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

IIIrd PLENARY ASSEMBLY

GENEVA, JUNE 1964

BLUE BOOK

VOLUME VI

Telephone signalling and switching

RECOMMENDATIONS (SERIES Q) — PART I TO PART XI
QUESTIONS (STUDY GROUPS XI, XIII AND SPECIAL B)
DOCUMENTARY PART

Published by the
INTERNATIONAL TELECOMMUNICATION UNION
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CONTENTS OF THE C.C.I.T.T. BOOKS STILL APPLICABLE FOLLOWING THE THIRD PLENARY ASSEMBLY (1964)

A. RED BOOK

Volume V — Recommendations (Series P) and Questions (Study Group XII) relative to telephone transmission performance and apparatus.

Volume V bis — Additions and amendments to Volume V following the IIIrd Plenary Assembly.

B. BLUE BOOK

Volume I — Minutes and reports of the IIIrd Plenary Assembly of the C.C.I.T.T.
— Resolutions and Opinions issued by the C.C.I.T.T.
— List of Study Groups and Working Groups for the period 1964-1968.
— Summary Table of Questions under study in 1964-1968.
— Recommendations (Series A) relative to the organization of the work of the C.C.I.T.T.
— Recommendations (Series B) and Questions (Study Group VII) relative to means of expression.

Volume II — Recommendations (Series D) and Questions (Study Group III) relative to the lease of circuits.
— Recommendations (Series E) and Questions (Study Group II) relative to telephone operation and tariffs.
— Recommendations (Series F) and Questions (Study Group I) relative to telegraph operation and tariffs.

Volume III — Recommendations (Series G, H and J) and Questions (Study Groups XV, XVI and C) relative to line transmission.

Volume IV — Recommendations (Series M and N) and Questions (Study Group IV) relative to transmission maintenance of international lines, circuits and chains of circuits.

Volume VI — Recommendations (Series Q) and Questions (Study Groups XI, XIII and B) relative to telephone signalling and switching.

Volume VII — Recommendations (Series R, S, T, U) and Questions (Study Groups VIII, IX, X and XIV) relative to telegraph technique.

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(This Recommendation also appears as Recommendation E.83 *quater* in Series E (Telephone Operation, Volume II of the *Blue Book*) of the C.C.I.T.T. Recommendations.)

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REC. Q.81 Determination of the number of circuits necessary to carry a given traffic flow in manual operation.
(This Recommendation dates from the XIIIth Plenary Assembly of the C.C.I.F. (London, 1946) and has not been revised in substance since.)
(This Recommendation also appears as Recommendation E.91 in Series E (Telephone Operation, Volume II of the *Blue Book*) of the C.C.I.T.T. Recommendations.)

REC. Q.82 Determination of the number of circuits necessary to carry a given traffic flow in semi-automatic operation.
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CORRESPONDENCE BETWEEN *RED BOOK* RECOMMENDATIONS, VOLUME VI AND *BLUE BOOK* RECOMMENDATIONS, VOLUME VI

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Q. 2	Q. 2	Q.56	Q.106
Q. 5	Q. 5	Q.57	Q.107
Q. 6	Q. 6	Q.58	Q.108
Q. 7	Q. 7	Q.60	Q.120
Q.10	Q. 10	Q.62	Q.112
Q.11	Q. 11		Q.113
Q.15	Q. 15		Q.114
Q.16	Q. 16	Q.65	Q.125
Q.20	Q. 20	Q.66	Q.127
Q.21	Q. 21	Q.67	Q.128
Q.22	Q. 22	Q.68	Q.109
Q.25 (a part)	Q. 25	Q.69 (a part)	Q. 25
Q.26	Q. 26	Q.70	Q.129
Q.27	Q. 27	Q.81	Q.122
Q.28	Q. 28	Q.82	Q.123
Q.29	Q. 30	Q.83	Q.124
Q.30	Q. 29	Q.84	Q.121
Q.31	Q. 35	Q.86	Q.116
Q.35	Q. 50	Q.87	Q.117
Q.36	Q. 51	Q.88	Q.118
Q.37	Q. 52	Q.89	Q.131
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Q.43	Q. 72		Q. 75
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Q.52	Q.102		Q.136
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Q.54	Q.104	Q.95	Q.138

INTRODUCTION

1. The Recommendations in Volume VI of the *Blue Book* are in agreement with Series E of the C.C.I.T.T. Recommendations (Volume II of the *Blue Book*) and with the provisions of the *Instructions for the International Telephone Service* and of the *Instructions for the Intercontinental 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 *Blue 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, the term " Administration " has been adopted as a short form indicating a telephone Administration or, equally, a private telecommunications Agency.

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±2%, interrupted at a frequency of 20 c/s±2%, was provisionally chosen for manually-operated international circuits.

500 c/s was chosen as the frequency to be transmitted, under normal conditions, by carrier terminal equipment and line repeaters. To avoid false operation due to speech currents, it was also considered desirable to interrupt the 500-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; it must not exceed 2.5 microwatthours or 9000 microwattseconds at a zero relative level point. A reasonable value for the number of calls, or attempted calls, on a circuit during the busy hour was assumed and 2 seconds was assumed to be the sending duration of the signalling current to line by operation of the operator's ringing key.

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

Since, in general, the *Instructions for the International Telephone Service* (Article 28) and the *Instructions for the Intercontinental Telephone Service* (Article 29) require the signalling current sent over an international circuit to have a duration of at least 2 seconds to avoid the risk of signals being undetected at the incoming end, the means for limiting the sending duration of the signalling current will generally consist of an arrangement which controls the sending duration independently of the time the ringing key is operated and which automatically fixes that duration at 2 seconds.

Note. — In the case of short 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 ±2% interrupted at a frequency of 20 c/s±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:

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

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 level 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 ±2% and at an interrupting frequency of 20 c/s guaranteed to within ±2%.

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

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

Insertion loss. — The insertion loss introduced by the signal receiver in the circuit with which the signalling set is associated must be less than 0.3 decibel or 0.035 neper for any frequency effectively transmitted by the circuit.

CHAPTER II

RECOMMENDATION Q.2

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

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

The signal receivers must therefore conform with the Specifications for C.C.I.T.T. systems No. 3, No. 4 or No. 5.

Sending of signals

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

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

Reception of signals

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

- either an integral part of the signal receivers, or
- placed at the end of the circuit after the signal receiver.

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

- the minimum duration of 100 ms has been chosen so as to avoid the recognition of false signals due to imitation by speech currents;
- the maximum duration of 1200 ms has been chosen so as to permit the partial use of old 500/20-c/s signal-receiver equipment.

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

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

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PART II

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

RECOMMENDATION Q.5 *

ADVANTAGES OF SEMI-AUTOMATIC WORKING IN THE INTERNATIONAL TELEPHONE SERVICE

(Geneva, 1954)

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

DRAWS THE ATTENTION OF ADMINISTRATIONS

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

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

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 as well 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 accomplished 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 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 and Geneva, 1964)

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

CONSIDERING

1. that standardization of the signalling systems to be used for international automatic and semi-automatic working is necessary to keep to a minimum the number of different types of equipment serving the various routes at any one exchange;

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

2. that three systems are standard for international automatic and semi-automatic working, i.e.:

- System No. 3 (standardized by the C.C.I.F. in 1954, formerly called "one-frequency system"),
- System No. 4 (standardized by the C.C.I.F. in 1954, formerly called "two-frequency system"),
- System No. 5 (standardized by the C.C.I.T.T. in 1964);

3. that field trials conducted with public traffic in 1953 and 1954 with systems No. 3 and No. 4 and in 1963 and 1964 with system No. 5, all with semi-automatic working, indicated that these systems were satisfactory for international semi-automatic working;

4. that comprehensive discussions on the operational aspects of these systems have indicated that, under the conditions and subject to the reservations stated below, these systems may be expected to give acceptable results for international automatic working;

DESIRING

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

UNANIMOUSLY RECOMMENDS

that, in the conditions and subject to the reservations stated below, Administrations should use, for international automatic and semi-automatic working, one or more of the standard systems No. 3, No. 4 and No. 5, mentioned in section 2 above.

B. Characteristics and field of application of the C.C.I.T.T. standard systems

SYSTEM NO. 3 *

Fully described and specified in Part 5 of Volume VI of the *Red Book* (New Delhi, 1960).

Standardized in 1954 by the C.C.I.F. and based on the principles described in Annex 1 to Part 5, Volume VI of the *Red Book*.

Suitable for one-way operation of the circuits.

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

Applicable for semi-automatic and automatic working.

Used for terminal traffic on the European continent.

In general not to be used for new relations.

SYSTEM NO. 4

Fully described and specified in Part IX of Volume VI of the *Blue Book* (Geneva, 1964).

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* See also Part VIII of Volume VI of the *Blue Book*.

Standardized in 1954 by the C.C.I.F. and based on the principles described in Annex 1 to Part 5, Volume VI of the *Red Book*.

Suitable for one-way operation of the circuits.

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

Applicable for semi-automatic and automatic working.

Initially used for international traffic on the European continent.

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

Suitable for submarine or land cable circuits and microwave radio circuits. Not applicable for TASI-equipped systems.

Capable of interworking with system No. 5 in the combinations: No. 4—No. 5 and No. 5—No. 4.

SYSTEM No. 5

Fully described and specified in Part X of Volume VI of the *Blue Book* (Geneva, 1964).

Standardized in 1964 by the C.C.I.T.T. and based on the principles described in the Introduction to Part X of the *Blue Book*, Volume VI.

Suitable for both-way operation of the circuits.

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

Applicable for semi-automatic and automatic working.

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

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

Suitable for submarine or land cable circuits and microwave radio circuits, whether TASI is used or not.

Capable of interworking with system No. 4 in the combinations: No. 4—No. 5 and No. 5—No. 4.

Remark. — When, with automatic working, two or more international circuits equipped with this system are switched in tandem, there is a small probability that the called subscriber will release prematurely because the conditions for effective conversation have not been established quickly enough. The C.C.I.T.T. prefers to reserve its recommendation in the matter of automatic operation over several circuits switched in tandem and equipped with system No. 5.

C. Notes

Note 1. — The signalling systems standardized by the C.C.I.T.T. are designated by serial numbers as follows:

No. 1:	is assigned to the 500/20-c/s signalling system used in the international manual service (see Recommendation Q.1);
No. 2:	is assigned to the 600/750-c/s signalling system recommended by the C.C.I.F. in 1938 (Volume I *ter* of the *White Book*, Oslo, 1938) for international service on two-wire semi-automatic circuits but which was never used in international service;
No. 3, No. 4 and No. 5:	are assigned to the three systems recommended for semi-automatic and automatic working;
No. 6:	has been assigned tentatively to a proposed signalling system; see Note 4.

Note 2. — The application of systems No. 3, No. 4 and No. 5 in the international network is shown on the maps published in Supplement No. 6 in the Documentary Part of Volume VI of the *Blue Book* (Geneva, 1964).

Note 3. — Throughout the North American continent another signalling system is used for international automatic and semi-automatic working. This system was not studied by the C.C.I.T.T. and is therefore not designated by a standard C.C.I.T.T. serial number. A description of this system has been published as a matter of information in Supplement No. 7 in the Documentary Part of Volume VI of the *Blue Book* (Geneva, 1964).

Note 4. — In 1964, the C.C.I.T.T. decided to undertake the study of a new system to which the serial No. 6 has been assigned. This system is expected to be free from some limitations of systems No. 3, No. 4 and No. 5 and to make possible extended facilities. Practical application of system No. 6, however, is not likely before 1970.

CHAPTER II

Numbering plan for international working

RECOMMENDATION Q.10

DEFINITIONS RELATING TO NATIONAL AND INTERNATIONAL NUMBERING PLANS

1. International prefix

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

Examples:

00	in Switzerland
91	in Belgium

Notes:

a) In some countries two or more international prefixes may be used:
- to reach different groups of countries;
- to obtain different classes of call (e.g. station-to-station call or personal call).

In the first case the use of two or more international prefixes allows the use of different groups of switching equipment and the use of "abbreviated" dialling (i.e. shorter country codes) for the calls to a defined group of countries (see definition No. 2. Country code).

b) Where several countries are included in one integrated numbering plan, the international prefix is not used on a call from one of these countries to another.

2. Country code

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

Examples:

7	U.S.S.R.
54	Argentina
591	Bolivia

Notes:

a) In the case where a country uses different international prefixes abbreviated dialling can be used. In this case, for calls to one country of a defined group of countries, a regional country code, composed of fewer digits than the normal country code, may be used.

Examples:

For traffic between Latin American countries, the following regional country codes might be used:

1	Argentina
2	Brazil
3	Chile
	etc.

b) In the case where several countries are included in one integrated numbering plan, no country code need be dialled for the traffic from one of these countries to another. For access by other countries, these countries:

— may be included under one common country code, or

— may have separate country codes,

always keeping in mind the necessity to avoid exceeding the recommended maximum number of digits in the international number.

3. Trunk prefix

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

Examples:

0	in Belgium, Italy, Japan, Netherlands, Switzerland, United Kingdom
1 and 0	in Canada and in the U.S.A.
9	in Finland and Spain
16	in France

Note. — In the case where several countries are included in one integrated numbering plan, the trunk prefix is also used for calls from one of these countries to another.

4. Trunk code

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

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

The trunk code varies from one country to another and is composed of:

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

Example:

In France:

Paris area (Departments of Seine, Seine-et-Oise, Seine-et-Marne, Oise): trunk code 1
Nice area (Department of Alpes-Maritimes): trunk code 93

In Belgium:

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

In the Federal German Republic and the Netherlands:

the geographical area defined above corresponds in general to the local network.

Düsseldorf local network: trunk code 211
Amsterdam local network: trunk code 20

In the United Kingdom:

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

In Canada and the U.S.A.:

The geographical area defined above corresponds to a " Numbering Plan Area " (NPA)

Montreal area: NPA code: 514
New York City area: NPA code 212

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

Example:

in certain areas of the United Kingdom:

Truro (group centre):	trunk code TR2
Perranporth (in the Truro group):	trunk code TR257

5. Subscriber number *

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

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

6. National (significant) number

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

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

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

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* Care should be taken not to use the term "local number" instead of "subscriber number".

Examples:

Subscriber	National (significant) number	
12 34 56 in Brussels	2	12 34 56
12 34 56 in Düsseldorf	211	12 34 56
21 34 56 in Nice	93	21 34 56
870 12 34 in Montreal	514	870 12 34
12 34 in Perranporth	TR257	12 34
CIT 45 67 in London	1	CIT 45 67

Note. — Where several countries are included in one integrated numbering plan, only the national (significant) number is to be dialled after the trunk prefix on calls from one of these countries to another.

7. International number

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

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

Examples:

Subscriber	International number		
12 34 56 in Brussels	32	2	12 34 56
12 34 56 in Düsseldorf	49	211	12 34 56
21 34 56 in Nice	33	93	21 34 56
870 12 34 in Montreal	1	514	870 12 34
12 34 in Perranporth	44	87	257 12 34
CIT 45 67 in London	44	1	248 45 67

Note. — Where several countries are included in one integrated numbering plan, the international number is not used on calls from one of these countries to another. (See the note to definition No. 6.)

RECOMMENDATION Q.11 *

NUMBERING FOR INTERNATIONAL WORKING

1. National numbering plan

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

1.2 *Number analysis*

1.2.1 The national numbering plan of a country should be such that an analysis of a minimum number of digits of the national (significant) number ***

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

** See the C.C.I.T.T. Manual on national telephone networks for the automatic service for a comprehensive study of national numbering plans from the national point of view.

*** See definitions in Recommendation Q.10.

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

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

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

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

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

1.2.4 For the requirements relating to frontier traffic see Recommendation Q.50, paragraph 3.

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

2.1 *International number*

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

2.2 *National (significant) number*

Noting that:

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

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

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

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

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

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

3. Digit capacity of international registers

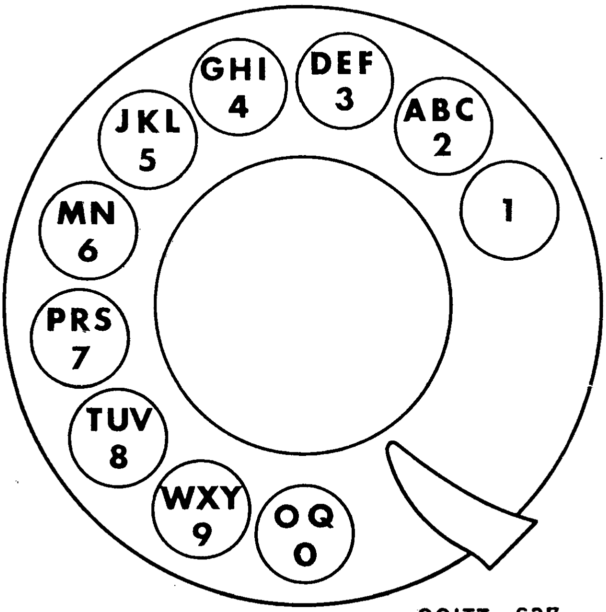
The C.C.I.T.T. considers it advisable to recommend that the digit capacity of registers dealing with international traffic should allow for future conditions that may arise, but not possible to specify at the present time. In this regard, registers dealing with international traffic should have a digit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

4. Use of figures and letters on dials

4.1 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.

4.2 For automatic international service, it is preferable that the national numbering plan 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 numbering plans may, however, be necessary for national reasons. For example, countries using letters in their subscriber numbers will naturally use them in their national numbering.

