of countries may be routed by means of 2 digits. In this two-digit number, one or more digits are not used for the numbering of the first digit. These unused digits may then serve to indicate that traffic with another group of countries is requested, while another digit—which may be dialled afterwards—could indicate which group is required. This system would lead to the use of 2-digit numbers for traffic in the same group, and of 3 or 4-digit numbers for traffic with countries belonging to other groups.

Annex 2

(to Question 2/XIII)

Suggestions submitted by the Federal German Administration

1. The code systems existing for the routing of automatic traffic in different countries are generally subdivided as follows:

a) trunk or local traffic,

b) national trunk traffic,

c) international traffic.

Intercontinental traffic (with its relatively small percentage of the total trunk traffic) could be included:

— either in the same class as international traffic (same access code to the international network for continental and intercontinental traffic);

— or in a special class for intercontinental traffic (special access code to the intercontinental network).

In the first case, an international code of 3 digits should be used for continental traffic in place of the 2-digit code used up to the present, so that all countries with a uniform code can be reached once the automatic service is completely installed.

In the second case, continental traffic could continue to be routed with a 2-digit code. The special code for access to the network necessary for *intercontinental* traffic would then hamper existing national codes to a minimum degree provided only one additional digit were added to the code for access to the *continental* international network. For this purpose, one digit, for example 0, can be used from the present list of international codes for routing traffic in Europe, without causing any harm (loss of 10 international codes).

Because of this, however, the numbers to be dialled in intercontinental traffic have two extra digits (for example, the trunk access code with three digits, the international code with three digits).

As an example:

Local traffic	a b c d e	$a \neq 0$
National trunk traffic	0-A B C-a b c d e ...	$A \neq 0$
International traffic	0 0-J M N-(0) A B C-...	
or		
Continental traffic	0 0-M N-(0) A B C-a...	$M \neq 0$
Intercontinental traffic	0 0 0-J M N-(0) A B...	

2. Transition to a *three*-digit international code for continental traffic, or, in the other solution, the addition of *two* digits in intercontinental traffic, could be avoided:

(a) if each of the five continents were characterized by an intercontinental digit (J) preceding the two-digit international code (M, N) in intercontinental traffic only;

(b) if the first digit in the international code (M) was never a figure for a foreign continent. The characteristic digit for a particular continent (for example, J=6) can be used without inconveniences as first digit in the international code (for example M=6) for that particular continent, so that we have, in each case, 6 x 10 international codes. In this fashion, the two streams of traffic could be identified by the same trunk access code (two digits), with an international two-digit code for continental traffic and an international three-digit code for intercontinental traffic. In actual operation, the characteristic continental digit can be considered as an integral part of the trunk access code.

For example:

Continental traffic	0 0-M N-(0) A B C-a...	M = 1 to 6
Intercontinental traffic	0 0-J M N-(0) A B C-...	J = 7 to 0
	or 0 0 J-M N-(0) A B C-...	

In the registers for international traffic, the two or three digits of the international and intercontinental access code might be used to deal with the charging and routing of the two traffic streams. If the first digit in the international code (M) were allocated on a geographical basis, the assessment of the two digits (J, M) would in many cases be enough in intercontinental traffic too, if this digit M stands for the area of destination as far as routing and charging are concerned.

For Europe, the sixty remaining international codes are enough. In continental traffic there would be thus no increase in the number of digits in relation to the present plan and in intercontinental traffic one digit only would have to be added. By using a three-digit code, continents with more than sixty countries can have more than one hundred international codes, usable for traffic on their own continent too, without departing from the system.

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In fact, this course presupposes that the list of codes already drawn up by the C.C.I.T.T. for the countries in Europe and the Mediterranean Basin will be revised. But this is a matter of no great difficulty with international traffic in its present stage of development.

3. The least change in the existing list would be obtained by releasing only such digits as are needed to reach foreign continents (for example, 7 to 0), by shifting the higher international codes into the gaps existing between the lower ones, for example.

However, a more systematic distribution will be obtained when countries are classified on a geographical basis and on the volume of their international traffic. Geographical classification is of secondary importance for continental traffic because it cannot be used for routing and charging except when the first digit in the international codes covers a complete area as regards routing and charging. But it can if necessary be used for incoming traffic from distant parts of the world. Generally speaking, classification according to the volume of traffic saves time when there is pulse selection, especially when the countries with most incoming traffic are given codes with a minimum number of digits. This saving applies only to systems using decimal selection.

The Federal German Administration has undertaken a systematic classification of European countries from these two points of view. A table showing this classification is attached. To simplify the assessment of the volume of traffic, we have taken as our starting point the number of telephone sets at the beginning of 1958.

As hitherto, a full set of twelve codes is shown for the European republics in the Union of Soviet Socialist Republics. The codes from 10 to 19 are withdrawn, for use as special codes in individual countries. They can, for example, be used in direct traffic to reach adjacent countries in the Mediterranean Basin. That leaves nine codes in reserve, i.e., 15% of all the codes.

Supplement

Country	Telephone sets in 1958	Codes hitherto existing	Proposed codes		
			West. Europe	Cent. Europe	North Europe and Balkans
I. *European countries, except the Union of Soviet Socialist Republics*					
United Kingdom of G.B. and N. Ireland	7,36 . 10^6	44	21		
Fed. Rep. of Germany	5,85	49		31	
France	3,50	33	22		
Italy	2,87	39		32	
Sweden	2,41	46			41
Switzerland	1,39	66		33	
Spain	1,34	50	23		
Netherlands	1,32	55	24		
Belgium	0,99	22	25		
Denmark	0,95	61			42
Norway	0,65	38			43
Austria	0,59	23		34	
Finland	0,53	25			44
Poland.	0,41	20		35	
Hungary	0,39	35		36	
Czechoslovakia	0,35	57		37	
Portugal	0,31	42	26		
Turkey	0,20	36			45
Yugoslavia	0,20	63		38	

Country	Telephone sets in 1958	Codes hitherto existing	Proposed codes		
			West. Europe	Cent. Europe	North Europe and Balkans
I. *European countries, except the Union of Soviet Socialist Republics* (contd.)					
Greece	0,15	30			46
Ireland	0,13	52	27		
Rumania	0,13	47			47
Bulgaria	0,05	28			48
Luxemburg	0,04	60	28		
Iceland	0,03	64	29		
Malta	0,01	43		39	
Gibraltar	0,002	29	20		
Albania	0,002	59			49
Cyprus	0,001	27			40
II. *European republics of the Union of Soviet Socialist Republics*		68 to 79	51 to 62		
III. *Special codes* f.e. North Africa, Near East		00 to 19	10 to 19 11 to 15 16 to 19		
IV. *Codes in reserve*			30, 50, 63 to 69		

Annex 3

(to Question 2/XIII)

Suggestions submitted by the Chile Telephone Company

Considering:

— that in the international automatic service any ambiguity or error is liable to result in wrong connections which could be the subject of complaints by subscribers and cause unnecessary loading of circuits;

— that the number of errors may be partly dependent on the number of digits which are needed to establish an international connection;

— that ambiguity may result from the use of a coding arrangement which is not easy to understand;

1. Is it desirable and possible to lay down general rules, valid for all administrations who intend to participate in the automatic international service, for determining clearly and without ambiguity the digits to be sent by the calling party before those forming the national number of the called subscriber (such as might be shown on the letter-heading of subscribers' correspondence)?