4.3 The dial shown below uses the arrangement of letters and figures employed by some European Administrations. It may be convenient that the dials or key-sets *used by international operators for semi-automatic working in Europe* have this arrangement of letters and figures.



CCITT - 637

FIGURE 1

4.4 For 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 an automatic service is available;

b) to supply at the time of opening this 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.

4.5 It would also be desirable, in countries with letter dials, that subscribers with considerable international traffic should be asked to show on their letter-heads, next to their telephone number, the international number with figures only. (See general recommendation for letter-heads in 5.3.2.)

5. Prefixes and codes

5.1 *International prefix* *

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

5.2 *Country code* *

5.2.1 Country codes will be used:

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

5.2.2 A list of country codes was prepared by the C.C.I.T.T. in 1964 within the framework of a world-wide automatic telephone numbering plan.

This list was set up according to the following principles:

a) the number of digits of the country code is one, two or three according to the foreseeable telephonic and demographic development of the country concerned;

b) the nine digits from 1 to 9 have been allocated as the country code or as the first digit of the country code. These digits define *world numbering zones;*

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* See definitions in Recommendation Q.10.

c) in the case of Europe, owing to the large number of countries requiring two-digit codes, the two digits 3 and 4 have been allocated as the first digit of the country codes.

5.2.3 The list of country codes * is given at the end of this Recommendation.

5.3 *Trunk prefix* **

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

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

5.3.2 The C.C.I.T.T. recommends that Administrations ask those subscribers likely to receive an appreciable amount of international traffic to indicate on their letter-heads, next to their telephone number as dialled in the national service, a second number for the international service in which:

— the trunk prefix does not appear;

— the letters are converted into digits;

— the national (significant) number is preceded by the country code.

Example:

For a subscriber in London whose subscriber number is MOUntview 1234

national number:	0	1	MOU	1234
international number:	44	1	608	1234

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* According to a decision of the IIIrd Plenary Assembly:

a) The International Numbering Plan (i.e. the list of country codes) mentions only codes for countries within the jurisdiction of Members and Associate Members of the Union and the names of those countries should be as they appear in the International Telecommunication Convention.

b) Some changes will have to be made therein and within its general framework at a later C.C.I.T.T. Plenary Assembly further to document AP III/89 (Hungarian People's Republic) and further to other requests made *viva voce* in the third plenary meeting.

The Plenary Assembly asked the World Plan Committee and its Regional Committees to study in 1964-1968 what changes might be made in the Numbering Plan to meet the requests submitted without infringing the decisions taken by the IIIrd Plenary Assembly.

** See definitions in Recommendation Q.10.

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

The reasons for this recommendation are:

— to provide the maximum degree of standardization of the trunk prefixes used in different countries, so that dialling is made as easy as possible for a person travelling in different countries, and

— to minimize the number of digits to be dialled in the national automatic service.

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

LIST OF COUNTRY CODES FOR THE INTERNATIONAL SEMI-AUTOMATIC AND AUTOMATIC SERVICE

Foreword

In accordance with the decision reached by the IIIrd Plenary Assembly of the C.C.I.T.T. (Geneva, 1964), the international telephone numbering plan should mention only the codes of countries within the jurisdiction of the Members and Associate Members of the International Telecommunication Union, and the names of those countries should be as they appear in the International Telecommunication Convention.

In the list hereunder, the countries in each world numbering zone are not arranged in alphabetical order but in the numerical order of their codes, those with two-digit codes preceding those with three-digit codes.

Each " territory " which has been given a country code, but the telecommunications of which come under the international jurisdiction of another State, is listed:

— either immediately after that State when it is in the same numbering zone,

— or at the end of the code list in the relevant numbering zone when the State responsible for its telecommunications is included in a different numbering zone.

Numbering zone 1 is an integrated numbering area covering the North-American continent, and the countries in it are listed in geographical order from North to South, beginning with Canada.

" Territories " the telecommunications of which come under the jurisdiction of other States are listed in the different numbering zones in the order and with the official names used in the " List of countries, territories and groups of territories Members or Associate Members of the International Telecommunication Union ", published by the I.T.U. General Secretariat, i.e. in the following order: Group of Territories represented by the French Overseas Post and Telecommunication Agency (No. 35 in the List), Kingdom of the Netherlands (No. 87), Portuguese Oversea Provinces (No. 93), Territories of the United States of America (No. 113), and Overseas Territories for the international relations of which the Government of the United Kingdom of Great Britain and Northern Ireland are responsible (No. 114).

List of country codes for the international semi-automatic and automatic service

World numbering Zone 1

(Integrated numbering plan)

Canada
United States of America
Mexico
Jamaica
Costa Rica
El Salvador (Republic of)
Guatemala
Honduras (Republic of)
Nicaragua
Panama

Puerto Rico, The Virgin Islands
  (Territories of the United States of America)
French Antilles
  (France)
Netherlands Antilles
  (Kingdom of the Netherlands)
Bermuda, Bahamas, British Honduras
  (Overseas Territories for the international relations of which the Government of the United Kingdom of Great Britain and Northern Ireland are responsible)

World numbering Zone 2

20	United Arab Republic	
21	Maghreb (integrated numbering plan)	Algeria (Democratic and Popular Republic of) Morocco (Kingdom of) Tunisia Libya (Kingdom of)
27	Republic of South Africa, and 264 Territory of South-West Africa	
221	Senegal	
222	Mauritania (Islamic Republic of)	
223	Mali (Republic of)	
224	Guinea (Republic of)	
225	Ivory Coast (Republic of the)	
226	Upper Volta (Republic of)	
227	Niger (Republic of the)	
228	Togolese Republic	
229	Dahomey (Republic of)	
231	Liberia (Republic of)	

232	Sierra Leone
233	Ghana
234	Nigeria (Federation of)
235	Chad (Republic of the)
236	Central African Republic
237	Cameroon (Federal Republic of)
241	Gabon (Republic)
242	Congo (Republic of the) (Brazzaville)
243	Congo (Republic of the) (Leopoldville)
249	Sudan (Republic of the)
250	Rwanda (Republic)
251	Ethiopia
252	Somali Republic
254	Kenya
255	Tanzania (United Republic of)
256	Uganda
257	Burundi (Kingdom of)
260	Northern Rhodesia
261	Malagasy Republic
263	Southern Rhodesia
265	Malawi

253	French Somaliland (1)
262	Reunion (France)
269	Comores (1)
238	Cape Verde Islands (3)
239	St. Thomas and Prince (3)
244	Angola (3)
245	Portuguese Guinea (3)
258	Mozambique (3)
220	Gambia (5)
266	Basutoland (5)
267	Bechuanaland (5)
268	Swaziland (5)

Spare codes: 28, 29, 230, 240, 246, 247, 248, 259

World numbering Zones 3 and 4

30 *	Greece
31	Netherlands (Kingdom of the)
32	Belgium
33 *	France
34	Spain
36 *	Turkey

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(1) Group of Territories represented by the French Overseas Post and Telecommunication Agency.

(3) Portuguese Oversea Provinces.

(5) Overseas Territories for the international relations of which the Government of the United Kingdom of Great Britain and Northern Ireland are responsible.

* Same as C.C.I.T.T. Volume VI of the *Red Book* allocation.

38	Federal Socialist Republic of Yugoslavia
39 *	Italy
41	Switzerland (Confederation)
42	Czechoslovak Socialist Republic
43	Austria
44 *	United Kingdom of Great Britain and Northern Ireland
45	Denmark
46 *	Sweden
47	Norway
48	Poland (People's Republic of)
49 *	Federal Republic of Germany
351	Portugal
352	Luxembourg
353	Ireland
354	Iceland
356	Malta
357	Cyprus (Republic of)
401	Finland
402	Hungarian People's Republic
403	Bulgaria (People's Republic of)
404	Roumanian People's Republic
405	Albania (People's Republic of)

350	Gibraltar (5)

Spare codes: 37, 355, 358, 359, 400, 406, 407, 408, 409

World numbering Zone 5

53	Cuba
54	Argentine Republic
55	Brazil
56	Chile
57	Colombia (Republic of)
58	Venezuela (Republic of)
591	Bolivia
593	Ecuador
595	Paraguay
596	Peru
598	Uruguay

594	French Guiana (France)
597	Surinam (Kingdom of the Netherlands)
592	British Guiana (5)

Spare codes: 50, 51, 52, 590, 599

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* Same as C.C.I.T.T. Volume VI of the *Red Book* allocation.

(5) Overseas Territories for the international relations of which the Government of the United Kingdom of Great Britain and Northern Ireland are responsible.

World numbering Zone 6

60	Malaysia
61	Australia (Commonwealth of), and
	675 Papua New Guinea
62	Indonesia (Republic of)
63	Philippines (Republic of the)
64	New Zealand, and
	685 Cook Isles
	688 Niue
66	Thailand
683	Western Samoa

678	New Hebrides (1)
687	New Caledonia (1)
689	French Polynesia (1)
672	Portuguese Timor (3)
682	Guam (4)
684	American Samoa (4)
676	Tonga (5)
677	British Solomon Isles (5)
679	Fiji Isles (5)

Spare codes: 65, 69, 670, 671, 673, 674, 680, 681, 686

World numbering Zone 7

7	U.S.S.R.

World numbering Zone 8

81	Japan
82	Korea (Republic of)
84	Viet-Nam (Republic of)
86	China
855	Cambodia
856	Laos

853	Macao (3)
852	Hongkong (5)

Spare codes: 80, 83, 87, 88, 89, 850, 851, 854, 857, 858, 859

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(1) Group of Territories represented by the French Overseas Post and Telecommunication Agency.

(3) Portuguese Oversea Provinces.

(4) Territories of the United States of America.

(5) Overseas Territories for the international relations of which the Government of the United Kingdom of Great Britain and Northern Ireland are responsible.

World numbering Zone 9

91	India (Republic of)
92	Pakistan
93	Afghanistan
94	Ceylon
95	Burma (Union of)
98	Iran
961	Lebanon
962	Jordan (Hashemite Kingdom of)
963	Syrian Arab Republic
964	Iraq (Republic of)
965	Kuwait (State of)
966	Saudi Arabia (Kingdom of)
967	Yemen
972	Israel
977	Nepal

969	Aden (5)
975	Hadramaut (5)

Spare codes: 90, 99, 960, 968, 970, 971, 973, 974, 976, 978, 979

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(5) Overseas Territories for the international relations of which the Government of the United Kingdom of Great Britain and Northern Ireland are responsible.

CHAPTER III

Routing plan for international working

RECOMMENDATION Q.12

OVERFLOW — ALTERNATIVE ROUTING — REROUTING AUTOMATIC REPEAT ATTEMPT

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

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

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

4. When congestion occurs at a transit exchange, arrangements can be made at the outgoing international exchange on receipt of a busy-flash signal sent by the transit exchange to reroute the call automatically from the outgoing international exchange over another route. This process is called *rerouting*.

It should be noted that rerouting serves no purpose when congestion conditions exist at the incoming exchange. In the same way, a call must not overflow from a direct route used exclusively for terminal traffic to an alternative transit route if the busy-flash signal has been received on the direct route.

5. Although the use of rerouting is not envisaged in the world routing plan, the specification of system No. 4 does not prohibit the inclusion of the facility.

Note. — In system No. 4, in order to avoid rerouting in the case of congestion on the national network of the incoming country, a call switched via a transit centre shall not be rerouted if a busy-flash signal is received by the outgoing register after the receipt of a terminal proceed-to-send signal.

6. Rerouting cannot be applied in signalling system No. 5.

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

An automatic repeat attempt may take place

— on the same circuit, or

— on another circuit of the same group of circuits, or

— on a circuit in another group of circuits.

RECOMMENDATION Q.13 *

INTERNATIONAL ROUTING PLAN

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

1.1 *Aim of the Plan*

The aim of the Plan is to obtain satisfactory connection between any two stations in the world with an adequate grade of service and quality of transmission.

1.2 *Main reason for the Plan*

The Plan should achieve maximum over-all economy by the most efficient use of long and costly circuits.

1.3 *Field of application of the Plan*

The Plan should be able to evolve as a function of traffic streams, the establishment of new routes and new international transit centres. It has thus been established independently of the numbering plan and the rules for charging the calling subscriber and the apportionment of charges.

There is therefore no need to anticipate its application by trying to determine far in advance how it will apply on a route where semi-automatic or automatic operation is not foreseen for a period of about 5 years.

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* This Recommendation also appears as Recommendation E.15 in Series E (Telephone operation, Volume II of the *Blue Book*) of the C.C.I.T.T. Recommendations.

2. Structure of the network

2.1 *Number of circuits in tandem* (see Recommendation Q.40)

For reasons of transmission quality and the efficient operation of signalling, it is desirable to limit as much as possible the number of circuits connected in tandem.

The apportionment between national and international circuits in such a chain may vary.

The maximum number of circuits to be used for an international call is fixed by the C.C.I.T.T. at 12 with up to a maximum of 6 of the circuits being international.

In exceptional cases and for a low number of calls, the total number of circuits may be 14, but even in this case the maximum number of international circuits is 6.

2.2 *Transit centres*

There are three categories of transit centres, called CT1, CT2 and CT3. Each of these centres can connect international circuits to its national network. The CT1's and CT2's may interconnect international circuits (and act as "international transit exchange" as defined in the definition 17.13 of the C.C.I.T.T. *List of Definitions)*. Each CT normally serves its own zone.

2.2.1 The CT1's are connected together two by two by low loss probability circuit groups. However, in exceptional cases where a significant economy may be made and provided that transmission and other quality of service standards are maintained, two CT1's may be interconnected through an intermediate transit centre of unspecified order (hereinafter called CTX). The intermediate centre then acts as a CT1 for this traffic and must be connected to the other two CT1's by low loss probability circuit groups, provided for final route grade of service.

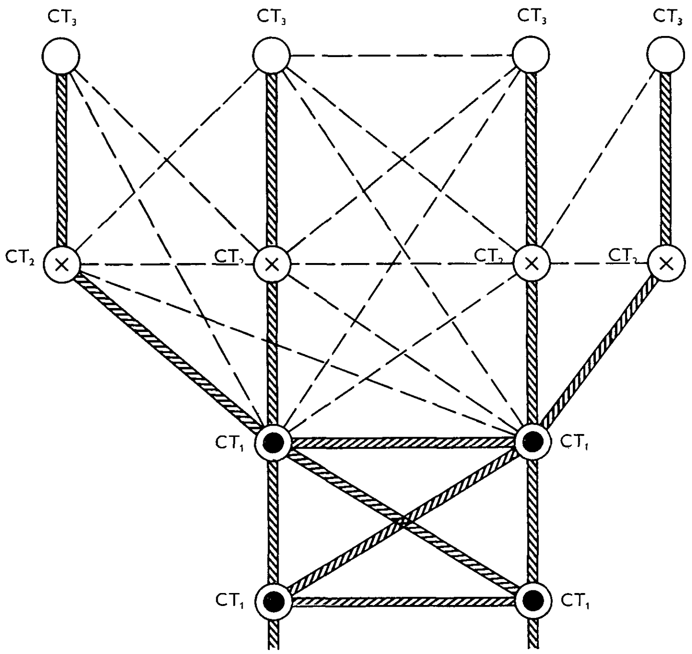
Each CT1 is connected by low loss probability circuit groups to all the CT2's in its zone. The final route for incoming traffic in the zone of a CT1 passes, in principle, through this CT1.

2.2.2 Each CT2 is connected by low loss probability circuit groups to its homing CT1 and to all the CT3's in its zone. The final route for incoming traffic to one of these CT3's passes, in principle, through the homing CT2.

2.2.3 In a very large country, the zone of a CT2 may be restricted to its own country. Certain very large countries may have several CT2's to cover their territory.

2.2.4 As a general rule, the zone of a CT3 is restricted to its own country.

2.2.5 The world telephone network will have the structural plan shown in Figure 2.



▨ Final route with low loss probability

– – – – High-usage route (direct or transverse route)

◉ CT1—First category transit exchange

⊗ CT2—Second category transit exchange

○ CT3—Third category transit exchange

FIGURE 2

3. Routing principles

The division into zones of various classes *is to be considered only for incoming traffic and for the theoretical final route.*

3.1 For outgoing traffic, the country of origin governs its routing.

3.2 A country may also consider it useful to alter its routing of outgoing traffic according to the time of day or period of the year.

3.3 The agreement of the country situated at the end of the circuit groups concerned should always be obtained in the cases referred to in paragraphs 3.1 and 3.2.

3.4 The traffic between two countries can be routed either by direct groups between these countries or through transit centres.

To obtain a good loading of the long and costly circuits a substantial fraction of the international traffic may be allowed to overflow from a direct circuit group called a high-usage group.

At the same time, for good service the overflow traffic must be capable of being routed over a series of low loss probability circuit groups, called the final route.

The routing plan specifies the rules to be followed for routing traffic between two countries which are not connected by a low loss probability circuit group.

3.5 From a CT, the various groups for routing a call are used in the following order:

a) high-usage direct route, if it exists;

b) high-usage transverse routes which by-pass a part of the final route. The order of selection of the routes begins with those that end up at the transit centres nearest to the terminal incoming centre ("far-to-near sequence");

c) as a last choice, the final route (final groups in tandem) passing through the parent transit centres of increasing category of the outgoing zone and then of decreasing category of the incoming zone:

CT3 → CT2 → CT1 → CTX → CT1 → CT2 → CT3

(This arrangement illustrates the maximum of six international circuits quoted in 2.1.)

However, at the outgoing end a route which is not the theoretical final route can be set up with a low loss probability such that no overflow has to be provided to another route and, in particular, to the theoretical final route (this latter being by-passed, as it were).