2. In particular, is it possible to establish desiderata in respect of the use of numbers so as to avoid errors, reduce setting-up time and facilitate routing, bearing in mind that the connections which are longest have (i) the highest cost, (ii) the most digits, (iii) the greatest probability of

error, (iv) the longest setting-up time and (v) the greatest need for routing flexibility? In addition to the arrangement of digits is it reasonable to seek other forms of protection against error, such as a recorded announcement on the conclusion of dialling to confirm that a very long connection has been ordered?

3. In the numbering schemes already in use for semi-automatic operation a series of codes have been assigned, for the use of any administration, to assist in distinguishing different sections of the network of another administration. Is it desirable and possible to reserve codes for similar or other uses in intercontinental relations, particularly those in parts of the world where the intercontinental connection might be quite short?

Annex 4

(to Question 2/XIII)

Suggestions submitted by the Italian Administration

The Italian Administration proposes the following wording for the new question to be set for study concerning the List of International Codes:

" In view of the impending entry into service of intercontinental automatic telephone circuits, and of the fact that about 60 international codes have already been allocated to countries in Europe,

a) would it be desirable to keep the two-digit international codes and prefix them with a digit indicating the continent required, or

b) would it be better, as proposed by the Federal German Administration, to allot international codes with fewer digits (and pulses) to countries having the heaviest traffic, or

c) in order to reduce to the minimum the total number of digits to be dialled, would it be preferable to choose international codes with a varying number of digits as under *b)*, but allotted taking into consideration the number of digits making up each national numbering system?

Annex 5

(to Question 2/XIII)

Suggestions submitted by the Australian Administration

Essential features of a world-wide numbering scheme are that it should —

1. retain the existing C.C.I.T.T. international access codes where possible;
2. retain the existing national numbering plans while providing flexibility for future designs;
3. define each continent or geographical region by a single-digit destination-prefix;

4. make efficient use of codes on a world-wide basis, thus allowing international numbers to be as short as possible, consistent with providing capacity for long-term development.

By way of illustration, the allocation of single-digit distinction-prefixes to continents and geographical regions could be —

U.S.A. and Canada	1
U.S.S.R.	2
Europe	3 and 4
South and Middle America	5
South East Asia and Oceania	6
Africa and South-West Asia	7
Asia, General	8
India	9
China	0

In the European area, the following C.C.I.T.T. country codes could be retained —

France	33	Italy	39
Germany	49	Rumania	47
Greece	30	Sweden	46
Great Britain	44	Turkey	36
Hungary	35		

The international number of any subscriber could be limited to a maximum of 11 digits, neglecting the international access code. Where a national number of less than 10 digits will suffice, this could be accommodated in this proposal.

By using country codes of 1, 2, or 3 digits, national numbers of 10, 9 or 8 digits respectively could be catered for. Examples could be as follows:

Country	Country code	National No. length (with sufficient capacity up to year 2000 A.D.)
North America	1	10 digits
Chile	561	8 »
Germany	49	9 »
Portugal	453	8 »
Great Britain	44	9 »
U.S.S.R.	2	10 »
India	9	10 »
Japan	81	9 »

Consideration should be given to the advantages of simplified directory presentation which results from the use of the same continental or country codes throughout the world, and the incorporation unaltered of the national number of the subscriber.

With a scheme such as this, satisfactory international charging and routing could be achieved by discrimination on 2, 3 or a maximum of 4 digits.

(Question 2/XIII)

Annex 6

(to Question 2/XIII)

Suggestions submitted by the American Telephone and Telegraph Company

The following characteristics should be considered in formulating a world-wide numbering plan:

1. Uniformity of intercontinental or interregional access codes for fully automatic operation (customer dialled).
2. A single-digit destination-prefix for each continent or major region.
3. A customer's national telephone number not to exceed ten digits and preferably having a fixed number of digits. An area code, office code and station number to designate a particular telephone in the continental or regional communications complex. PBX extensions reached by direct inward dialling to be designated in this same manner.
4. For intercontinental and interregional calling, all number dialling with designations based on a dial numbered from 1 through 9 to 0 *.
5. Uniformity for the codes for distant international operators and other service functions **

Question 3/XIII

(continuation of Question 22 of SSG 2/4 studied in 1957/60)

CONSIDERING

— that experience has shown that traffic is subject to continual variation and consequently there is difficulty in choosing a representative sample,

— that for an economic yet acceptable grade of service it is necessary to take into account both the busiest hours as well as the mean busy hour values,

— that because there is no operator in the automatic service a shortage of circuits will have more influence on the grade of service than with a manual service and as a consequence more complete data may be needed,

— that it is desirable that a routine method of obtaining traffic data should be established,

— that the collection and analysis of traffic measurement represents a complicated, long and costly task when carried out manually.

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* This point is already covered by paragraph 2.1 of Recommendation Q.11 (which constitutes Recommendation E.29 of the Operating Recommendations).

** This point can be regarded as within the framework of the study of operating facilities for the intercontinental service.

1. How should the grade of service for the international circuits be defined to take into account the service both for the busiest hours and during the main busy hour?

2. What is the minimum amount of traffic data necessary to plan for any specified grade of service?

3. Is it practical to make a greater use of automatic measurement and analysis to obtain essential traffic data?

Remark 1. — Recommendations which might be modified after this study are those relating to Recommendation E.1, paragraph 20 and to New Recommendation E.95.

Remark 2. — For the study it should be assumed that the percentage of calls encountering congestion in the national network would be 1% due to the circuit and 10% due to the subscriber being busy.

Remark 3. — The following annexes are given below:

Annex 1. — Comments by Mr. Wright's working party in 1960 regarding the use of automatic traffic-recording machines.

Annex 2. — Draft specifications for such machines, submitted by the same working party.

ANNEX 1

(to Question 3/XIII)

Electronic traffic-recording machines

1. It is considered to be a major objection to the routine at present recommended for traffic measurement that it requires *too much of the time* of the maintenance or clerical staff. Simplification is needed not only to reduce this effort but also to prepare the way for obtaining the more comprehensive statistics necessary to make an accurate forecast of future traffic conditions. Such statistics can be obtained from histograms obtained by the arduous process of recording the traffic flow for the mean busy hour over a long period of time and arranging the results in order of magnitude.

2. An electronic traffic-recording machine could be designed to collect the essential data to build up the histograms, and thereafter the processes indicated by Figs. 1, 2 and 3 could be used to determine how many circuits should be provided to limit the congestion to the appropriate amount. In addition, some check could be applied to ascertain the grade of service for the busy hours during which the traffic was exceptionally high. With the histogram information it would be possible to make an accurate calculation of traffic growth.

Modern electronic digital computers are designed to eliminate human effort by obeying instructions passed to them by push-buttons or punched paper tape. Such a programme of instruction not only causes the necessary operations to be carried out but also arranges for the

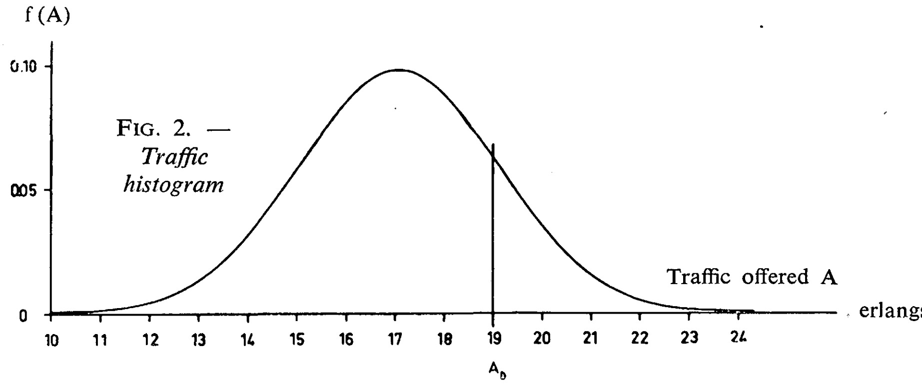

FIG. 2. — *Traffic histogram*

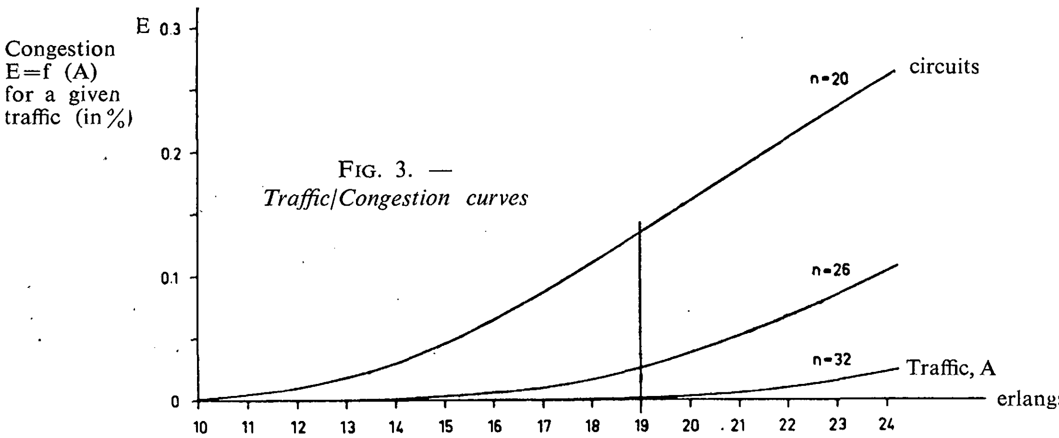

FIG. 3. — *Traffic/Congestion curves*

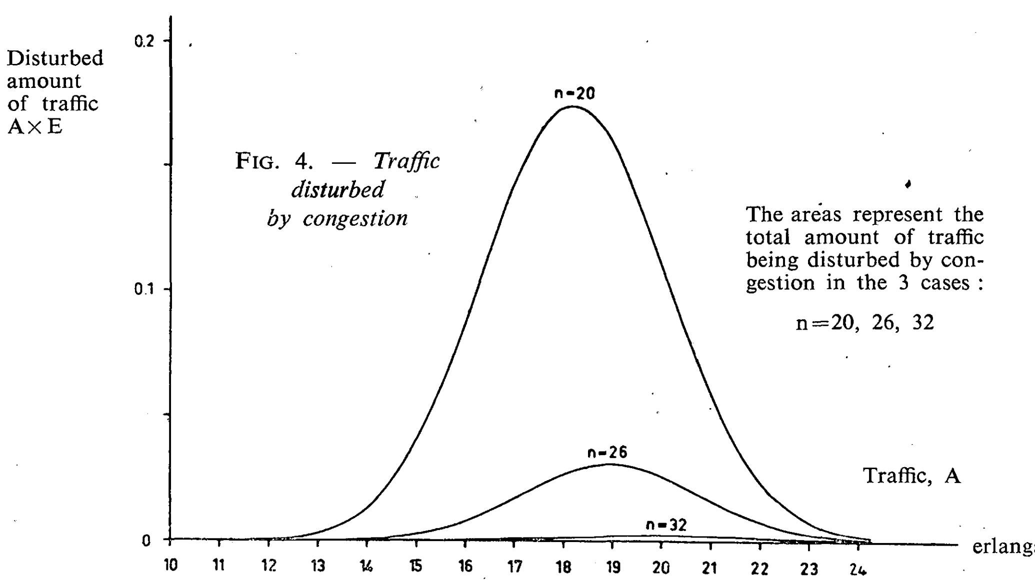

FIG. 4. — *Traffic disturbed by congestion*

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results to be produced in a form which can be read by eye or subjected to further automatic processing by other machines.

It is a further advantage that computers can be programmed not only to measure the traffic flow on a group of circuits but also to count the number of calls during the same period, thus allowing the average holding time to be calculated also.

3. The speed of computer operation is so high that time-sharing arrangements can be employed, and in consequence a single set of counting devices can serve a number of different groups of circuits. It is also possible for a single output circuit to be used for printing out the measured totals for a number of different groups.

4. As the programme can be arranged to check abnormal conditions such as excessive congestion, it will be possible to give an alarm at once which will result in corrective action being taken more quickly than with most existing routines.

5. It will be seen from the outline specification in Annex 2 below that facilities are required to allow measurements to be made of both the calls and the traffic for a group of circuits. This will enable the average holding time to be obtained.

6. There is another form of electronic traffic-recording machine. In general terms this machine is planned to record statistics in such a form that on request a report will be made of the traffic for days or hours during which the estimated traffic flow has been exceeded. Such estimated traffic-flow values may be arranged to increase from month to month. A more detailed appreciation of this second form of machine can be obtained by reference to the outline specifications in Annex 2, paragraphs 2 and 3.

7. The use of either form of traffic-recording machine to construct a traffic histogram might also be considered as a means of measuring not only the mean busy-hour traffic but, in fact, the traffic for all hours. The larger volume of traffic examined would give more precision and a better idea of the total number of calls encountering congestion. Such an arrangement would eliminate the need to determine the mean busy hour, but on the other hand there may be cases, such as with alternative routing, for which a mean busy-hour traffic may be essential, and it would therefore be required that the traffic machine should provide information on the basis of day and busy-hour traffic flow.

The access apparatus needed by an electronic machine for measuring traffic would not be entirely identical to that needed for measuring conversation time, but the control circuits would be very similar and there should be economic advantages in using a common machine in spite of the fact that quite independent outputs are required.

8. It appears to be a reasonable conclusion that a traffic-recording machine which eliminates most of the human operations will lead to a more accurate, a faster and a more economical routine. Furthermore, it seems likely that such a machine would have the ability of obtaining additional information of value for forecasting future traffic conditions.

It is a matter of importance to ascertain the accuracy and estimated annual charges of any of such new methods so that Administrations can decide whether their introduction would be likely to eliminate the difficulties which are at present evident.

(Question 3/XIII)

ANNEX 2
(to Question 3/XIII)

Outline specifications for automatic traffic-recording machines

1. Specification of requirements for an automatic traffic-recording equipment

1.1 *Purpose*

The equipment is primarily intended for ordinary traffic engineering purposes, i.e. to collect the traffic data which is generally desired for the continuous supervision of a network and its long-term planning.

It is the main purpose of the equipment referred to in this specification that measurements may be made, sometimes over extended periods, with the minium of maintenance attention. In consequence it is envisaged that each measurement will be provided as the result of instructions given to the machine in advance. The results of such a measurement should be printed out or recorded on tape. A typical instruction will be to measure the traffic on a group of circuits between, say, 10 a.m. and 11 a.m. and to connect an output circuit at 11 a.m. which will print out and/or record the results on a tape.