3.6 A CT1 must be provided with a direct group of circuits of low loss probability to each dependent CT2, and to every other CT1 (subject to the exception permissible under paragraph 2.2.1 above). A CT2 must similarly be provided with a direct group of circuits of low loss probability to each dependent CT3 as well as to its homing CT1. These circuit groups form the final routes which are an essential basis of the Plan for carrying overflow traffic and without which the CT's could not fulfil their proper function.

3.7 *a)* As a general rule, a direct high-usage route is used for traffic to the zone of the CT where this route ends.

b) Nevertheless, the same route can be used as a transverse route for traffic to another zone of the same order, on condition that the route between the second and third CT's is of low loss probability.

c) In the case of a direct route between a CT3 and its CT1, this route can be used as a transverse route to reach any centre connected to this CT1, even if the group of circuits connecting the CT1 to the latter centre is not established with a low loss probability.

3.8 The establishment of the routing plan was based on the desire for maximum over-all economy. Its basic principle is the passage of part of the traffic as overflow through transit centres.

CHAPTER IV

General recommendations relative to signalling and switching systems (national or international)

A. Power limits of signals of a signalling system

RECOMMENDATION Q.15 *

NOMINAL MEAN POWER DURING THE BUSY HOUR

To simplify calculations when designing 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 plus signalling currents, etc., transmitted over a telephone channel in one direction of transmission during the busy hour.

The value adopted for this mean absolute *power* level corrected to a zero relative level point is –15 dbm0 (–1.73 Nm0) (mean power = 31.6 microwatts); this is the mean with time and the mean for a large batch of circuits.

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.

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

36 000 microwattseconds for one direction of transmission;
72 000 microwattseconds for both directions of transmission.

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* This Recommendation also appears as Recommendation G.223 in Series G (Line transmission, Volume III of the *Blue Book*) of the C.C.I.T.T. Recommendations.

** See Supplement No. 1 in the Documentary Part for a calculation of the energy transmitted for the national tones.

Note 1. — It is assumed that few of the telephone channels of the system concerned will be used for voice-frequency telegraphy or for phototelegraphy; under these conditions, the power of the telegraph signals can be distributed over the whole of the telephone channels without changing the nominal mean power of 22 microwatts. A system designed on this basis and having a capacity of about 1000 telephone channels would carry some 300 or 400 telegraph channels without difficulty.

Note 2. — No account is taken 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. For carrier systems now in service, the pilot power can be treated as negligible.

Note 3. — The nominal mean power of 22 microwatts takes account of a mean activity factor of 0.25 for a telephone channel (for one direction of transmission).

RECOMMENDATION Q.16 *

MAXIMUM PERMISSIBLE VALUE FOR THE ABSOLUTE POWER LEVEL 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	
		Decibels referred to 1 mW	Decinepers referred to 1 mW
800	750	—1	—1.1
1200	500	—3	—3.5
1600	400	—4	—4.5
2000	300	—5	—5.7
2400	250	—6	—7.0
2800	150	—8	—9.0
3200	150	—8	—9.0

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 3.5 decinepers) below the above figures.

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

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* This Recommendation also appears as Recommendation G.224 in Series G (Line transmission, Volume III of the *Blue Book*) of the C.C.I.T.T. Recommendations.

B. Signalling in the speech frequency band and outside the speech frequency band

RECOMMENDATION Q.20

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

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

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

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

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

A. *Advantages of in-band signalling*

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

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

3. 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 than with a smaller signalling bandwidth. With in-band signalling, realization of this advantage is limited to those signals not required to be protected against signal imitation due to speech currents. 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 advantages (3) and (6) of in-band signalling.

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

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

a) No direct current repetition is necessary, and no distortion of signals arises, at carrier system terminals when a telephone circuit comprises two or more carrier links.

b) 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—systems No. 3 and No. 4 between 1946 and 1949, and system No. 5 between 1960 and 1964—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 −3 dbm0 (−0.3 Nm0).

Type II

A. (discontinuous signals)
Frequency: 3825 c/s
Level: high,
for example −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 II_A *and* II_B are compatible with only those group and supergroup reference pilots having a displacement from the virtual carrier frequency (zero frequency) of 80 c/s.

ANNEX 2

(to Recommendation Q.21)

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

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

Frequency: 4.3 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 IN-BAND SIGNALLING

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

SPLITTING ARRANGEMENTS AND SIGNAL RECOGNITION TIMES

A. General

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

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

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

B. Sending-end splitting arrangements

1. In order to satisfy condition A.1 above, care should be taken that the correct operation of the signal receiver at the other end of the circuit is not disturbed by:

— surges (transient currents) caused by the opening or closing of direct current circuits connected to the speech wires of the switching equipment, whether these surges precede or follow the sending of a signal;

— noise, speech currents, etc., coming from tandem switched circuits, preceding or during the sending of a signal.

2. For this reason the following arrangements have been made in the C.C.I.T.T. standard systems No. 3, No. 4 and No. 5 for the transmission of voice-frequency signals on the international circuit:

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

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

3. Arrangements of the same type are required on national signalling systems (see C.4.1 *b*).

C. Receiving-end splitting arrangements

1. *General*

1.1 In order to satisfy condition A.2 above, the length of the part of a signal which passes into another system is limited by splitting the speech wires beyond the signal receiver when a signal is received and detected by this receiver.

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

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

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

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

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

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

1) the *international* signal that may be able to pass:

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

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

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

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

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

2. *Protection of national and international systems against international systems*

Conditions 1.2.1 *a)* and *b)* above are met because international signalling systems have a splitting device on each circuit. The splitting times of such systems are:

55 milliseconds for the compound signal element in C.C.I.T.T. system No. 4;
35 milliseconds for a signal element in C.C.I.T.T. system No. 5.

3. *Protection of the international system against national systems*

Condition 1.2.2 *a)* above is generally covered because:

— the value given in the Specifications of the C.C.I.T.T. standard systems as the minimum recognition time of a line signal:

60 milliseconds for systems No. 3 and No. 4
100 milliseconds for system No. 5 *

is in general greater than the splitting time of national systems (see the tables giving the basic characteristics of national signalling systems in Supplement No. 3 in the Documentary Part of this volume).

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

It may be necessary, if the splitting time of 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 (protection defined under 1.2.2 *b)* above), it has been recommended by the C.C.I.T.T. since 1954 that new national in-band signalling systems should comply with the following two clauses:

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* Except seizing and proceed-to-send signals (minimum recognition time of 30 milliseconds), these signals not being subject to spill-over interference.

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

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

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

4.2. Clause 4.1 *a)* permits the signalling system used in country A to have a minimum signal recognition time based on this value of 35 milliseconds. It will then be possible to ensure, without taking any other precautions at the incoming end of an international circuit, that no fraction of a signal coming from country B, and being of the same, or nearly the same, frequency as that used in country A, will be wrongly recognized as a signal in country A.

One method of meeting clause 4.1 *a)* is to adopt a splitting time of less than 35 milliseconds for the national systems.

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

4.3. Clause 4.1 *b)* avoids the false operation of the guard circuit of a signal receiver situated at the distant end of a national circuit.

D. Miscellaneous provisions

RECOMMENDATION Q.26

DIRECT ACCESS TO THE INTERNATIONAL NETWORK FROM THE NATIONAL NETWORK

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

In addition, where a group of national circuits used in the above manner carries both semi-automatic and automatic traffic, means should be provided for distinguishing between these two classes of traffic for the purposes of international accounting (see Recommendation Q.51, section 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) splitting of the speech path, where in-band signalling is used.

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

- short send line splitting,
- short duration of the signal, and
- fast termination of the sending and receiving splits on cessation of the signal.

RECOMMENDATION Q.28

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

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

- charging the calling subscriber (cf. Article 229 of the Instructions for the International Telephone Service, Article 210 of the Instructions for the Intercontinental Telephone Service and Recommendation E.26), and
- measuring the call duration (cf. Recommendation Q.50).

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 (see Recommendation Q.102).

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

RECOMMENDATION Q.29

CAUSES OF NOISE AND WAYS OF REDUCING NOISE IN TELEPHONE EXCHANGES

Circuit noise may be classified as follows:

a) power supply noise,

b) noise generated in the speech path circuit,

c) noise induced in the speech path circuit.

1. Power supply noise

1.1 *Power sources*

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

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

1.2 *Supply leads*

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

These common impedances may be reduced by:

1.2.1 the use of common power supply leads of sufficiently low resistance, the use of large capacitors fitted at apparatus ends of supply leads, 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 a suitable choice of contact materials;

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

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

2.1.6 careful maintenance cleaning and lubrication in accordance with specifications.

2.2 *Frying noise*

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

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

2.3 *Contact noise caused by wetting currents*

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

2.4 *Charge and discharge clicks*

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

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

These effects may be reduced:

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

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

2.5 *Unsound contacts*

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

2.6 *Tapping losses*

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

2.7 *Reduction of the number of switching contacts*

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

3. Noise induced in the speech circuit

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

3.1.1 speech crosstalk;

3.1.2 signalling frequency crosstalk;

3.1.3 induction from tone supplies;

3.1.4 direct current pulses;

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

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

3.2 *Noises due to unbalanced transmission bridge circuits*

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

3.2.1 the use of balanced components;

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

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

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

3.2.5 taking the precautions listed at the end of 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.

RECOMMENDATION Q.30

IMPROVING THE RELIABILITY OF CONTACTS IN SPEECH CIRCUITS

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

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

b) use of high contact pressure,

c) double contacts,

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

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

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

g) the maintenance of suitable humidity,

h) the use of protective covers,

i) protection against fumes, vapours and gases,

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

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

RECOMMENDATION Q.31

NOISE IN A NATIONAL FOUR-WIRE AUTOMATIC EXCHANGE *

1. Definition of a "connection through an exchange"

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

2. Mean noise power over a long period

2.1 Limits of *psophometrically* weighted noise introduced when passing through a national four-wire exchange

The value of the busy-hour mean psophometric noise power measured on a "connection" through a national four-wire automatic exchange and referred to a point of zero relative level should not exceed 100 picowatts (i.e. a level of –70 dbm0 or –8 Nm0). This figure should be regarded as a design objective, it being admitted that a number of existing national four-wire exchanges possess higher noise levels.

2.2 Limits of *unweighted* noise introduced when passing through a national four-wire exchange

The limits of the busy-hour mean unweighted noise measured in the same conditions as in 2.1 are defined thus: The unweighted noise power referred to a point of zero relative level should not exceed 100000 picowatts (a level of –40 dbm0 or –4.6 Nm0).

Note. — Pending the outcome of the investigations now in progress (Question 5/XI), it is suggested that unweighted noise should be measured with a device possessing a uniform response curve throughout the band between 30 and 20000 c/s.

3. Clicks and pulse noise

(Being studied, see Questions 5/XI and 8/XI.)

RECOMMENDATION Q.32

REDUCTION OF THE RISK OF INSTABILITY BY SWITCHING MEANS

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

— during the period between the moment when the speech path is established and the moment when the called subscriber answers, and

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

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* This Recommendation is the subject of Question 5/XI to be studied in 1965-1968.

This can be achieved in principle by any of the methods *a)*, *b)* or *c)* shown in Figures 3, 4 and 5.

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

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

FIGURES 3, 4 and 5. — **Possible methods for reducing the risk of instability**

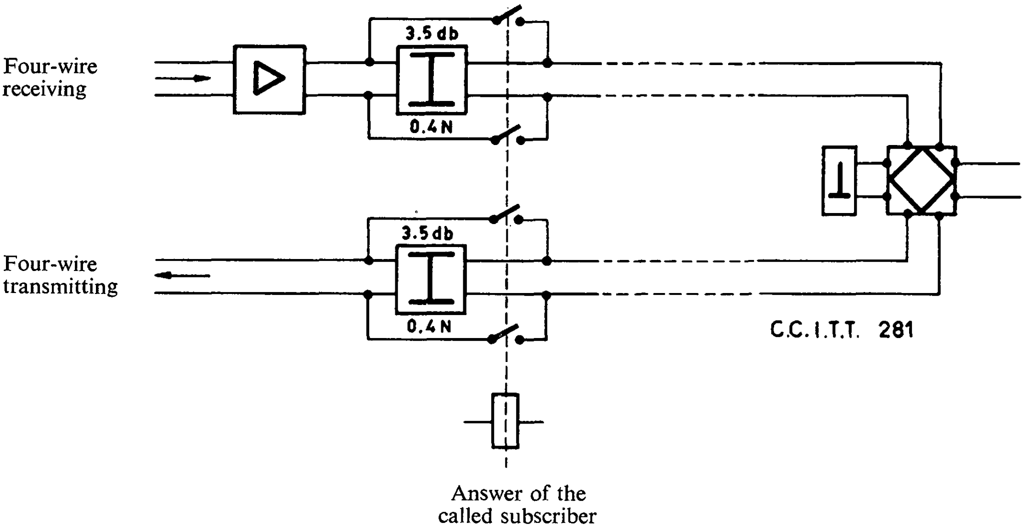

FIGURE 3. — *Method a)* **Inserting an attenuator in each channel of the four-wire chain of the connection**

In principle, the attenuators may be inserted in any of the exchanges, for example the incoming international centre.

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

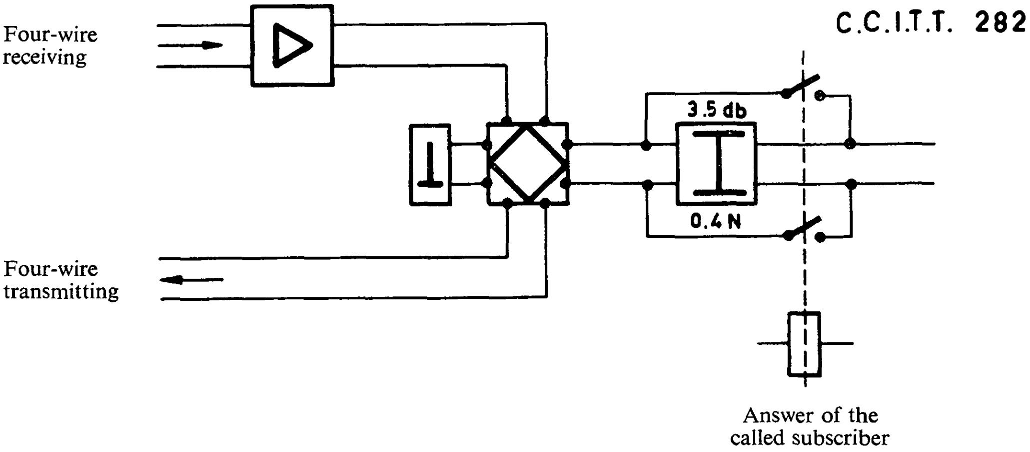

FIGURE 4. — *Method b)* **Inserting an attenuator in the two-wire extension of the connection**

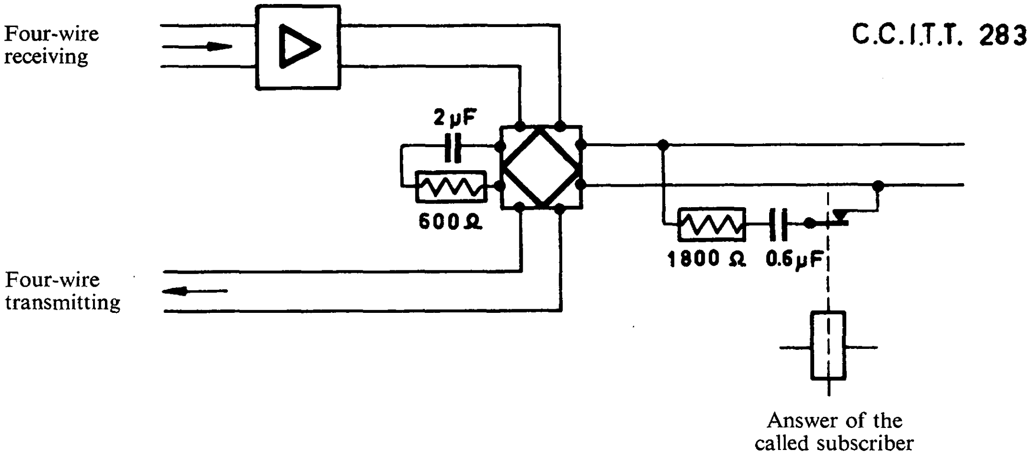

FIGURE 5. — *Method c)* **Bridging a terminating impedance across the two-wire extension of the connection**

CHAPTER V

Tones for national signalling systems

RECOMMENDATION Q.35

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

1. General

Administrations are reminded of the advantages of standardizing as far as possible 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. in 1960 took account of the nature of the various tones already used in Europe, and 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 introducing new tones would find it helpful to know the preferred limits of cadence, frequency and level.

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

Besides the limits applying to specifications 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 (in the traffic direction) 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.

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 second. For existing exchanges, the *accepted* upper limit for the tone period is 2.5 seconds.

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

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

Figure 6 shows the recommended and accepted limits for the ringing tone periods.

2. The *recommended* frequency for the 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.

Figure 7 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.

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* The frequency used for the busy tone in North America is 600 c/s modulated by 120 c/s.

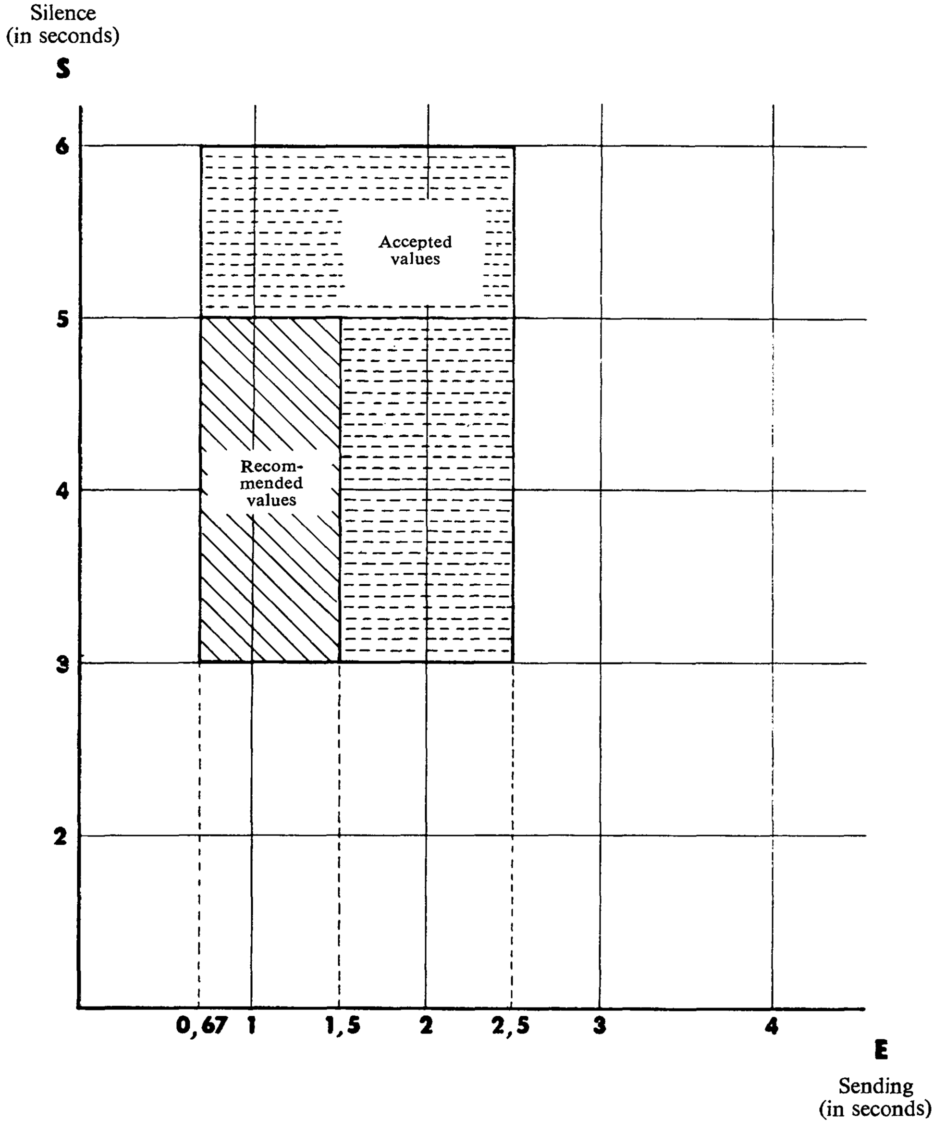

FIGURE 6. — **Ringing tone**

Frequency:

- recommended interval: 400-450 c/s
- accepted interval: 340-500 c/s

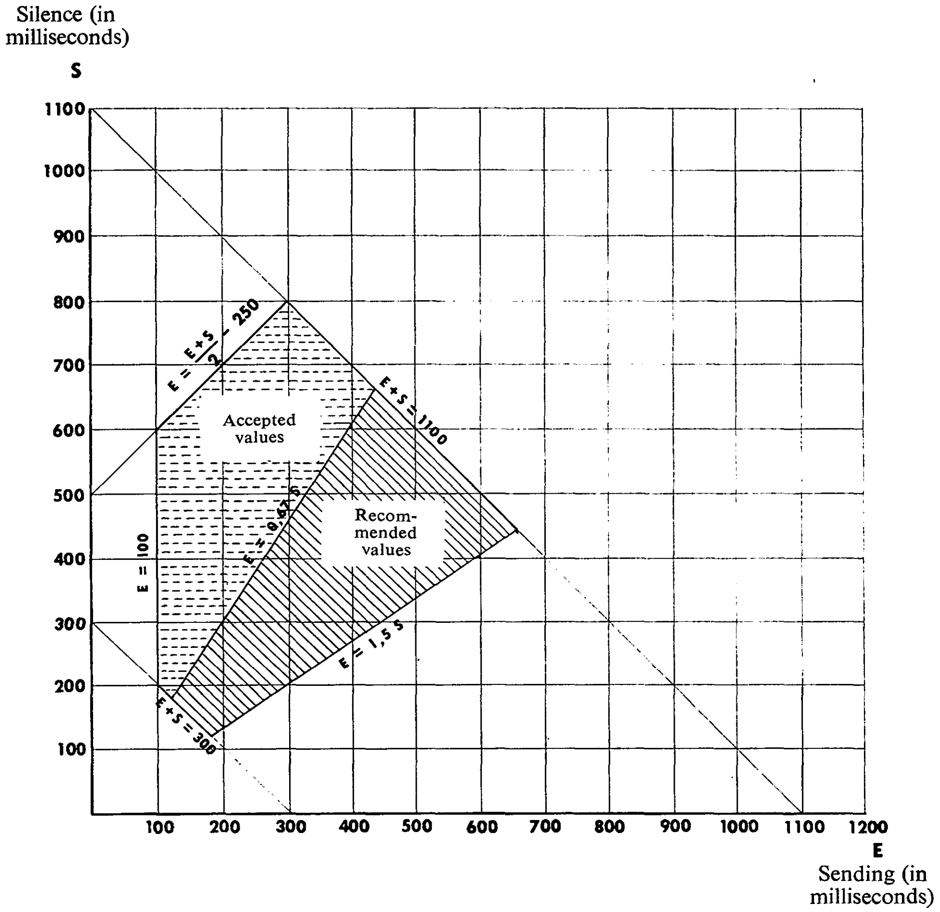

FIGURE 7. — **Busy tone**

Frequency:

- recommended interval: 400-450 c/s
- accepted interval: 340-500 c/s

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 operating 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 either to 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.

CHAPTER VI

Transmission characteristics and requirements for international telephone connections

1.0 *General*

RECOMMENDATION Q.40 *

THE NEW TRANSMISSION PLAN

A. Principles

The new transmission plan set up in 1964 was drawn up with the object of making use in the international service of the advantages offered by four-wire switching.

. . . .

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

Recommendation G.122, Volume III, *Blue Book*, describes the conditions to be fulfilled by a national network for the new transmission plan to be put into effect.

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

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

. . . .

B. Definition of the constituent parts of a connection

a) The international chain and the national systems

A complete international telephone connection consists of three parts, as shown in Figure 8:

— *An international chain* made up of one or more four-wire international circuits. These are interconnected on a four-wire basis in the international transit centres and are also connected on a four-wire basis to national systems in the international centres.

— *Two national systems*, one at each end. These may comprise one or more four-wire amplified national trunk circuits with four-wire interconnection, as well as circuits with two-wire connection up to the terminal exchanges and to the subscribers.

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* This Recommendation is an extract of Recommendation G.101 in Series G (Line transmission, Volume III of the *Blue Book*) of the C.C.I.T.T. Recommendations.

The suspension dots show where a passage in Recommendation G.101 has not been reproduced under Q.40.

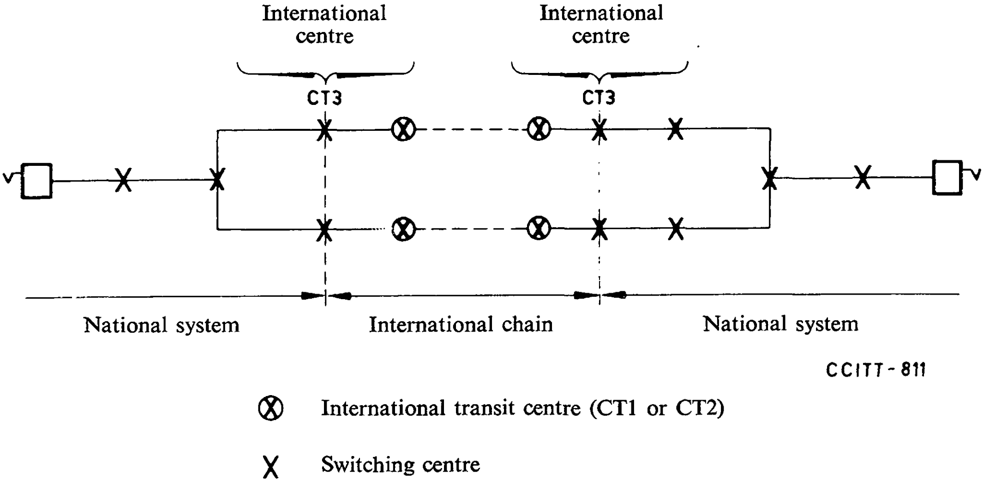


FIGURE 8. — **Definition of the constituent parts of an international connection**

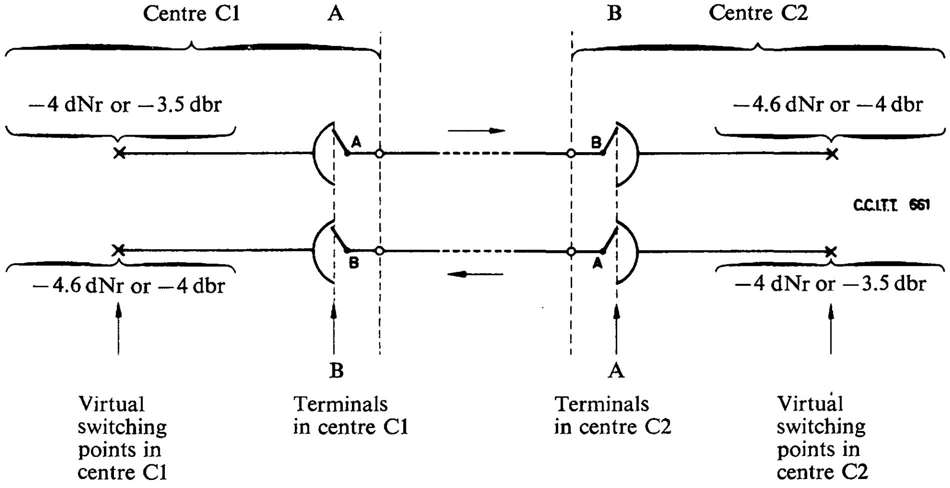


FIGURE 9. — **Definitions for an international circuit**

A four-wire circuit is defined by its *virtual switching points* in an international transit exchange or an international exchange. These are theoretical points with specified relative levels (see Figure 9).

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

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

The virtual switching points may not be the same as the points at which the circuit terminates physically in the switching equipment. These latter points are known as the *circuit terminals;* the exact position of these terminals is decided in each case by the Administration concerned (see Figure 9).

b) National extension circuits: four-wire chain

When the maximum distance between an international exchange and a subscriber who can be reached from it does not exceed about 600 miles or 1000 km—exceptionally, 1000 miles or 1500 km—the country concerned is considered as of average size. In such countries, at the most three national four-wire circuits can be interconnected on a four-wire basis between each other and to international circuits. They should comply with the recommendations of sub-section 1.2 of Volume III of the *Blue Book.*

In a large country, a fourth and possibly a fifth national circuit may be included in the four-wire chain, provided it has the nominal transmission loss and the characteristics recommended for international circuits used in a four-wire chain (see Recommendation Q.43 and the recommendations in sub-section 1.5 of Volume III of the *Blue Book*).

Note. — The abbreviation "four-wire chain" (see Figure 10) signifies the chain composed of the international chain and the national extension circuits connected to it, either by four-wire switching or by some equivalent procedure (as understood in section A above).

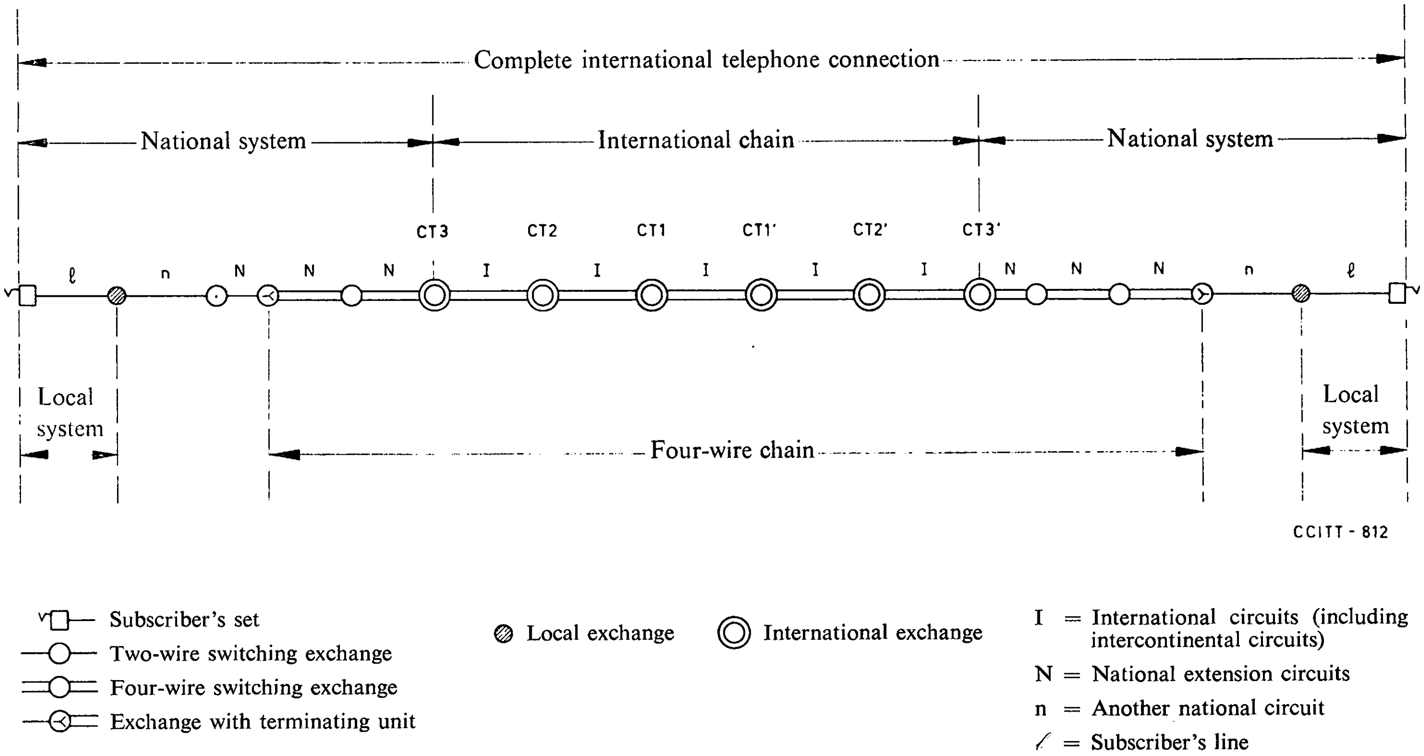
C. Maximum number of circuits

a) National circuits

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

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

The representative maximum international connection considered by the C.C.I.T.T. for the study of transmission performance (see Figure 10) thus includes eight national circuits, besides the international ones. The cumulative distortion of these eight circuits



I = International circuits (including intercontinental circuits)

N = National extension circuits

n = Another national circuit

ℓ = Subscriber's line

FIGURE 10. — **A representative maximum international connection**

is likely to be large, and close to the maximum allowable value. Consequently, the international circuits must not introduce any further appreciable deterioration. This principle has been borne in mind during the drafting of the recommendations dealing with such circuits.

b) International circuits

Implementation of the routing plan for automatic and semi-automatic international telephone traffic (Recommendation Q.13) presupposes that the new transmission plan is applied. In the routing plan, the C.C.I.T.T. has defined three classes of international centres, CT1, CT2 and CT3, and has arranged to restrict the number of international circuits to five or exceptionally six. The CT3 connect international and national circuits together; the CT2 and CT1 interconnect international circuits.

c) Four-wire chain

The above shows that in principle a connection between two countries of average size should not comprise more than thirteen circuits—five international circuits plus four national ones at each end—while the corresponding four-wire chain should not comprise more than eleven circuits.

These theoretical maxima may, however, be exceeded in certain circumstances (see paragraphs C *a)* and C *b)* above) and in large countries it will be legitimate to exceed these figures systematically; see paragraph B *b)*). Besides this, a telephone circuit may possess more than one channel modulator-demodulator pair.

. . . .

1.1 *General characteristics of a complete international telephone connection*

RECOMMENDATION Q.41*

MEAN ONE-WAY PROPAGATION TIME

A. Limits for connections

It is necessary in an international telephone connection to limit the propagation time between two subscribers. Recent tests have shown that international connections probably will not cause adverse subscriber reaction due to the combined effect of delay and echo suppressors if the mean one-way propagation time ** is increased from near zero to about 150 ms. As the propagation time is increased beyond 150 ms, subscriber difficulties increase, and the rate of increase of difficulty rises, up to and including the maximum

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* This Recommendation is an extract of Recommendation G.114 in Series G (Line transmission, Volume III of the *Blue Book*) of the C.C.I.T.T. Recommendations.

The suspensive points show where a passage in Recommendation G.114 has not been reproduced under Q.41.

** Mean of the times in the two directions of transmission.

one-way propagation time tested, namely 400 ms. The C.C.I.T.T., therefore, provisionally recommends the following limitations on mean one-way propagation times when echo sources exist and echo-suppressors are used:

a) Acceptable without reservation, 0 to 150 ms.

b) Provisionally acceptable, 150 to 400 ms. In this range connections may be permitted, in particular, when compensating advantages are obtained.