1.2 *Traffic characteristics to be measured*

The following data, characterizing the telephone traffic, may be recorded:

a) Traffic carried

b) Congestion time

c) Number of calls

d) Number of calls experiencing congestion

The indications for the above traffic characteristics may be given from the individual circuits or from common circuits, as, for example, markers or registers. It is desirable that the indications follow a given standard.

The number of groups of circuits for which simultaneous facilities are required should be specified separately.

In order that statistics may be collected in respect to both outgoing and incoming calls, and in order to keep the measuring equipment as flexible as possible, the indications from the circuits under measurement to the measuring equipment should be given in a similar way.

In applications in which it is desired to separate the statistics between calls established by an operator and those established by subscriber dialling, separate indications must be given.

1.3 *Measuring programme*

Facilities should be provided for measuring simultaneously the four traffic characteristics listed above on any specified group of circuits. It should be possible to give varying instructions to the machine when to make measurements. The individual measuring results should be printed out or recorded on tape.

It should be possible to make measurements on a specified number of routes. As a general rule, traffic carried and congestion time will always be referred to the whole of one single route, while the total number of calls and the number of calls experiencing congestion may also be referred to a part of a single route or to a part of a number of routes. In this case the part may be characterized by the combinations of calling and called national areas.

1.4 *Examples of measurements which may be provided by the automatic measuring equipment*

There follow a number of examples of measurements that may be desired. In order to indicate what importance different measurements can be expected to have, with regard to the experience of to-day, the different items have been given the signs I, II or III, having the following meanings:—

I. Measurements expected to be generally used on all routes for the supervision of the network, including its long-term planning.

II. Measurements expected to be used occasionally on a few routes at the same time. The facilities are recommended to be included in the automatic equipment only if the additional cost which they cause is tolerable.

III. Measurements expected to be used occasionally on a few routes, provided that the facility does not noticeably increase the cost of the equipment.

1.5 *Facilities*

(a) Facilities should be provided for measuring the average traffic carried during a specified sample period. (I).

Note. — As an example, it should be possible to instruct the machine to provide measurements for each of 10 consecutive working days, so that the average may be calculated. The sample busy hour is described in *(c)* below.

(b) Facilities should be provided for measuring the congestion time and/or the number of calls experiencing a congestion condition. It is required that the equipment should allow measurement totals to be made available daily on either a busy-hour, a 2-hour or a 24-hour basis. Facilities should be provided for giving an alarm if the amount of congestion exceeds a specified limit. (I).

(c) Facilities should be provided for measuring and either printing out or recording on tape the total traffic carried during each 15-minute period, so that the sample busy hour may be determined. The term " sample busy hour " is used to express the continuous 60-minute period carrying the maximum average traffic during the days forming the sample. (II).

Note. — As an example, the facilities can be provided by causing the machine to produce an output total at 15-minute intervals from any starting hour to any finishing hour.

(d) Facilities should be provided for measuring both the traffic and the number of calls and for printing out or recording on tape the totals for a specified hour or for 24 hours. (II).

Note. — The results can be used for the calculation of holding times.

(e) Facilities should be provided for indicating the distribution of certain variable parameters such as the message holding times and the daily busy-hour traffic carried.

Provision should be made for sorting into 10 to 60 adjustable brackets and for counting the number of items falling within each pair of brackets. (III).

Note. — Experience may prove that a measurement of the distribution of the traffic flow may replace the requirements specified in 1. The distribution obviates the necessity for choosing the busiest season of the year to make a sample measurement.

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(f) Facilities should be provided for counting calls in common circuits (such as registers, markers, etc.) for the following purposes:—

(i) To identify the sample busy hour by periodically printing out or recording on tape the totals as in *(c)*. (II).

(ii) To determine the number of calls prefixed by a specified country code during the sample busy hour. (I).

(iii) To determine the number of calls switched over a direct route to a specified country. (I or II).

(iv) To determine the number of calls switched over one or a number of overflow routes to a specified country. (I or II).

(v) To determine the number of calls to a specified country which are ineffective due to the absence of a proceed-to-send signal. (I).

(vi) To determine the number of calls to a specified country which are ineffective due to all direct and overflow circuits being in use. (I).

(vii) To determine the number of operator-handled calls in a route. (II).

(viii) To determine the number of subscriber-dialled calls in a route. (II).

1.6 *Control*

It is intended that in principle the recording equipment should be operated in response to a message on tape. It is desirable that the tape should be of such a form that remote control can easily be arranged.

2. Specification of requirements for a supplementary traffic-recording equipment

2.1 *Purpose*

The equipment is primarily intended for ordinary traffic engineering purposes, i.e. to collect the traffic data which are generally desired for the continuous supervision of a network and its long-term planning.

Whereas the requirements specified in Section 1 are generally needed for this equipment also, there is one basic difference. For this equipment a typical instruction will be to measure whether the traffic on a group of circuits between, say, 10 a.m and 11 a.m. exceeds a reference value which is available to the machine. If there should be an excess, it is required that an output circuit should be connected at 11 a.m. and that this circuit shall then print out and/or record the traffic measured.

2.2 *Traffic characteristics to be recorded*

These requirements are similar to those in Section 1 and differ chiefly in regard to the fact that an average traffic-flow value is not required for a sample period but that the traffic-flow value should be passed to an output circuit when it exceeds a reference value.

2.3 *Output record equipment*

This equipment forms the subject of Section 3. If a common output is used, then the traffic route must be recorded but the date could be inserted only once per day.

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2.4 *Measurement period*

It is required that the traffic-recording equipment covered by this specification should be capable of making traffic comparisons either for a single busy hour or for a number of periods during a day.

2.5 *Reference traffic value*

Facilities should be provided for permitting the reference value to be changed periodically as a consequence of the input programme applied to the machine.

It should also be arranged that, at specified times indicated by the programme, the reference value should be passed to the output tape together with the traffic-route indication and the date.

3. Specification for a centralised traffic-analysing equipment

This equipment is required to examine the traffic records which have been accumulated by the equipment described in Section 2, preferably over a considerable period of time, and to produce a report from which future traffic can be estimated.

For these purposes it is desirable that the analysing equipment should be capable of identifying the busiest season, the traffic flow at the busiest season, the annual growth of the traffic flow, and the extent to which the busiest season exceeds other seasons.

Furthermore the equipment should be capable of receiving data in respect to both the present number of circuits in operation and the dates on which it is planned that the present facilities will be extended. With this information it should be possible for the machine to estimate when the amount of disturbed traffic may be expected to exceed a specified grade of service.

In order to illustrate these possibilities, the following schedule shows for each of 14 months the traffic-flow values for the 30 highest days during the preceding 12 months. These traffic-flow values are listed in order of magnitude, with the day and month concerned shown beside them. The entries in brackets indicate the high traffic days which have occurred during the last 12 months concerned. It will be observed that the busy seasons are indicated by the fact that the month, or months, concerned contain an abnormally high number of entries from the preceding month, such values for the 12 months being shown at the foot of the columns.

Further studies are needed to ascertain whether some arbitrary rule, such as the use of the 25th highest day, would provide a satisfactory estimate of the mean busy-hour traffic. It is also possible that further study would show that it might be desirable not to use the 25th highest day in all cases but to choose a " highest " day according to the extent to which the busy season exceeds the other periods of the year.

The schedule shows an example in which the growth has been unusually rapid, and this condition also tends to emphasise the busy season and the desirability of choosing the 15th or the 20th highest day. It is relatively easy to imagine the traffic-flow values when the busy season is less extreme. A sufficient analysis of the traffic can be provided without producing the complete information contained in the schedule.