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

. . . .

B. Values for circuits

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

a) National extensions

. . . .

b) International circuits

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

1. Terrestrial (including submarine cable)

100 statute miles/ms (160 km/ms).

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

2. Satellites

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

Satellite at 14 000 km (8700 miles) altitude	110 ms
Satellite at 36 000 km (22 500 miles) altitude	260 ms

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

Note. — The one-way propagation time referred to above is the group delay as defined in the *List of definitions of essential telecommunication terms* (Definition 04.17), calculated at a frequency of about 800 c/s.

(Q.41)

1.2 *General characteristics of national systems forming part of international connections*

(See Recommendations G.121 to G.125)

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

RECOMMENDATION Q.42 *

STABILITY AND ECHOES — ECHO-SUPPRESSORS **

A. Stability of telephone transmission

. . . .

B. The limitation of echoes

The main circuits of a modern telephone network providing international communications are high-velocity carrier circuits on symmetric or coaxial pairs or radio-relay systems and echo-suppressors are not normally used except on connections involving very long international circuits. There is often no general need for echo-suppressors in national networks but they may be required for the inland service in large countries. Echo-suppressors may also be needed on loaded-cable circuits (low-velocity circuits) used for international calls.

Echoes may be limited in one of two ways; either the over-all loss of the four-wire chain of circuits may be adjusted so that echo currents are sufficiently attenuated (which tacitly assumes a particular value for the echo balance return loss) or an echo-suppressor can be fitted.

a) Transmission loss adjustment

. . . .

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* This Recommendation is an extract of Recommendation G.131 in Series G (Line transmission, Volume III of the *Blue Book*) of the C.C.I.T.T. Recommendations.

The suspensive points show where a passage in Recommendation G.131 has not been reproduced under Q.42.

** See also Recommendation Q.115.

b) *Echo-suppressors*

The preferred type of echo-suppressor is a terminal, differential, far-end operated, half echo-suppressor *. The operating characteristics of echo-suppressors and the basic clauses of a specification are given in Recommendation G.161 (Volume III of the *Blue Book*).

The operate level (referred to a point of zero relative level on the circuit with which the echo-suppressor is fitted) of the echo-suppressor should be adjusted to lie in the range of –30±4 dbm0 or –35±5 dNm0. The upper limit is necessary to ensure satisfactory response to speech signals, and the lower limit is necessary to avoid false operation due to noise.

Note 1. — The redesign of echo-suppressors to make them more suitable for longer delays and low echo balance return losses is being actively studied by several Administrations.

Note 2. — There is some evidence that the operate levels of the half echo-suppressors at the two ends of the connection must be substantially equal. The range of 8 db (10 dN) permitted above may therefore have to be reduced.

Furthermore, it would appear that the blocking attenuation ought not to be removed by a signal whose level on the transmit path is less than the level of the signal on the receive path.

c) *Rules governing the use of echo-suppressors*

Only telephony is considered here. Echo-suppressors are an embarrassment to data and other telegraph-type transmission. It may be noted that echo-suppressors with tone disablers may prove useful when circuits are used for both telephone and data services (see Recommendation G.161, C, in Volume III of the *Blue Book*).

1. IDEAL RULES

The fundamental requirements that an *ideal* scheme should comply with are given in rules A to D below.

Rule A. — The probability that an international connection between any two subscribers will exhibit an objectionable echo should not be greater than 1%. If the probability is greater, an echo-suppressor must be provided.

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* Definitions of Recommendation G.161 (Volume III of the *Blue Book*):

A terminal echo-suppressor is an echo-suppressor designed for operation at either terminal of a circuit.

A differential echo-suppressor is an echo-suppressor in which the action is controlled by the difference n level between the signals on the two speech paths.

A half echo-suppressor is an echo-suppressor in which the speech signals of one path control the attenuation introduced into the other path but in which this action is not reciprocal.

A far-end operated, terminal half echo-suppressor is a half echo-suppressor fitted at the end of a circuit and which introduces the blocking attenuation into the transmit path under the control of speech signals from the receive path.

Rule B. — Not more than the equivalent of one full echo-suppressor (i.e. two half echo-suppressors) should be included in any connection needing an echo-suppressor. When there is more than one full echo-suppressor the conversation is liable to be clipped; lock-out can also occur.

Rule C. — Connections that do not require echo-suppressors should not be fitted with them, because they increase the fault rate and are an additional maintenance burden.

Rule D. — The half echo-suppressors should be associated with the terminating sets of the four-wire chain of the complete connection. This reduces the chance of speech being mutilated by the echo-suppressors because the hangover times can be very short.

2. PRACTICAL RULES

It is recognized that no practical solution to the problem could comply with rules so exclusive and inflexible as the ideal Rules, A to D, above. Some practical rules, E to K, are suggested below in the hope that they will ease the switching, signalling and economic problems. They should not be invoked unless Rules A to D cannot reasonably be complied with.

Rule E. — For connections involving the longest national four-wire extensions of the two countries, a probability of encountering objectionable echo not of 1% (Rule A) but of 10% can, by agreement between the Administrations concerned, be tolerated. This Rule E * is valid only in those cases where it would otherwise be necessary, according to Rule A *, to use an echo-suppressor solely for these connections, and where there is no need for echo-suppressors on connections between the regions in the immediate neighbourhood of the two international centres concerned.

Rule F. — If, as is appreciated, Rule D above cannot be complied with, the echo-suppressor may be fitted at the international exchange or at an appropriate national transit centre. Should it prove impracticable to fit the echo-suppressor at the terminal international centre (CT3) on multi-circuit connections then it may be fitted at an international transit centre (CT2 or CT1).

For either of these arrangements the hangover time should normally be 50 ms. Exceptionally it may be increased to 70 ms when there is a long chain of circuits extending the connection beyond the point where the half echo-suppressor is situated.

Rule G. — In isolated cases a full echo-suppressor may be fitted at the outgoing end of a transit circuit (instead of two half echo-suppressors at the terminal centres) provided that neither of the two hangover times exceeds 70 ms. This relaxation may reduce the number of echo-suppressors required and may also simplify the signalling and switching

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* Annex 2 to Question 2/XI is a study of the application of Rules A and E to the United Kingdom-European network relations.

arrangements. It is emphasized that full echo-suppressors must not be used indiscriminately; the preferred arrangement is two half echo-suppressors as near the terminating sets as possible. A full echo-suppressor should be as near to the "time-centre" of the connection as possible, because this will require lower hangover times.

Rule H. — In exceptional circumstances, such as breakdown, an emergency route may be provided. The circuits of this route need not be fitted with echo-suppressors if they are usable without them for a short period. However, if the emergency routing is to last more than a few hours, echo-suppressors must be fitted according to Rule A or E above.

Rule J. — It is accepted that a connection that does not require an echo-suppressor may in fact be unnecessarily equipped with one or two half echo-suppressors, or a full echo-suppressor. (The presence of an echo-suppressor in good adjustment on a circuit with modest delay times can hardly be detected.)

Rule K. — On a connection that requires an echo-suppressor, up to the equivalent of two full echo-suppressors (e.g. three half echo-suppressors or two half echo-suppressors and a full one) may be permitted. Every effort should be made to avoid appealing to this relaxation because the equivalent of two or more full echo-suppressors, with long hangover times on a connection, can cause severe clipping of the conversation and considerably increases the risk of lock-out.

d) Introducing the echo-suppressors into the connection

Ways of doing this which have been considered are:

1. Provide a pool of echo-suppressors common to several groups of circuits, and arrange for an echo-suppressor to be associated with any circuit that requires one *.

2. Arrange for the circuits to be permanently equipped with echo-suppressors but switch them out (or disable them) when they are not required **.

3. Divide the circuits of an international route into two groups, one with and one without echo-suppressors and route the connection over a circuit selected from the appropriate group according to whether the connection merits an echo-suppressor. However, it is recognized that circuits may not be used efficiently when they are divided into separate groups. This must be borne in mind.

4. It is possible to conceive schemes in which the originating country and the terminal country are divided into zones at increasing mean radial distances from the international centre and to determine the nominal lengths of the national extensions by examining routing digits and circuits-of-origin.

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* See Annex 2 to Question 2/XI.

** See Annex 3 to Question 2/XI.

As far as telephone transmission is concerned there is nothing to distinguish one method from another and the economic solution to the problem may well be found in the judicious use of all these methods. The C.C.I.T.T. is not in a position to recommend a preferred method. The nature and volume of the traffic carried by a particular connection will also influence the economics of the methods and hence the choice among them.

It should be appreciated that different continents need not use the same method although the methods must be compatible to permit intercontinental connections. There appears no great difficulty in arranging this.

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

RECOMMENDATION Q.43 *

TRANSMISSION LOSSES, RELATIVE LEVELS AND ATTENUATION DISTORTION

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

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

–3.5 dbr or –4.0 dNr, sending
–4.0 dbr or –4.6 dNr, receiving

The nominal transmission loss of this circuit at the reference frequency between virtual switching points is therefore 0.5 db or 0.6 dN.

Note 1. — The relative level at a given point of a four-wire circuit is determined by reference to the specifications of the transmission system on which the circuit is set up, the performance of the system (noise, crosstalk, limiting, linearity, etc.) being evaluated at a point of zero relative level. For example, the nominal mean power of signals during the busy hour, at a point of zero relative level, is indicated in Recommendation Q.15.

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

Note 3. — If a four-wire circuit forming part of the four-wire chain contributes negligible delay and variation of transmission loss with time it may be operated at zero nominal transmission loss between virtual switching points rather than 0.5 db (0.6 dN). This relaxation refers particularly to short four-wire tie-circuits between switching centres, for example circuits between a CT3 and a CT2 in the same city.

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* This Recommendation also appears as Recommendation G.141 in Series G (Line transmission, Volume III of the *Blue Book*) of the C.C.I.T.T. Recommendations.

B. Interconnection of international circuits in a transit exchange

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

In this way a chain of *n* international circuits has a nominal transmission loss in transit of *n* times 0.5 db or 0.6 dN in each direction of transmission which contributes to the stability of the connection; see Recommendation G.131, A (Volume III of the *Blue Book*).

C. Attenuation distortion of the international chain of four-wire circuits

Attention is drawn to the note of Recommendation G.132 (Volume III of the *Blue Book*) in which the opinion is expressed that the chain of six circuits using channel translating equipment complying with Recommendation G.232 will exhibit an attenuation distortion in terminal service that will meet the limits of Figure 12 of Recommendation G.132 (Volume III of the *Blue Book*). However, the additional distortions of seven international centres have not been included and this is being studied.

RECOMMENDATION Q.45 *

TRANSMISSION CHARACTERISTICS OF AN INTERNATIONAL CENTRE (CT)

A. GENERAL

1. Introduction

For the purposes of this recommendation, an international centre is a collection of equipment regarded as an entity by the Administration concerned. In the case of an international transit centre, it extends from the end of the incoming international line to the beginning of the outgoing international line (e.g. between such points as A_1 and D_1 or A_4 and D_3 in Figure 11 or any other suitable pair and points).

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

The essential requirements are:

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

b) The *distortions* introduced should be small. These distortions include attenuation, group delay, and non-linear distortion.

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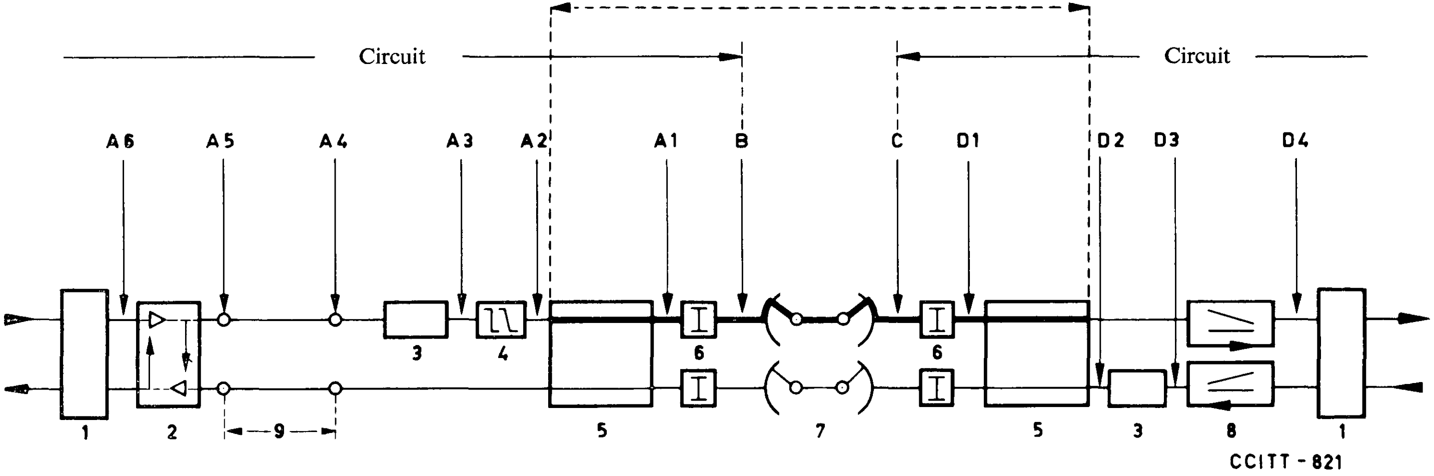
* This Recommendation also appears as Recommendation G.142 in Series C (Line transmission, Volume III of the *Blue Book*) of the C.C.I.T.T. Recommendations.

This recommendation is the subject of Question 4/XI to be studied in 1965-1968. Some of the values quoted in the Recommendation may therefore be regarded more as tentative objectives than as values specified.

Annexes 1, 2 and 3 to Question 4/XI reproduce a number of national specifications for sake of information.

The heavy line denotes
a "connection through the international exchange"



1. Channel translating equipment.
2. Echo-suppressor.
3. Line signal receiver.
4. Equalizer.
5. Outgoing and incoming relay sets.
6. Switchable exchange pads.
7. Automatic switching equipment.
8. Compressor and expander.
9. Tie cable.

Some of the elements may be in a different order from that shown, e.g. the echo-suppressor may be on the exchange side of the signalling receiver.

The international *circuit* extends from point C of one exchange to point B of the next.

The international *line* extends from any point D_1 - D_4 to any point A_1 - A_6.

FIGURE 11

c) *Noise and crosstalk* should be negligible.

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

e) *Four-wire test access-points* should be provided and the impedance thereat should be closely controlled. (See Recommendation M.66, Volume IV of the *Blue Book* and Recommendation Q.75 of this volume.)

2. Definition of a "connection through an exchange"

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

A connection through the international exchange is shown by a heavy line in Figure 11.

B. NET SWITCHING LOSS

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

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

The switching equipment input point associated with a receive channel may be such that the nominal relative level is different from –4.0 dbr (–4.6 dNr). Let this nominal relative level be R *.

The switching equipment output point associated with a transmit channel may be such that the nominal relative level is different from –3.5 dbr or –4.0 dNr. Let this nominal relative level be S *.

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

When a transit connection is established through a centre by connecting the receive and transmit channels of one circuit to the transmit and receive channels respectively of another circuit, in order to ensure that the virtual switching points have been connected together without additional loss or gain, the *nominal* value of the attenuation (loss) to be introduced between the switching equipment input and the switching equipment output is $R-S+T$.

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

Net switching loss = Actual loss – nominal loss = $A-(R-S+T)$.

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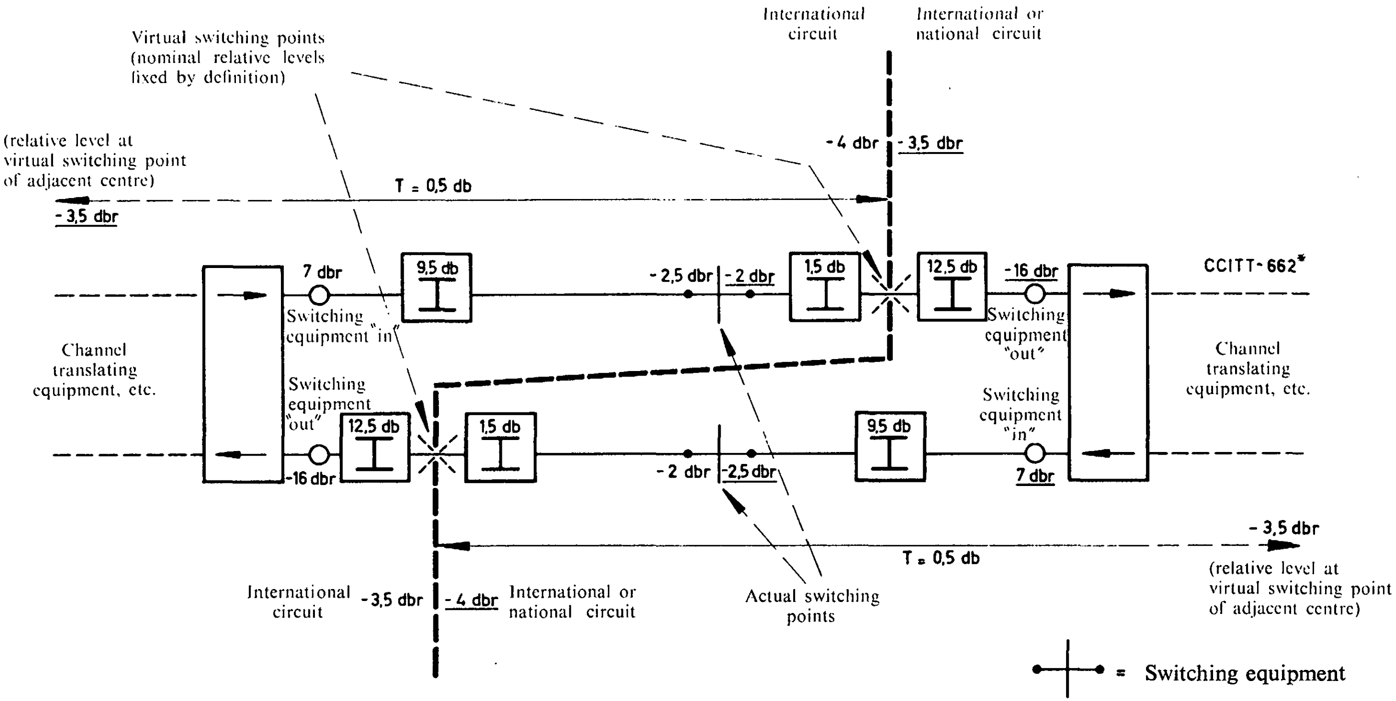
* If the value of R is chosen to be higher than the value of S, the level difference can be used to offset any inherent transmission loss in the switching equipment and the requirements of the transmission plan can be met without any need to install supplementary audio-frequency amplifiers.



Note. — Underlined values of relative level refer to the circuit on the right of the point concerned.

Values of relative level not underlined refer to the circuit on the left of the point concerned.

In an actual switching centre, the virtual switching points would not physically exist and the loss of 14 db between the switch and the channel equipment would not necessarily comprise a 1.5 and a 12.5 db pad.

FIGURE 12. — **Example showing, on a simplified representation of a transit connection, the possible location of virtual switching points in an international transit centre**

The recommended value of the net switching loss is zero. That is, the *actual* loss (A) should equal the *nominal* loss ($R-S+T$).

Example. — The relationship between the actual switching points and the virtual switching points in a practical international centre is illustrated in Figure 12. In this arrangement $R = +7$ dbr (+8 dNr), $S = -16$ dbr (–18 dNr) and T is assumed to be 0.5 db (0.6 dN) so that the nominal transmission loss needed between the +7 and –16 dbr (+8 and –18 dNr) points is:

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

or

$$(+8) - (-18) + (0.6) = 26.6 \text{ dN}$$

C. CROSSTALK

1. Between different circuits

In an international centre or an international transit centre, the signal-to-crosstalk ratio, measured at the test-jack frame between any two "connections through the exchange" (see definition in A.2) should not be less than 70 db or 8 N.

This limit of 70 db or 8 N was defined in 1954 to give a tolerable transmission impairment of the chain of national and international circuits, taking into account the fact that there are at least two international terminal exchanges involved in an international call and that the number of the international exchanges (terminal and transit exchanges) could be four in the future.

This limit of 70 db or 8 N should normally apply to the most unfavourable case, in which two "connections" have parallel paths throughout the international exchange. It should be noted that this does not occur in practice, because normal cabling layout is such that when, at one switching stage, two "connections" use adjacent switches, in the following stage, the two "connections" generally use switches which are not adjacent.

Note. — Recommended methods for the measurement of crosstalk are described in the Remark to Recommendation G.134 (Volume III of the *Blue Book*).

2. Between the two directions of transmission of a chain of circuits

Provisionally the C.C.I.T.T. has recommended that the signal-to-crosstalk ratio between the two "connections" (see definition in A.2) which constitute the go and return channels of a chain of four-wire circuits switched through the international exchange should be not less than 50 db or 5.8 N.

D. NOISE

1. Mean noise power over a long period

1.1 In any four-wire international exchange, the busy-hour mean *psophometric* power level measured on any "connection" through the exchange (see definition in A.2) and referred to points of zero relative level of the circuits connected to the exchange, shall not exceed -65 dbm or -7.5 Nm, with the exception of not more than 5 % of the "connections" tested for which a value of -62 dbm or -7.1 Nm is acceptable.

For future development, the design target should be –70 dbm or –8 Nm, i.e. a psophometric power of 100 picowatts.

1.2 In any four-wire international exchange, the busy-hour mean *unweighted* noise power measured in the same conditions as in 1.1 and referred to points of zero relative level of the circuits connected to the exchange should not exceed 100 000 picowatts—i.e. a level of –40 dbm or –4.6 Nm.

Note. — Pending the outcome of the investigations now in progress (study of Question 5/XI), it is suggested that unweighted noise should be measured with a device with a uniform response curve throughout the band 30-20000 c/s.

2. Clicks and pulse noise

(being studied, see Questions 5/XI and 8/XI).

E. USE OF CABLES SPECIFIED BY THE I.E.C.

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

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

PART III

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 (Volume II of the *Blue Book*).

. . . .

14. *conversation time (call duration) (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.

15. *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.

16. *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.

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RECOMMENDATION Q.50 *

ACCOUNTING 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 of all call durations measured in the international outgoing exchanges on the appropriate meters. A charge in gold francs per minute of call duration, 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 holding time of the outgoing circuits. In that case, a correction factor shall be applied to the traffic figures so as to assess, in total 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 with the Administration of the incoming country (and, when necessary, with the transit countries) on the arrangements to be made.

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* This Recommendation also appears as Recommendation E.52 *bis* in Series E (Telephone operation, Volume II of the *Blue Book*) of the C.C.I.T.T. Recommendations.

3. 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) a further analysis of the national (significant) number of the called subscriber than the one which is quoted in Recommendation Q.11, and

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

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

(Q.50)

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 over-all 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.

10. It is not essential that call duration meters be read at midnight on the last day of the month; it will suffice if they are read on the last day of the month at the most convenient time. Should the last day of the month not be a working day, these meters can be read the day before or the day after.

The monthly account forwarded to the other Administrations shall show the day on which meters were read. It ought to be possible to arrange for all meters in an exchange to be read on the same day, since there are relatively few circuits on which call duration meters have to be read.

11. The degree of accuracy of the call duration measurement equipment shall be ± 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 ± 2% accuracy should be obtained on the over-all 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).

CHAPTER II

RECOMMENDATION Q.51

BASIC TECHNICAL PROBLEMS CONCERNING THE MEASUREMENT AND RECORDING OF CALL DURATIONS

1. Recording call duration

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

— the moment when 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.50, an Administration using a simplified signalling system has recourse to recording holding 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 holding time. The determination of this conversion factor requires fairly close observation. The ratio of holding 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 holding 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 holding time for a given call duration may thus be extremely variable.

2. Discrimination between automatic and semi-automatic calls

Since different accounting procedures are 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 for calls containing the "discriminating" digit 0 used in automatic working (see para. 1.4.2 in Recommendation Q.104).

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 originating in that 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; the recording apparatus should therefore be capable of identifying the destination of a call and of associating the measured call duration with this destination.

Note. — For drawing up international accounts (apart from frontier relations) 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 national (significant) number* (see Recommendation Q.11).

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* See the definition of the national (significant) number in Recommendation Q.10.

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) further analysis of the national (significant) number of the called subscriber than the one which is quoted in Recommendation Q.11, and

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

5. Discrimination 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.50 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, Figure 1 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 on the figure:

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 link circuits and registers. Only group *(ii)* and possibly group *(iv)* would be involved in measuring call duration.

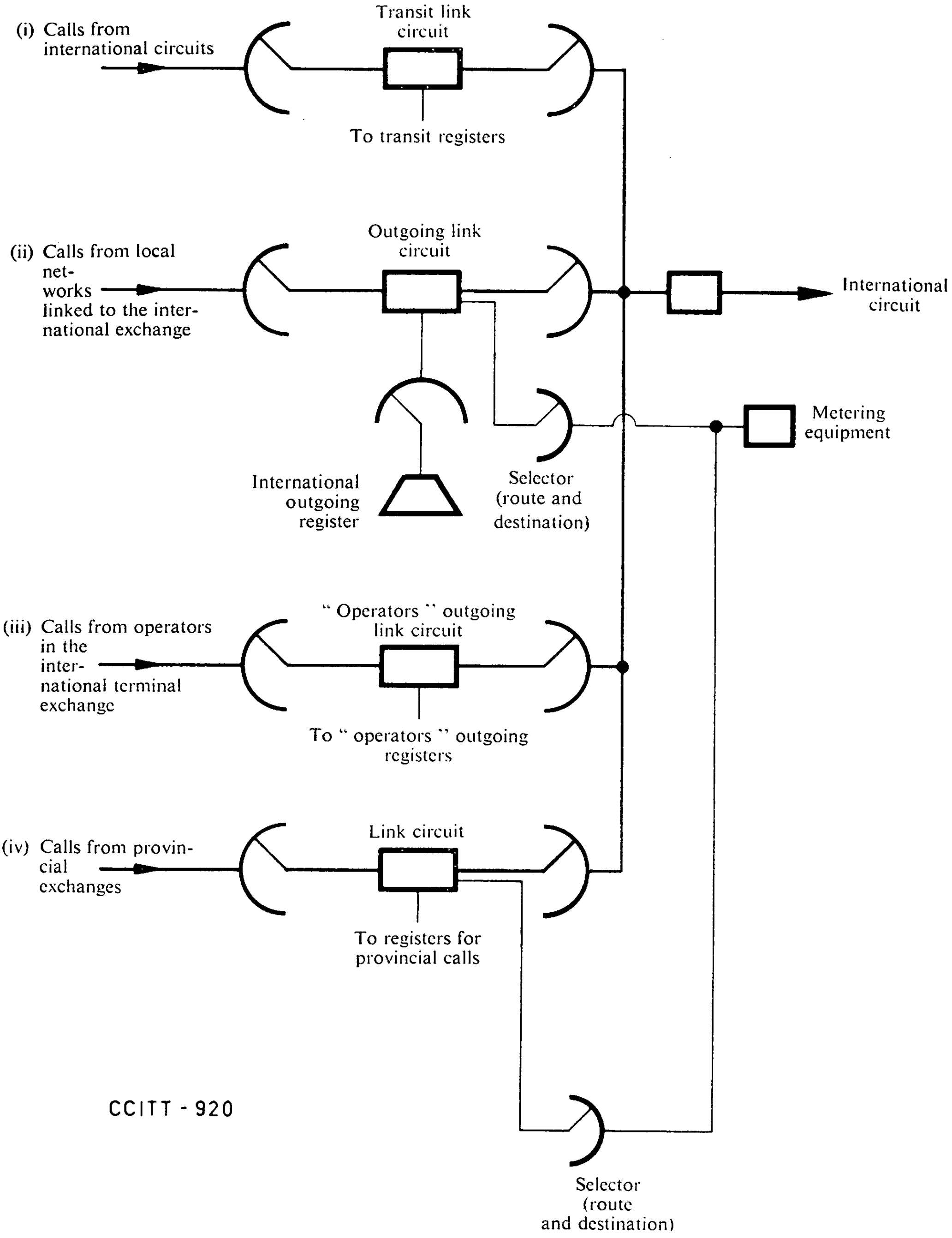

FIGURE 1. — **Diagram giving an example of traffic distribution in an international exchange**

The following auxiliary equipment is envisaged:

a) for each link circuit in groups *ii)* and *iv)*, a selecting device capable of dealing with every possible combination of route/country or "charging area" destination;

b) for each link circuit in group *iv)*, a device to take care of the discrimination between semi-automatic and automatic traffic;

c) for registers in groups *ii)* and *iv)*, equipment for analysing country codes and if necessary an appropriate number of digits of the national (significant) number of the called subscriber in order to discriminate between charging areas (see Recommendation Q.11, item 1.2).

d) for registers in group *iv)*, a device to recognize the "discriminating" digit 0 used for automatic working;

e) a means of recording the call duration for each combination of route/country or "charging area" destination.

CHAPTER III

RECOMMENDATION Q.52

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 (shunt included) 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. (See also Annex to Recommendation Q.85.)

4. Degree of accuracy of methods 2 and 3

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

— the average call duration and the statistical distribution of call 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 a 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 information will be found in the Annex hereafter.

ANNEX

(to Recommendation Q.52)

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 2 illustrates an arrangement in which selector *A* is positioned under the control of the register to connect the appropriate route and destination recorder to the register access relay set.

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.

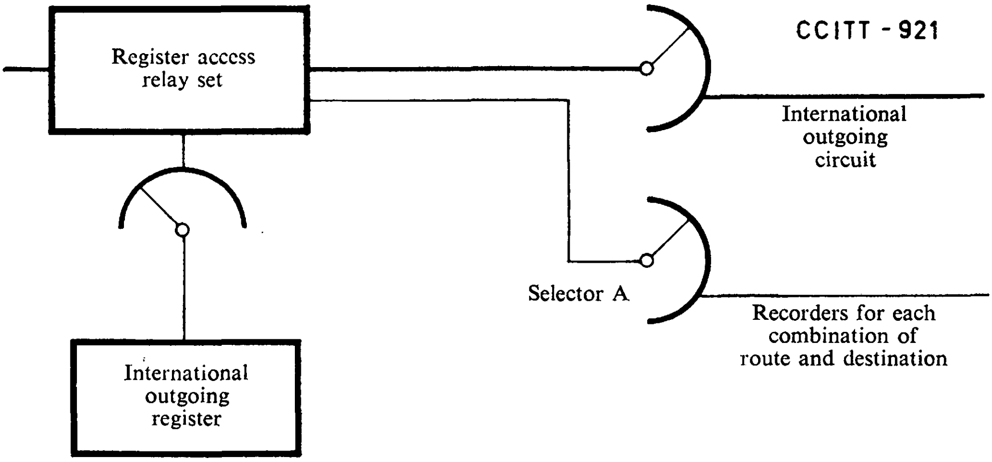

Figure 2

4. A similar arrangement to Figure 2 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 2 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, 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

CHECKING THE INTERNATIONAL TELEPHONE SERVICE

RECOMMENDATION Q.60 *

CHECKING THE INTERNATIONAL TELEPHONE SERVICE

Administrations are recommended to draw up a programme for observations and tests designed for assessment of circuits and equipment, supervision of operators and evaluation of the quality of service given to subscribers. It would be desirable if telephone Administrations were to exchange statistics on quality of service directly, and immediately after they have been made out, in accordance with Tables I, II and III in Recommendations Q.61, Q.62 and Q.63.

Table I in Recommendation Q.61 relates to the observations on the outgoing end on the quality of international automatic and semi-automatic service. It provides in particular a check of the percentage of unsuccessful calls due to technical faults (equipment shortages or failures).

Table II in Recommendation Q.62 relates to observations on traffic set up by operators. It provides, in manual and semi-automatic working, a means of determining the efficiency of international circuits, of assessing the work of operators and the quality of transmission.

Table III in Recommendation Q.63 is used to record the results of test calls undertaken especially when the observations shown in Table I make it clear that the percentage of faults is too high.

Notes on Tables I and II

a) The number of observations to be made on each group of circuits is a point which the outgoing Administration is left free to decide **. However, observations should be numerous enough to be representative for the traffic concerned, i.e. at least 200 observations. These statistics should be exchanged between Administrations with all possible speed as soon as it is felt that the observations made are numerous enough to show what the conditions really are.

b) The frequency of exchange of Tables I and II of Recommendations Q.61 and Q.62 may depend, among other things, on the volume of traffic and on the quality of service observed. Every group of international circuits should be monitored at least once a year, for a suitable period.

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* This Recommendation also appears as Recommendation E.83 in Series E (Telephone operation, Volume II of the *Blue Book*) of the C.C.I.T.T. Recommendations.

** Question 13/XIII to be studied by the C.C.I.T.T. in 1964-1968 deals with how many observations should be entered in Tables I and II, together with how often such information should be exchanged.

RECOMMENDATION Q.61 *

MONITORING OF INTERNATIONAL OUTGOING TELEPHONE CIRCUITS FOR QUALITY OF SERVICE

(See Table I opposite)

Remarks

a) This table summarizes observations made on outgoing automatic and semi-automatic traffic. In general, observations are made on outgoing circuits. If made at another point in the outgoing international exchange at which the international circuits terminate, account will be taken only of calls which have actually caused the international circuit to be seized. These observations will be made only while the call is being set up, and a few seconds after the called subscriber's reply.

A separate form will be used for each country of destination, and for each group of circuits.

Should certain Administrations wish to monitor incoming traffic too, the outcome of such observations could be entered in a similar form.

b) These observations should be spread over the day, the number per hour being roughly proportional to the traffic carried by the group considered, so as to produce a representative sample of the traffic carried.

c) One and the same attempt to set up a call will be entered under one category only, namely the most appropriate one. In the case of several faults on one attempt, the most significant cause of failure should be entered.

d) In completing this table, reference should be made to the following explanations:

HOW TO FILL IN TABLE I

Monitoring of international outgoing telephone circuits for quality of service

Category

1. Under this category, enter calls successfully put through to a conversation without difficulty. If it is observed that the caller has dialled a wrong number, the call will be entered under 4.1. Category 1 will also include calls put through correctly to operator positions, information services, or to machines replying in place of the subscriber.

2. Enter calls which did not lead to a conversation, provided this fact was not attributable to some equipment failure or to incorrect handling by the caller.

2.1 Calls on which no answer is received after ringing tone has been received for at least 30 seconds.

2.2 Calls which encounter called subscriber busy (see 2.3).

2.3 Every effort should be made to distinguish between the "busy" circumstances under 2.2, 3.1, 3.2 and 3.3. If no complete distinction between these categories can be made, calls encountering a busy indication will be entered here.

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* This Recommendation also appears as Recommendation E.83 *bis* in Series E (Telephone operation, Volume II of the *Blue Book*) of the C.C.I.T.T. Recommendations.