Although the schedule shows the traffic flow for the 30 highest days in the preceding 12 months, the data sent to the analysing equipment may contain more information than that shown in the schedule as it may prove to be more economical to design the recording equipment to record all days during which the busy-hour traffic exceeds some predetermined value than to design it to ascertain, as a continuous process, which are the 30 highest days. In either case the recording equipment must measure the busy-hour traffic each day, and it is likely to be simpler to make a record of all days which exceed a predetermined value than to have to ascertain whether the value for a particular day will be needed or not.

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Recording of traffic values

	1.6.59	1.7.59	1.8.59	1.9.59	1.10.59	1.11.59	1.12.59	1.1.60	1.2.60	1.3.60	1.4.60	1.5.60	1.6.60	1.7.60
1	(20/5 54)	(9/6 55)	9/6 55	(31/8 58)	31/8 58	(26/10 72)	(23/11 75)	(16/12 78)	16/12 78	16/12 78	(17/3 79)	17/3 79	(31/5 92)	(23/6 95)
2	12/12 54	(15/6 54)	15/6 54	(24/8 57)	24/8 57)	(29/10 70)	(12/11 72)	(18/12 76)	18/12 76	18/12 76	16/12 78	16/12 78	(24/5 90)	(20/6 94)
3	15/10 54	(8/6 54)	8/6 54	9/6 55	(25/9 56)	(21/10 70)	(4/11 72)	23/11 75	23/11 75	23/11 75	18/12 76	(11/4 77)	(30/5 86)	(13/6 92
4	(28/5 53)	20/5 54	20/5 54	(17/8 54)	9/6 55	(28/10 67)	26/10 72)	(3/12 75)	3/12 75	3/12 75	23/11 75	18/12 76	(23/5 86)	31/5 92
5	17/1 53	12/12 54	12/12 54	(10/8 54)	(15/9 54)	(27/10 67)	(16/11 71)	(11/12 74)	11/12 74	11/12 74	3/12 75	23/11 75	(16/5 82)	(7/6 90)
6	18/12 53	15/10 54	15/10 54	15/6 54	(14/9 54)	(30/10 66)	(30/11 70)	(14/12 73)	14/12 73	14/12 73	11/12 74	3/12 75	(25/5 82)	24/5 90
7	17/12 53	(26/6 53)	26/6 53	8/6 54	17/8 54	(19/10 65)	29/10 70	(21/12 72)	(28/1 72)	28/1 72	14/12 73	(12/4 75)	17/3 79	(8/6 89)
8	25/11 53	28/5 53	28/5 53	20/5 54	10/8 54	(20/10 64)	21/10 70	12/11 72	(26/1 72)	26/1 72	(31/3 72)	11/12 74	(11/5 79)	(3/6 88)
9	4/11 53	17/1 53	17/1 53	12/12 54	15/6 54	(22/10 62)	(9/11 69)	4/11 72	(14/1 72)	14/1 72	28/1 72	14/12 73	(17/5 79)	(22/6 88)
10	28/10 53	18/12 53	18/12 53	15/10 54	8/6 54	(23/10 61)	(5/11 69)	26/10 72	21/12 72	21/12 72	26/1 72	31/3 72	16/12 78	(14/6 86)
11	27/10 53	17/12 53	17/12 53	(27/8 53)	20/5 54	(16/10 59)	(25/11 68)	(17/12 71)	12/11 72	12/11 72	14/1 72	28/1 72	(18/5 78)	(10/6 86)
12	(25/5 52)	25/11 53	25/11 53	(26/8 53)	12/12 54	31/8 58	(13/11 68)	(9/12 71)	4/11 72	4/11 72	21/12 72	26/1 72	(9/5 77)	30/5 86
13	(11/5 52)	4/11 53	4/11 53	26/6 53	15/10 54	24/8 57	(18/11 67	16/11 71	26/10 72	26/10 72	12/11 72	14/1 72	11/4 77	23/5 86
14	27/4 52	28/10 53	28/10 53	28/5 53	(23/9 53)	25/9 56	28/10 67	30/11 70	17/12 71	17/12 71	4/11 72	21/12 72	(18/5 76)	(9/6 84)
15	22/4 52	27/10 53	27/10 53	17/1 53	(22/9 53)	9/6 55	27/10 67	29/10 70	9/12 71	9/12 71	26/10 72	12/11 72	(20/5 76)	(21/6 84)
16	28/1 52	25/5 52	25/5 52	18/12 53	(16/9 53)	15/9 54	(26/11 66)	21/10 70	16/11 71	16/11 71	17/12 71	4/11 72	18/12 76	(1/6 83)
17	26/1 52	11/5 52	11/5 52	17/12 53	(8/9 53)	14/9 54	(20/11 66)	(18/12 69)	(12/1 70)	(15/2 70)	9/12 71	26/10 72	(12/5 75)	16/5 82
18	20/1 52	27/4 52	27/4 52	25/11 53	(2/9 53)	17/8 54	(2/11 66)	(10/12 69)	13/11 70	12/1 70	16/11 71	(4/4 71)	12/4 75	25/5 82
19	9/12 52	22/4 52	22/4 52	4/11 53	(1/9 53)	10/8 54	30/10 66	(8/12 69)	29/10 70	30/11 70	15/2 70	17/12 71	23/11 75	(15/6 81)
20	1/12 52	28/1 52	28/1 52	28/10 53	27/8 53	15/6 54	(19/11 65)	(7/12 69)	21/10 70	29/10 70	12/1 70	9/12 71	3/12 75	(17/6 81)
21	20/11 52	26/1 52	26/1 52	27/10 53	26/8 53	8/6 54	(6/11 65)	9/11 69	18/12 69	21/10 70	30/11 70	16/11 71	(10/5 74)	(29/6 79)
22	18/11 52	20/1 52	20/1 52	(21/8 52)	26/6 53	20/5 54	19/10 65	5/11 69	10/12 69	18/12 69	29/10 70	(19/4 70)	11/12 74	(2/6 79)
23	10/11 52	9/12 52	9/12 52	25/5 52	28/5 53	12/12 54	(11/11 64)	(1/12 68)	8/12 69	10/12 69	21/10 70	15/2 70	14/12 73	11/5 79
24	3/11 52	1/12 52	1/12 52	11/5 52	17/1 53	15/10 54	20/10 64	25/11 68	7/12 69	8/12 69	18/12 69	12/1 70	(13/5 72)	17/3 79
25	30/10 52	20/11 52	20/11 52	27/4 52	18/12 53	23/9 53	(3/11 63)	13/11 68	9/11 69	7/12 69	10/12 69	30/11 70	31/3 72	16/12 78
26	21/10 52	18/11 52	18/11 52	22/4 52	17/12 53	22/9 53	22/10 62	(4/12 67)	5/11 69	9/11 69	8/12 69	29/10 70	28/1 72	18/5 78
27	30/9 52	10/11 52	10/11 52	28/1 52	25/11 53	16/9 53	(27/11 61)	18/11 67	(13/1 68)	5/11 69	7/12 69	(20/4 69)	26/1 72	(28/6 77)
28	29/9 52	3/11 52	3/11 52	26/1 52	4/11 53	8/9 53	23/10 61	28/10 67	1/12 68	13/1 68	9/11 69	(13/4 69)	14/1 72	9/5 77
29	10/9 52	30/10 52	30/10 52	20/1 52	28/10 53	2/9 53	16/10 59	27/10 67	25/11 68	1/12 68	5/11 69	18/12 69	21/12 72	11/4 77
30	24/6 52	21/10 52	21/10 52	9/12 52	27/10 53	1/9 53	31/8 58	26/11 66	13/11 68	25/11 68	(29/3 69)	10/12 69	12/11 72	(27/6 76)
	4	4	0	7	9	11	18	14	5	1	3	6	15	18

Note (1). — An arbitrary value such as the 25th busiest hour during the previous 12 months can be taken as a rough estimate of the mean traffic flow. From the schedule it can be seen that on this basis the traffic flow for the 14 months is:—

52, 52, 52, 52, 53, 53, 63, 68, 69, 69, 69, 70, 72, 78 erlangs.

On this basis the growth between 1/6/59 and 1/6/60 is 20 erlangs, and between 1/7/59 and 1/7/60, 26 erlangs.

Note (2). — A safeguarding check can also be applied to establish that even in the extremely high busy hours the loss does not exceed 1 in 10, or perhaps 1 in 5. This check can be applied to the 5th highest hour:—

53, 54, 54, 54, 54, 67, 71, 74, 74, 74, 75, 75, 82, 90 erlangs.

Note (3). — Further information about the traffic flow can be obtained by examining the number of entries in brackets for each month:—

4, 4, 0, 7, 9, 11, 18, 14, 5, 1, 3, 6, 15, 18.

This series gives an indication of the busy seasons, i.e. November and May, and of the slack seasons, i.e. July and February. The difference between the two higher months (both 18 entries) and the two lower months (0 and 1 entry) gives some measure of the peakiness of the seasons.

Question 4/XIII

(New question)

What guiding principles should be followed in the preparation of a routing plan for the international network so as to achieve the most economical and reliable network structure?

Both continental and intercontinental traffic should be studied.

As an example, the description of a " systematic project " for such a plan is given below.

ANNEX

(to Question 4/XIII)

Methodical design of a routing plan for international automatic telephone traffic

For a proper flow of semi-automatic international traffic, and later on, fully-automatic too, a routing plan is required. The international exchanges would be interconnected by groups of circuits in accordance with this routing plan.

In general, the groups of circuits would not be used most economically if each international exchange was connected to all the other international exchanges, i.e., if there were to be a network of links between all the international exchanges. Small groups of circuits, in particular, can be used more efficiently if the traffic for the various international exchanges is concentrated into streams and routed through one, or perhaps two, international transit exchanges.

In devising a routing plan and making use of the transit exchanges as required, we shall naturally have to make do with the possibilities offered by, and the rules laid down in, the " Specifications " (*Red Book*, Volume VI) in connection with re-routing via an overflow route and the use to be made of transit exchanges. In addition, it would be most desirable for there to be some other restrictions too, if we wish to have a logical and methodically designed routing plan.

The following are a few ideas about such a routing plan:

1. In an international network for automatic telephone traffic there are international terminal exchanges and international transit exchanges.

2. Each terminal exchange is connected to at least one transit exchange. The terminal exchanges are not all connected to all the transit exchanges.

3. If it is desired to provide for connection of each terminal exchange to all the other terminal exchanges, the transit exchanges must be joined by a linked network.

4. The international network will then consist of at least:

— a linked network between the transit exchanges,

— star networks from each transit exchange to the terminal exchanges it serves (see figure 1).

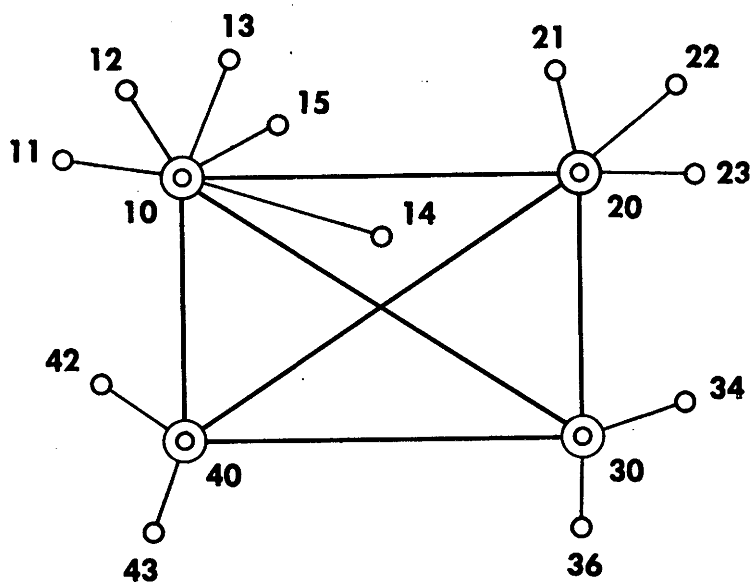


FIGURE 1

All the connections shown in Figure 1 are terminal routes having relatively low loss probabilities and are shown in this figure, and in the following ones, by full lines. The transit exchanges are shown by the numbers 10, 20, etc., and the terminal exchanges by the numbers 11, 12, 13, etc., or 21, 22, etc., according to whether they depend on transit exchanges 10 or 20, etc.

5. Besides the connections shown in Figure 1, high-preference connections will also be established, providing a direct route between two terminal exchanges or between a terminal exchange and " another " transit exchange (shown by a dotted line). Thus a full international network can be shown as follows (Figure 2).

The terminal routes must then be considered as overflow routes in relation to the high performance ones.

6. In the international network shown in Figure 2, the following routing combinations may arise, in so far as 1, 2, 3 or 4 different routes may exist between two exchanges (we merely give a few examples—see Figures 3 to 6).

In Figures 3 to 6, the numbers 1, 2, 3 and 4 indicate first, second, third and fourth choice routes.

7. The following general rules may be deduced from the routing plan shown in Figure 2:

(a) It must be possible to reach every terminal exchange from a single transit exchange by means of a terminal route.

(b) In terminal exchange, the choice of route to reach the desired destination will be limited to the following possibilities, the directions being taken successively:

1. straight to the incoming exchange;
2. straight to the transit exchange serving the incoming exchange;
3. to the transit exchange serving the outgoing terminal exchange.

(c) In a transit exchange, the following directions may be taken:

1. straight to the incoming exchange;
2. to the transit exchange serving the incoming exchange.