Table I

MONITORING OF INTERNATIONAL OUTGOING TELEPHONE CIRCUITS FOR QUALITY OF SERVICE

Outgoing international exchange: ______________________________

Group of circuits: ______________________________________

Service { automatic[a]
{ semi-automatic[a]

Period from: ____________________ to: ____________________

Category	Number		%	
	Sub-total	Total	Sub-total	Total
1. Calls[b] successfully put through		...		...
2. Calls[b] which did not lead to a conversation (but failure not due to equipment or incorrect handling by the caller)		...		...
2.1 No answer	...		...	
2.2 Subscribers busy[c]	...		...	
2.3 Subscribers or routes occupied	...		...	
3. Unsuccessful calls[b] due to equipment		...		...
3.1 Congestion at the international transit exchange[c]	...		...	
3.2 Congestion at the incoming international exchange[c]	...		...	
3.3 Congestion in the incoming national network[c]	...		...	
3.4 Wrong number obtained	...		...	
3.5 Non-reception of answer signal on chargeable calls	...		...	
3.6 Reception of answer signal when the called party does not reply	...		...	
3.7 Very poor speech transmission	...		...	
3.8 No tone, no answer	...		...	
3.9 Other failures of a technical kind	...		...	
4. Unsuccessful calls[b] due to incorrect handling by the caller (subscriber or operator)		...		...
4.1 Wrong number dialled	...		...	
4.2 Incomplete number	...		...	
4.3 Call abandoned prematurely before receipt of a tone	...		...	
4.4 Call abandoned prematurely within 30 seconds after receipt of the ringing tone	...		...	
4.5 Other failures due to incorrect handling	...		...	
5. Unclassified failures		...		...
Total calls[b] monitored		...		100

[a] Delete whatever is inapplicable.

[b] The term "calls" throughout this Table refers to circuit seizures by outgoing traffic.

[c] In so far as a distinction is possible; otherwise, 2.3 will apply.

3. Unsuccessful calls due to equipment.

3.1, 3.2 and 3.3 Calls which encounter congestion (see 2.3).

3.4 Wrong number obtained, although the caller has dialled correctly.

3.5 Calls on which the answer signal has not arrived on the called subscriber's reply, and speech follows. Do not include calls correctly put through, on which the answer signal is not to be sent (for example, the information services in some countries).

3.6 Calls on which an answer signal has been received although the called subscriber has not answered.

3.7 Calls abandoned by the caller because of very poor speech transmission, although the answer signal has been received.

3.8 Calls on which the digital information has been correctly and completely sent, but the caller receives no tone, although he has waited for at least 15 seconds after the sending of the last digit before abandoning the call.

3.9 This covers failures which cannot be classified under 3.1 to 3.8. It will also cover cases of poor speech transmission detected during the period of observation, even though the call was not abandoned *.

4. Enter all unsuccessful calls due to incorrect handling by the caller. Calls under this category will be subdivided into:

4.1 Wrong number dialled **.

4.2 Incomplete number **.

The observer must as far as possible be aware of the number of digits to be dialled for a successful call. Note that in certain circumstances too long a period between the figures dialled may lead to an anomaly which should be included under this category.

4.3 Prematurely abandoned calls before receipt of a tone. The caller has hung up without awaiting a tone before 15 seconds have elapsed since the last digit of the called number was sent over the international circuit.

4.4 Call prematurely abandoned after receipt of the ringing tone. The caller has hung up less than 30 seconds after the ringing tone began.

4.5 All cases of incorrect handling by the caller which cannot be entered in 4.1 to 4.4 *.

5. Enter anomalies which cannot be classified under 2 to 4 *.

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* The monitoring Administration should supply all possible information about the failures observed.

** This applies only to observations where it is possible to determine that the caller has dialled a wrong or incomplete number.

RECOMMENDATION Q.62 *

OBSERVATIONS ON TRAFFIC SET UP BY OPERATORS

(See Table II overleaf)

Remarks

a) This table summarizes observations relating to manual and semi-automatic outgoing traffic originated by operators. These observations will be made, if possible, during the whole call duration.

b) Administrations should, if possible, make a distinction between the different types of call, e.g. station-to-station, personal and collect calls; they should use a separate column for each under the heading " Type of call ".

c) For collect calls, the times to be recorded will be those observed in the country where the call request was made.

d) It is recommended that these observations be spread over the whole day, the number in each hour being approximately proportional to the traffic routed in the circuit group concerned, in order to give a representative sample of the traffic routed.

e) Each outgoing Administration will select the international circuit groups on which observations should be carried out.

f) In completing this table, reference should be made to the following explanations:

HOW TO FILL IN TABLE II

Observations on traffic set up by operators

Category

1. This category should show the mean duration of all calls observed which are successful and have been charged for ("effective" calls).

2. This category will show the mean *chargeable* duration of all effective calls observed.

3. This category will show, for each type of observed call, the average time per effective call during which the international circuit has been occupied for manœuvres or for call preparation.

This average should be based on the time during which the international circuit is held:

a) to obtain information concerning the called number;

b) to obtain information about routing and trunk codes;

c) to call operators, in the incoming international exchange;

d) to exchange information on how to set up the call;

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* This Recommendation also appears as Recommendation E.83 *ter* in Series E (Telephone operation, Volume II of the *Blue Book*) of the C.C.I.T.T. Recommendations.

Table II. — OBSERVATIONS ON TRAFFIC SET UP BY OPERATORS

International outgoing exchange:

Circuit group:

Service { semi-automatic[a] / manual[a]

Period from: to:

Category	Type of call[b]			
	Ordinary	Préavis or personal		
1. Mean call duration – in seconds				
2. Mean chargeable duration – in seconds				
3. Mean holding time of circuits for manœuvres and preparation of calls – in seconds				
4. Number of effective calls observed				
5. Mean number of times the international circuit was seized per effective call				
6. Mean number of "attempts" per effective call				
7. Percentage of calls set up at the first "attempt"				

8. Time-to-answer by operators	Total number of calls answered and unanswered		Calls answered						Calls unanswered (abandoned calls)			
			under 15 seconds		in 15 to 30 seconds		after 30 seconds		within 30 seconds		after 30 seconds	
Operators:	Number	Mean waiting time in seconds	No.	%	No.	%	No.	%	No.	%	No.	%
incoming operator (code 11)												
delay operator (code 12)												
assistance operator												
information operator												

9. Quality of transmission from the subscriber's viewpoint:	Number	%	
— good			
— defective (total – as classified below)			▨
i) calls interrupted while in progress		▨	
ii) bad hearing conditions *a)* circuit overamplified or underamplified		▨	
b) noise during call		▨	
c) fading		▨	
d) crosstalk		▨	
Total:		**100**	**100**

10. Comments:

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[a] Delete whichever is inapplicable.

[b] In accordance with (*b*) under remarks.

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e) to (or attempt to) obtain the called number even when it is engaged or does not reply;

f) to (or attempt to) obtain the called person (in personal calls);

g) between replacement of the receiver by the called person and release of the circuit;

h) because the operator is holding the circuit (whether she is on the line or not) and for any other reasons for which the circuit is engaged.

The times listed above, which exclude the conversation time, should be added together. This total should be divided by the number of effective calls observed during the period in question to obtain the value to be entered in Table II.

4. The number of effective calls observed considered in category 1.

5. The mean number of times the international circuit was seized per effective call (see category 3). This number is usually obtained by meter recordings.

6. The mean number of "attempts" (as specifically defined hereafter from the operating point of view) to set up a call. Should the operator try several times to set up a call while continuously occupied on that call, all these operations must be considered as being one attempt. Similarly, if the operator makes several tries to set up a call and each time encounters a congestion or busy condition and if, after the last try, she informs the caller, only one attempt must be entered. Calls to information services or to obtain routing particulars, and all calls not directly related to the establishment of a call or to information required by the caller, should not be considered as attempts and should not be included.

The total number of attempts during the period of observation should be divided by the number of effective calls observed in the same period to obtain the mean number of attempts per call.

The total number of attempts is usually determined from markings or notations on call tickets.

7. The data for this category will be taken from call tickets prepared for the relation concerned, during the period of observation or a comparable period.

8. The mean waiting time for outgoing operators to receive an answer will be indicated in seconds. This average will include both answered and unanswered calls.

An outgoing operator waits on the circuit (waiting time) for the period:

a) until the incoming operator answers

b) or, until she abandons the attempt, should the incoming operator not answer.

Thus while mean waiting time relates to the outgoing operator it is also a measure of the performance of the incoming operators.

9. It will be difficult to obtain absolutely comparable results from all observers for this category. However, the observer should consider the quality of transmission from the subscribers' viewpoint, taking into account comments made in this respect by subscribers and the number of requests for conversation to be repeated.

10. This category should include any comments likely to explain the probable cause of difficulties frequently noted during the observations.

RECOMMENDATION Q.63 *

RESULTS OF TEST CALLS

(See Table III overleaf)

Remarks

a) Table III summarizes tests carried out manually or automatically to assess the functioning of the international circuit or connection.

b) The tests will be undertaken only after agreement between the Administrations directly concerned.

c) It is essential to indicate clearly the way in which the tests have been carried out and give full information about the testing apparatus used.

d) Administrations may insert additional categories in Table III as they see fit.

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* This Recommendation also appears as Recommendation E.83 *quater* in Series E (Telephone operation, Volume II of the *Blue Book*) of the C.C.I.T.T. Recommendations.

Table III

RESULTS OF TEST CALLS

International outgoing exchange: ____________________

Circuit group: ____________________

Service semi-automatic[a]
Service automatic[a]

Period from: ____________ to: ____________

Category	Number		%	
	Sub-total	Total	Sub-total	Total
1. Satisfactory tests		. . .		. . .
2. Signalling and charging faults		. . .		. . .
2.1 Wrong number	. . .		. . .	
2.2 No tone, no answer	. . .		. . .	
2.3 Absence of a backward line signal	. . .		. . .	
2.4 Other faults	. . .		. . .	
3. Transmission faults		. . .		. . .
3.1 Conversation impossible	. . .		. . .	
3.2 Call overamplified or underamplified	. . .		. . .	
3.3 Noise	. . .		. . .	
3.4 Fading	. . .		. . .	
3.5 Crosstalk	. . .		. . .	
4. Congestion		. . .		. . .
5. Other faults		. . .		. . .
	. . .		. . .	
	. . .		. . .	
	. . .		. . .	
Tests carried out		. . .		100

Test procedure followed (Apparatus used, destination of calls, etc.)

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[a] Delete whichever is inapplicable.

PART V

GUIDING PRINCIPLES FOR THE MAINTENANCE OF INTERNATIONAL AUTOMATIC CIRCUITS

CHAPTER I

RECOMMENDATION Q.70 *

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 good working order.

Preventive maintenance. — Tests, measurements and adjustments to specified 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.

Measurement. — The numerical assessment in suitable units of the value of a simple or complex quantity or magnitude.

Test. — A direct practical trial in whatever manner it may be made.

"Yes or no" test. — A test made to indicate whether a quantity or magnitude would fall above or below a specified limit or boundary defined to distinguish pass and fail conditions.

Functional test. — A "yes or no" test made to indicate whether a circuit, equipment or part of an equipment will function or not function under actual working conditions.

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* This Recommendation also appears in Volume IV of the *Blue Book* (Maintenance) as Recommendation M.70.

Limit test *

A test made to indicate whether a quantity would fall within or without a pair of limits or boundaries.

The required degree of precision of expression is to be achieved by extending the term to state:

— *on what the limit test is made*, for example "circuit limit test".

— *the function or characteristic that is tested,* for example "limit test of signalling", and

— *for what purpose the limit-tests are intended,* for example "limit test for readjustment purposes".

Location of faults

The *broad location* 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.

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* Such a test might be made to ascertain the margin of security in actual operating conditions.

CHAPTER II

RECOMMENDATION Q.71 *

GENERAL MAINTENANCE ORGANIZATION FOR INTERNATIONAL AUTOMATIC CIRCUITS **

1. Principles

For the maintenance of international automatic one-way circuits each Administration shall be responsible for the testing and clearing of faults on its outgoing circuits. That Administration shall be designated the "responsible Administration" for such circuits.

For the maintenance of international automatic both-way circuits, one of the Administrations shall be designated as the "responsible Administration" for each circuit, and shall be responsible for the testing and clearing of faults on that circuit. Such designation shall be mutually agreed upon by the Administrations concerned.

Other Administrations will co-operate in testing and clearing faults on circuits at the request of the appropriate service of the responsible Administration.

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

2.1 The appropriate service which will co-ordinate maintenance at each end of an international circuit is the "International Maintenance Centre", or in short I.M.C. Following section 1 above, in the case of one-way circuits, the I.M.C. of the international outgoing exchange shall be known as the "control I.M.C.", and for both-way circuits, the I.M.C. of the responsible Administration shall be the "control I.M.C."

The person in charge of the I.M.C. 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 For the maintenance of one-way circuits for which it is responsible, the control I.M.C. has the authority to request that appropriate action shall be taken by:

— the international automatic exchange in its own country;
— the control repeater station concerned;
— the maintenance centres in other countries.

For the maintenance of the both-way circuits for which its Administration is responsible, the control I.M.C. is authorized to request action by the other I.M.C.s. The I.M.C.s may call upon the international exchange or repeater station of their country. The control

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* This Recommendation also appears in Volume IV of the *Blue Book* (Maintenance) as Recommendation M.71.

** See Figure 1 (p. 110) at the end of this Recommendation.

I.M.C. must be informed of all faults affecting the circuit for which it is responsible and shall be kept informed of all action taken to trace faults. It shall be for the control I.M.C. to authorize any action likely to put the circuit out of service.

2.3 The operating services (see Figure 1) of an Administration will report all faults likely to affect the international service to their own I.M.C. and to this centre only. For both-way circuits this I.M.C. will in turn report the faults to the control I.M.C., when it is not the control I.M.C. itself.

2.4 The responsibilities of the International Maintenance Centre are as follows:

2.4.1 To receive reports of faults affecting the international circuits with which it is concerned and to report them in turn to the appropriate control I.M.C.

To conduct tests and take other action as appropriate in the clearance of faults. In the case of a control I.M.C., to direct such action in order to locate the fault and co-ordinate clearance of the fault.

2.4.2 To entrust the clearing of such faults to the services in its own country as determined by the location of the fault. In the case of a control I.M.C., to request action on the part of another I.M.C. as determined by the location of the fault.

2.4.3 To ensure that the out-of-service times, due to faults or other causes, of the international circuits, 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. In the case of a both-way circuit, the circuit is returned to service after authorization is given by the control I.M.C. The control I.M.C. shall verify, in co-operation with the corresponding I.M.C., the correct functioning of the circuit before authorizing such action.

2.4.5 To keep detailed records of the faults, locations and clearances with which it has been concerned.

2.4.6 To co-operate with other I.M.C.s concerned in respect of the broad location of faults on international circuits and to accept responsibility at the request of the control I.M.C. for the clearance of faults found to exist in a network depending on this I.M.C.

2.4.7 Having been informed that incoming international circuits have been put out of action, to inform the control I.M.C. For both-way circuits, to put an international circuit out of action at the request of the control I.M.C.

2.4.8 To ensure that the tests prescribed on international circuits are carried out at the specified times and that any faults revealed by such tests are reported to the control I.M.C.

2.4.9 To ensure that new international outgoing circuits are satisfactory in operation before being brought into service and to co-operate with the I.M.C.s in other countries for tests on new incoming circuits. In the case of a control I.M.C., to co-ordinate tests or other necessary action and to authorize the placing in service of the circuit.

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 their possible 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 action in the clearance of faults, the I.M.C.s concerned should possess circuit diagrams of the switching equipment installed in international centres depending on the other I.M.C.s together with any other useful information. It is particularly important that a control I.M.C. possess such information for the international circuits for which it is responsible. It is also desirable that the officer-in-charge of an I.M.C. be permitted to visit other I.M.C.s and installations with which he has contacts.

2.5.5 If considerable alterations are made to the numbering plan in a given country, all the I.M.C.s concerned will be given prior notice. They will moreover be informed of the action taken to deal with calls to the old numbers.