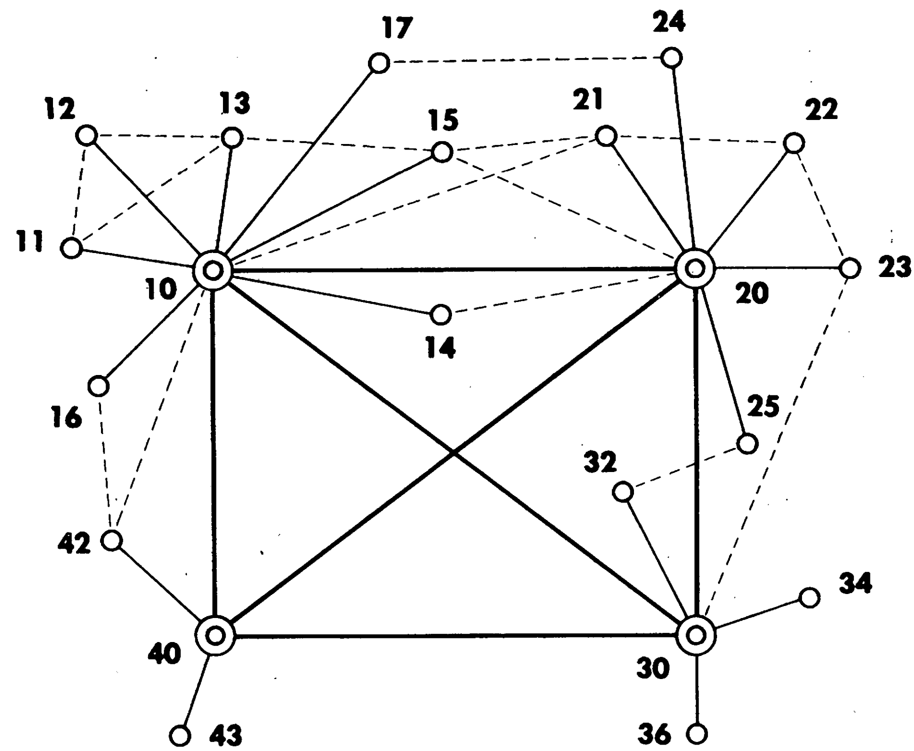


FIGURE 2

8. If a routing plan such as that described above be accepted, with the rules set out in paragraph 7 above, the following advantages will be achieved:

(a) The outgoing exchange will always know what route a call is following. This is exceedingly useful for:

1*a*. the preparation of international accounts (automatic service),

1*b*. routing indication to outgoing operator (semi-automatic service),

2. supervision of probabilities of loss on the routes,

3. tracing faults.

(b) Between two exchanges, there will always be four routes at the most. This means simplified equipment for:

1. showing the routes followed by semi-automatic calls,

2. metering the chargeable durations of fully-automatic calls, if these data are desired for each destination and for each route (preparation of international accounts).

(c) There is full protection against false routing combinations.

(d) The use of overflow routes is an essential element in the plan, and provides every opportunity of devising the best possible arrangements, in accordance with Recommendation E.93.

(Question 4/XIII)

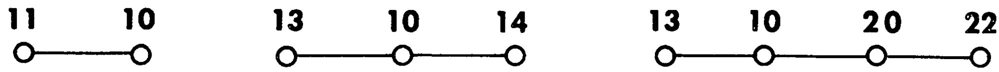
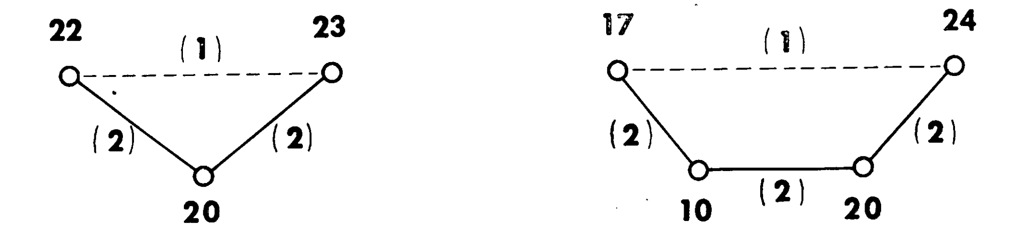
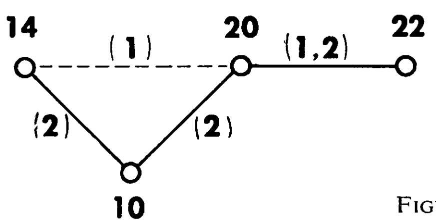


Figure 3 — 1 route





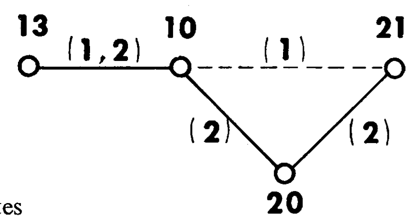


Figure 4 — 2 routes

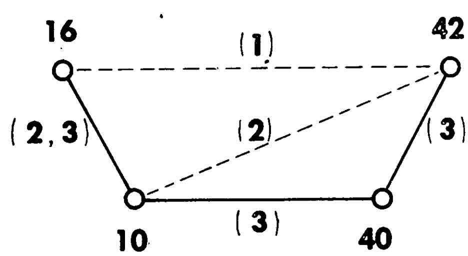


Figure 5 — 3 routes

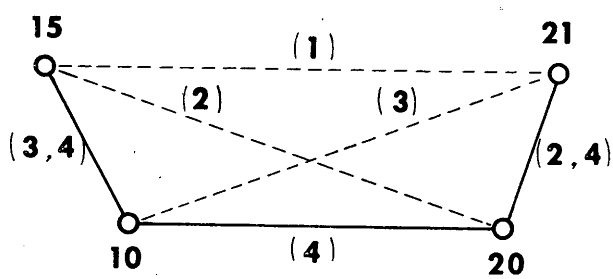


Figure 6 — 4 routes

(Question 4/XIII)

Question 5/XIII

(New question)

What routine arrangements should be adopted to ensure that Administrations receive regular advance estimates regarding the quantities of circuits and international exchange equipment required to meet future levels of traffic and methods of operation sufficiently early to ensure that plant is always ordered and installed in advance of the date when the circuits in question are required?

ANNEX 1

(to Question 5/XIII)

The routing plans for semi-automatic operation which have been prepared by Sub-Group 2/4 have enabled Administrations to plan for provision of equipment and international semi-automatic exchanges for the period 1958-62. Similarly the plans prepared by the Committee for the General Plan for the Development of the International Network have indicated the total circuit requirements of all types including manual circuits. There is however no organization which enables Administrations to determine which circuits of the various types should be provided in each year, or the quantities of equipment which must be ordered to meet future requirements. In the past it has proved sufficient to negotiate bi-lateral agreements based on the traffic recorded at both ends of manual circuits, but with the increasing numbers of unidirectional circuits for semi-automatic and fully automatic operation which will be required in future, each Administration will have to determine the numbers of outgoing circuits required and advise distant Administrations of these requirements in sufficient time to permit the ordering and installation of line plant and automatic equipment. This question will become of great importance in fully automatic relations in which it is most desirable that the provision of circuits and equipment should keep in step with increasing traffic.

National procedure followed by the United Kingdom Administration

In the United Kingdom the internal procedure is to prepare, at the beginning of each year, schedules of the estimated circuits required and the method of operation on each route in respect of the coming year, and of the two and five year periods. The first year schedule is regarded as a firm order for the provision of the circuits indicated, while the later estimates are used as a guide to the amount of line plant and exchange equipment to be ordered.

ANNEX 2

(to Question 5/XIII)

Below will be found a specimen table as advocated by the French Administration to contain data on the requirements of the international automatic and semi-automatic service.

When transit traffic routing is envisaged, the data cannot be expressed in circuit numbers, but should be given as an *amount of traffic* expressed in erlangs.

However, the specimen table as presented by the French Administration is adequate for present-day requirements since only a very small part of international traffic is routed in automatic transit. Traffic data concerning transit can easily be entered in the column headed "Observations", for instance,

— Group used for transit traffic (or overflow traffic) from ...
— Group used for transit traffic (or overflow traffic) to ...
— Overflow traffic routed by ...

Recommended specimen form

International exchange		Type of operation	Signalling system	Number of circuits in service			Observations
Outgoing	Incoming			on 1/11/60	......	......	
1	2	3	4	5	6	7	8
	Germany						
Paris	Düsseldorf . .	SA	1 F	22			
	Frankfurt . .	SA	—	18			
	Stuttgart . . .	SA	—	12			
Forbach . . .	Saarbrücken .	SA	S	5			
Nancy	Saarbrücken .	SA	S	3			
Strasbourg . .	Saarbrücken .	A	S	12			
	Belgium						
Paris	Bruxelles . . .	A	S	45			
	Bruxelles . . .	SA	1 F	20			
	Antwerpen . .	A	S	20			
Lille	Bruxelles . . .	A	S	17			
	Kortrijk . . .	A	S	13			
	Doornik . . .	A	S	8			

Question 6/XIII

(New question)

Use of manual circuits for delay calls in the international semi-automatic service.

Note. — The conclusions reached from experience during international semi-automatic operation tests (see Rec. E.21) were that all types of calls can be set up without difficulty over semi-automatic circuits, viz:

— ordinary,
— preavis,
— requiring an incoming B-operator or booking at incoming suspended-call positions,

and that it is, therefore, possible to use only semi-automatic circuits for international calls.

(Question 6/XIII)

Note. — The results of the study of Question 6/XIII should be forwarded for information to SG II.

ANNEX
(to Question 6/XIII)

In international semi-automatic operation, it is necessary to keep manual circuits in service between international exchanges for use either as reserves or for other sorts of transmission. It may be convenient to use such manual circuits for certain classes of call for which code 12 is at present used in the semi-automatic service. According to the instructions in force, code 12 is used when the outgoing exchange has difficulty in obtaining a number; code 12 enables the delay operator to be reached.

Code 12 is used in the following circumstances:

— when the called subscriber is still busy at the third attempt by the outgoing exchange to set up a call;

— when a preavis cannot be taken immediately;

— when the outgoing exchange requests confirmation of no reply;

— when a call is booked at the outgoing exchange without the telephone number being given;

— in an *avis d'appel* call, particularly when the called person has a telephone installed;

— in a collect call;

— in a general way, when it is difficult to get through to the country of destination (due to overloading, for example).

The question arises whether, in some of these cases, it would not be more practical to use manual circuits.

SUMMARY OF QUESTIONS SET FOR STUDY GROUP XIII

No.	Brief description	Observations
1/XIII	Suitability of international operating facilities for world-wide use.	Results of this study to be forwarded to SG II.
2/XIII	World-wide numbering plan.	
3/XIII	Studies of traffic statistics.	
4/XIII	Planning the automatic network.	
5/XIII	Estimates of automatic circuit requirements.	
6/XIII	Use of manual circuits for delay calls in the semi-automatic service.	Results of this study to be forwarded to SG II.

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Questions concerning the World-wide Automatic Network

entrusted to

Special Committee B

in 1961-1964

Question 1/B

What changes are necessary to existing recommendations, or what new recommendations are necessary, to provide for semi-automatic, and ultimately fully automatic, telephone operation on a world-wide basis?

Note. — Certain questions are already under study by those study groups dealing with specific aspects of this matter, notably:

Study Group XI: Questions 4/XI, 5/XI, 6/XI.

Study Group XIII: Questions 1/XIII, 2/XIII.

Study Group XVI: Question 1/XVI.

The Working Party on the maintenance of intercontinental circuits is also concerned. (See Question 14/IV of Study Group IV).

The Study Group XI and XIII questions appear in this Volume VI of the *Red Book*. Questions 1/XVI and 14/IV appear in Annexes 1 and 2 hereinafter.

ANNEX 1

(to Question 1/B)

Question 1/XVI (New transmission plan)

For manually operated international circuits, the C.C.I.T.T. at present recommends that the nominal overall loss (between the 2-wire ends) of a single circuit or of two circuits connected in tandem should be *not more* than 0.8 N or 7 db in each direction of transmission. For semi-automatic international circuits, the recommended nominal overall loss *in the present state of knowledge* is 0.8 N or 7 db in each direction of transmission, for a single circuit and for two circuits connected in tandem.

Is it desirable that these recommendations be modified, and, if so:

(a) What should be the new transmission switching plan for Europe (and perhaps other territories, N. America excluded)?

(b) What should be the transmission switching plan for a world-wide call?

(c) What rules should be applied for limiting echoes, including, where necessary, the use of echo-suppressors on long-distance calls?

Note. — In the Annex to Question 1/XVI (given in Volume III of the *Red Book*) there is a detailed description of the new transmission plan studied by SSG 1/2 in 1960. (Extracts from this Annex are also given in the Annexes to Questions 5/XI and 6/XI in this Volume VI of the *Red Book.*) For the study of Question 1/XVI the following points should be considered in particular:

1. Statistical distribution of balance return losses, from the echo standpoint, in national networks.
2. Same question as 1, but with respect to stability.
3. Variations of overall loss as a function of time (in cooperation with SG IV).
4. Statistical distribution of attenuation and phase distortion of international and intercontinental circuits.
5. Subscribers' tolerance of echoes for normal group delays.
6. Echo effects on circuits provided with echo suppressors, for very high group delay times.
7. Limitation of echo effects. Automatic insertion and removal or disablement of echo suppressors (see question 5/XI of SG XI).
8. Terminal equipment providing more than 12 channels per group.
9. Reference equivalents of national sending and receiving systems.
10. Conditions to be required for an international exchange from the transmission standpoint.
11. Problems associated with the use of TASI or similar devices.
12. Implementation of the new transmission plan. (In cooperation with SG XI; it is necessary to coordinate all the work which will be undertaken to apply the new transmission plan with studies concerning a switching plan).
13. Use of compandors.
    — effect on transmission quality.
    — limitation of number of compandors or of their effectiveness, influence on the variations of overall loss as a function of time.

ANNEX 2

(to Question 1/B)

Question 14/IV (Intercontinental maintenance)

Maintenance arrangements to be made for intercontinental automatic circuits.

Note. — Proposals by the American Telephone and Telegraph Company at the New Delhi meeting (December, 1960) are given in the following Appendix.

APPENDIX

(to Question 14/IV)

Uniform testing and maintenance methods and practices are needed to provide for effective, rapid and efficient testing and restoral of intercontinental and interregional circuits. These methods and practices should be established for both manual and automatic testing.

The following features proposed by the American Telephone and Telegraph Company should be considered:

(a) Outgoing testing equipment in the four-wire part of the circuit.

(b) Manual outgoing testing equipment arranged for:

1. Positive indication if circuit is busy (occupied).
2. Outgoing test calls.
3. Transmission loss tests.
4. Noise measurements.
5. Signalling tests.
6. Tests to incoming manual or automatic testing equipment.

(c) Automatic outgoing testing equipment arranged for:

1. Automatic outgoing test call to incoming automatic testing equipment.
2. Overall circuit transmission loss measurement to incoming automatic testing equipment.
3. Overall circuit noise test to incoming automatic noise test termination.
4. Overall circuit signalling tests to incoming automatic testing equipment.

(d) Four-wire termination for incoming test equipment.

(e) Patch-jacks, in addition to test jacks, for rapid restoration of services.

(f) Maintenance objectives for transmission loss and noise.

(g) Positive indication if the incoming test equipment is busy (occupied).

(h) Uniform signals from automatic incoming and outgoing testing equipment to ensure compatible operation.

(Question 1/B)

ALPHABETICAL INDEX TO VOLUME VI OF C.C.I.T.T. RED BOOK

PRINTED IN SWITZERLAND