3. Control repeater station

3.1 *One-way circuits*

For each international exchange, the associated repeater station shall be the control station for the automatic circuits leaving the international exchange. Hence, when an international service AB has automatic circuits operated in the direction A to B and automatic circuits operated in the direction B to A, there will be a control repeater station at each end, A and B:

— at A for the circuits from A to B, and

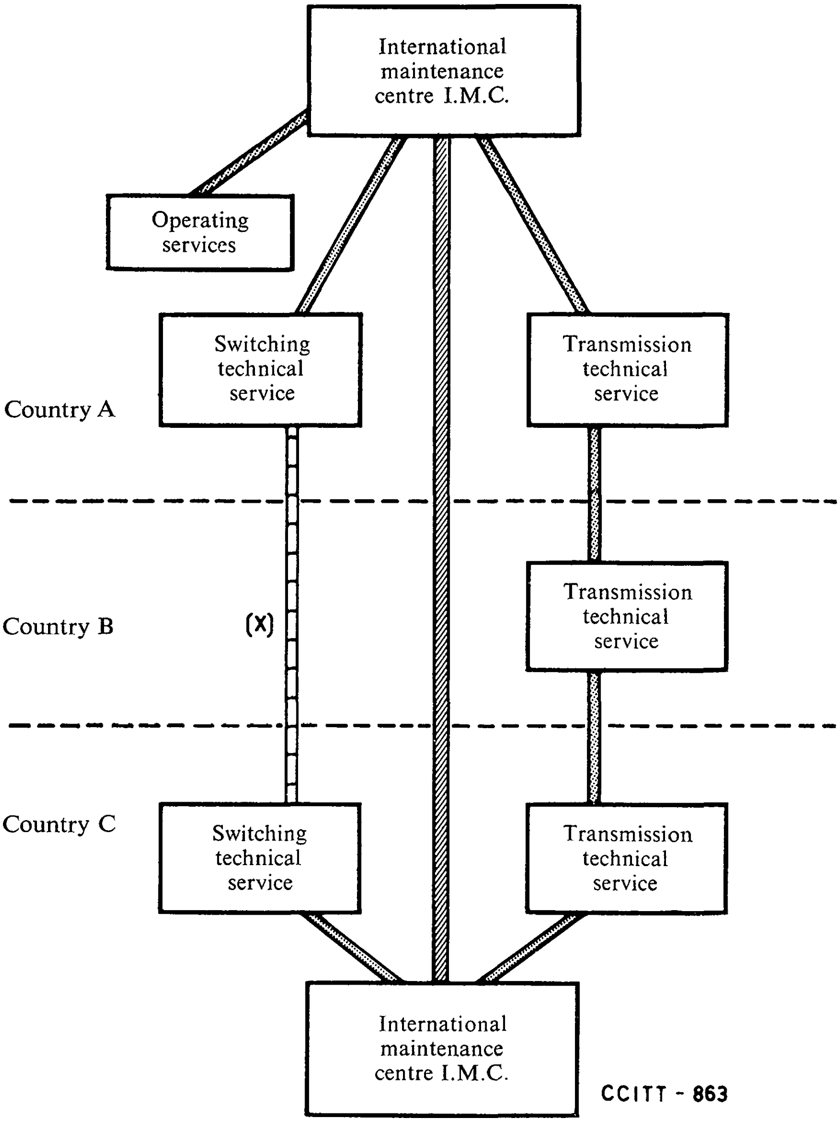
— at B for those from B to A.

3.2 *Both-way circuits*

The control repeater station for a particular international line and the control I.M.C. for the circuit in which this line is shall both lie at the same end of the circuit. Hence, in an international service AB with automatic both-way circuits, some of which depend on the I.M.C. A and others on the I.M.C. B, there will be one control repeater station at A and another at B:

— at A for circuits depending on the control I.M.C. A,

— at B for circuits depending on the control I.M.C. B.



(x) The link between switching technical services of different countries is not considered indispensable. The staff of international automatic exchanges do not normally need to know foreign languages. Where this link exists, it may be of value.

FIGURE 1. — **Organization chart for maintenance of international automatic circuits**

CHAPTER III

RECOMMENDATION Q.72 *

PREVENTIVE MAINTENANCE

1. Functional tests

1.1 In carrying out functional tests ordinary working conditions apply and the equipment and circuits are taken as found.

They are carried out on a systematic basis to discover faults that would influence the quality of service. The response to each signal may be tested by special equipment provided for this purpose. Such tests may be applied to any part of the signalling path.

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

1.3 The organization of the programme for carrying out functional tests locally is left to the discretion of the Administration responsible for the international exchange.

1.4 Over-all functional tests on an international circuit are such that they can be made from one end of the circuit without co-operation of technical personnel at the other end of the circuit. These tests may utilize the switching equipment at each end of the circuit, but such equipment is not being tested directly, only the circuit.

The verification of satisfactory signalling operation may be done by using various types of tests:

a) Certain types of tests not requiring any special equipment, for example 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.

b) Other types combining several tests, using special equipment at both ends. Any type which is in general use by Administrations may be used if suitable and agreed between the Administrations concerned.

2. Circuit limit tests

2.1 A circuit limit test is made to verify that the international circuit meets specified operating margins. These tests enable the performance of the whole international circuit to be checked. They will be made as required but normally at the following times:

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* This Recommendation also appears in Volume IV of the *Blue Book* (Maintenance) as Recommendation M.72.

— before putting the circuit into service,

— according to a systematic test programme which may be based on measurement results or fault (trouble) statistics, or quality of service observations.

They may also be made if functional tests indicate a fault, in order to help the I.M.C. in the location of such a fault.

Circuit limit tests may be made with respect either to transmission or to signalling conditions.

2.2 The frequency of such tests will be determined by the Administrations concerned and the test conditions to be applied will be in conformity with C.C.I.T.T. Recommendations.

2.3 The test equipment, the specifications and methods of gaining access to this equipment are described in the Specifications of international signalling, switching and transmission equipment.

3. Limit tests on the constituent parts of a circuit

3.1 These limit tests are made to verify that the constituent parts of a circuit meet specified operating margins. They will be made as required but normally at the following times:

— at installation,

— if functional or limit tests on the circuit indicate a fault, if such tests will help in fault-location,

— systematic test programmes which may be based on measurement results or trouble statistics or quality of service observations.

3.2 The frequency of such tests will be determined by the Administrations concerned and the test conditions to be applied will be in conformity with C.C.I.T.T. Recommendations.

3.3 Limit tests on constituent parts may indicate that the latter need to be readjusted; in such a case, measurements are made on those constituent parts and they are then readjusted in accordance with the relevant C.C.I.T.T. Recommendations.

3.4 The test equipment, its specification and the provision of access points will be determined by the Administration concerned taking into account the relevant C.C.I.T.T. Recommendations.

4. Maintenance measurements

4.1 Maintenance measurements are made periodically on complete circuits as well as on their constituent parts. Their object is to indicate whether the circuits and equipments will work under the specified conditions and, if not, to allow the necessary readjustment to be carried out.

Some maintenance measurements are made to check signalling operation; others are made to check transmission conditions. They are carried out by the respective technical services responsible for signalling and transmission (repeater stations in the latter case).

4.2 *Measurements concerning signalling*

The conditions for carrying out such measurements, the apparatus used and the periodicity of measurements are decided by the Administration concerned. The conditions for readjustment following such measurements are fixed by:

a) C.C.I.T.T. Recommendations,

b) equipment specifications when these are not given in detail by the C.C.I.T.T.

For example, for carrying out measurements concerning signalling on circuits using C.C.I.T.T. signalling systems No. 3 and No. 4, the C.C.I.T.T. has specified a calibrated signal generator and a signal measuring set (see Recommendation Q.138 in Part IX of this volume).

4.3 *Measurements concerning transmission*

These measurements include:

a) local measurements, for which the Administrations concerned decide the conditions and periodicity,

b) circuit and line measurements for which the conditions are generally defined in the Series M Recommendations of the C.C.I.T.T. *Blue Book*, Volume IV.

These Series M Recommendations give, in particular, the periodicity of the measurements and the conditions for readjustment of transmission equipment.

The C.C.I.T.T. has already specified certain measuring apparatus, and other specifications are being studied by Study Group IV.

CHAPTER IV

RECOMMENDATION Q.73 *

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 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 and outgoing countries, the personnel concerned with the maintenance of the national network 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 shall be reported:

— by the staff of the department to which faults are reported by subscribers;
— by operators;
— by the maintenance staff of the international automatic exchange;
— by the repeater station staff;
— by the officer-in-charge of an I.M.C. in another country.

The circumstances in which faults are to be reported to the I.M.C. shall 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.

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* This Recommendation also appears in Volume IV of the *Blue Book* (Maintenance) as Recommendation M.73.

If, in an international exchange, a fault occurs which affects much of the equipment in that exchange and may hinder the flow of incoming traffic, the I.M.C. of that exchange shall forthwith inform the I.M.C.s of the other exchanges working into the exchange in question.

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 the Part "Specifications" of this volume).

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 repeater station.

The blocking of a circuit by the incoming exchange by means of the blocking signal (C.C.I.T.T. signalling system No. 3) or by the continuous sending of one frequency (in the C.C.I.T.T. signalling system No. 4) 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 location 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 location of the fault. He will determine whether the fault is:

a) in his own country,

b) on the international line,

c) in the distant country.

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

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

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

The clearance of faults will be entrusted by the I.M.C.:

a) to the maintenance staff of the equipment concerned, if the fault is located in its country;

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

c) to the I.M.C. of the distant country, if the fault is located in that country. The latter I.M.C. will in turn entrust the clearance of the fault to:

— either the maintenance staff at its international automatic exchange,
— or any other of its national transmission or switching services concerned.

All faults occurring in a national network and affecting international traffic should be handled in the same way as faults in international circuits. The Administrations concerned will want to have as much information as possible to enable them to take the requisite action in the interests of the service as a whole. Administrations should agree among themselves as to how news about faults should be passed on; alternatively, the I.M.C.s concerned may be left free to decide on this.

7. Records of fault clearance

The control I.M.C. 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.

RECOMMENDATION Q.75 *

TEST ACCESS POINTS

1. The following three clear subdivisions are made for maintenance purposes:

a) the *international line*, i.e. the transmission system situated between the test jack panels of the two terminal repeater stations;

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* See also Recommendation M.66 of Volume IV of the *Blue Book*.

b) the *international circuit*, i.e. the whole of the international line together with the outgoing equipment and the incoming equipment or with the both-way equipments 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.

2. Access points must be provided for testing:

— the international line,

— the outgoing equipment and the incoming equipment or the both-way equipments proper to this line,

— the switching equipment.

It must be possible to test the international line, the outgoing equipment and the incoming equipment separately or in combination with one another. The same applies to an international line with both-way equipment.

It must be possible to test the incoming equipment or the outgoing equipment or the both-way 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.

3. 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 2 should be provided for international exchanges equipped for automatic switching.

4. 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,
- before (or as soon as) a circuit is seized from an access point, that circuit will be made inaccessible to the switching equipment (also at the other end where appropriate). Where necessary the circuit will be marked engaged on the outgoing operators' positions,
- when in System No. 4 an incoming circuit is seized at an access point, a blocking signal must be sent to the outgoing exchange.

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PART VI

TRAFFIC ENGINEERING

RECOMMENDATION Q.80 *

MEASUREMENT OF TRAFFIC FLOW

1. Traffic statistics should be measured for the significant period of each day of the whole year by automatic measuring and recording equipment capable of running continuously.

The recording equipment should make a record of the traffic flow carried during the mean busy hour for at least the 30 days (not necessarily consecutive) of the previous 12 months in which the mean busy-hour traffic flow is the highest. The record should also include the date of such measurements. This method gives traffic information of relatively high accuracy. This method is suitable for circuit groups operated automatically or semi-automatically.

Note. — The traffic flow for the busiest days having been recorded in this way, processing means can be employed to calculate values for the average traffic flow for the 30 and the 5 busiest days during periods of 12 consecutive months. Such pairs of values can be calculated for a period of 12 months terminating in December and/or periods of 12 months terminating at other times.

It is recommended that the minimum requirement is an annual series of values terminating at the same time each year.

2. A second method which yields information of a lower degree of accuracy may be used by Administrations until they are ready to use the first, which is the preferred method. However, under certain circumstances, for manually operated groups of circuits, the second method is the only one possible.

This second method comprises a measuring period of 10 consecutive normal working days during the busiest season of the year. In the determination of the busiest season of the year it is necessary to bear in mind that a pronounced annual growth may cause a busy season at the end of the year to appear to exceed the busiest season which occurred earlier in the year. Since in most cases the busiest season is not clearly defined and varies from

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* This Recommendation also appears as Recommendation E.90 in Series E (Telephone operation, Volume II of the *Blue Book*) of the C.C.I.T.T. Recommendations.

year to year, this method may be improved by taking a consecutive 10-day sample from the results of measurements made over a much longer period, for example 13 weeks covering the busy season(s). This extended period of measurement should provide information about the exceptionally busy days.

3. *Notification of mean busy hour traffic*

Measurements of the mean busy hour traffic, expressed in erlangs and quoting the busy hour on a G.M.T. basis, also the date of measurement or the period for which the estimate is valid, should be communicated to other Administrations concerned in the handling of the traffic.

ANNEX

(to Recommendation Q.80)

Definitions relating to traffic engineering appearing in Recommendation E.1

(see Volume II of the *Blue Book*)

. . . .

DEFINITION 18 **Traffic carried (by a group of circuits or a group of switches)**

18.1 *Amount of traffic carried*

The amount of traffic carried (by a group of circuits or a group of switches) during any period is the sum of the holding times expressed in hours.

18.2 *Traffic flow*

The traffic flow (on a group of circuits or a group of switches) equals the amount of traffic divided by the duration of the observation, provided that the period of observation and the holding times are expressed in the same time units. Traffic flow calculated in this way is expressed in erlangs.

DEFINITION 19 **Traffic offered (to a group of circuits or a group of switches)**

It is necessary to distinguish between traffic offered and traffic carried. The traffic carried is only equal to the traffic offered if all calls are immediately handled (by the group of circuits or group of switches being measured) without any call being lost or delayed on account of congestion.

The flow of traffic offered, and of traffic carried, is expressed in erlangs. The amount of traffic offered and of traffic carried is expressed in erlang hours.

DEFINITION 20 **Measurement of busy hour traffic**

20.1 *Busy hour (of a group of circuits, a group of switches or an exchange, etc.)*

The busy hour is the uninterrupted period of 60 minutes for which the traffic is the maximum.

Note. — It is usual for the period of the busy hour and the amount of traffic in the busy hour to vary from day to day. In order to obtain a representative traffic estimate, it is recommended that an average value should be calculated from the measurement of a sample, as described later.

It is possible to calculate an average traffic flow which is the mean for the busy hours of the different days in the sample. An alternative method is to find the continuous 60-minute period when the average of the sample is the maximum and to obtain from this period the representative traffic flow. The following recommendations relating to the determination of the sample period and of the mean busy hour (sometimes called "time-consistent" busy hour) apply particularly to the second method.

20.2 *Mean busy hour (of a group of circuits, a group of switches, or an exchange, etc.)*

The mean busy hour is the uninterrupted period of 60 minutes for which the total traffic of a sample is the maximum.

Note. — If it is not known which 60-minute period constitutes the mean busy hour, a sample measurement taken over 10 days should be sufficient to enable the position of the mean busy hour to be determined. As it is desirable to have a uniform method of analysing the statistics thus obtained, the following method is recommended for adoption in the international service, the observations being made over quarter-hourly periods:

- for a number of consecutive days the values observed for the same quarter of an hour each day are added together;
- the mean busy hour is then determined as being the four consecutive quarters which together give the largest sum of observed values.

RECOMMENDATION Q.81 *

DETERMINATION OF THE NUMBER OF CIRCUITS NECESSARY TO CARRY A GIVEN TRAFFIC FLOW** IN MANUAL OPERATION

1. The quality of an international manual demand service should be defined as the percentage of bookings which, during the average busy hour (as defined later under 3), cannot be satisfied immediately because no circuit is free in the relation considered.

By "bookings satisfied immediately" are meant those for which the call is established by the same operator who received the call, and within a period of two minutes from receipt of that call, whether the operator (when she does not immediately find a free circuit) continues observation of the group of circuits, or whether she makes several attempts in the course of this period.

Ultimately, it will be desirable to evolve a corresponding definition based on the "average speed" of establishing calls in the busy hour, that is to say the average time which elapses between the moment when the operator has completed the booking of the call and the moment when the called subscriber is on the line, or the caller receives the advice "subscriber engaged", "no reply", etc. But for the moment, in the absence of information about the operating time in the European international service, such a definition cannot be established.

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* This Recommendation dates from the XIIIth Plenary Assembly of the C.C.I.F. (London, 1946) and has not been revised in substance since. This Recommendation also appears as Recommendation E.91 in Series E (Telephone operation, Volume II of the *Blue Book*) of the C.C.I.T.T. Recommendations.

** It should be noted that the determination of the total holding time in this Recommendation is not consistent with the measurement of traffic flow as described in Recommendation Q.80.

2. The number of circuits it is necessary to allocate to an international relation, in order to obtain a given grade of service, should be determined as a function of the "total holding time" of the group in the busy hour.

The total holding time is the product of the number of calls in the busy hour and a factor which is the sum of the average call duration and the average operating time.

These durations will be obtained by means of a large number of observations made during the busy hours, by agreement between the Administrations concerned. If necessary, the particulars entered on the tickets could also serve to determine the average duration of the calls.

The average call duration will be obtained by dividing the total number of minutes of conversation recorded by the recorded number of effective calls.

The average operating time will be obtained by dividing the total number of minutes given to operating (including ineffective calls) by the number of effective calls recorded.

3. The number of calls in the busy hour will be determined from the average of returns taken during the busy hours on a certain number of busy days in the year.

Exceptionally busy days, such as those which occur around certain holidays, etc., will be eliminated from these returns. The Administrations concerned should plan, whenever possible, to put additional circuits into service for these days.

In principle, these returns will be taken during the working days of two consecutive weeks, or during ten consecutive working days. If the monthly traffic curve shows only small variations, they will be repeated twice a year only. They will be taken three or four times a year or more if there are material seasonal variations, so that the average established is in accordance with all the characteristic periods of traffic flow.

4. The total occupied time thus determined should be increased by a certain amount determined by agreement between the Administrations concerned according to the statistics of traffic growth during earlier years, to take account of the probable growth in traffic and the fact that putting new circuits into service takes place some time after they are first found to be necessary.

5. The total holding time of the circuits thus obtained, in conjunction with a suitable table (see below), will enable the required number of circuits to be ascertained.

6. In the international manual telephone service, the following tables A and B should be used as a basis of minimum allocation:

Table A corresponds to about 30% of calls failing at the first attempt because of all circuits being engaged and to about 20% of the calls being deferred.

Table B, corresponding to about 7% of calls deferred, will be used whenever possible.

These tables do not take account of the fact that the possibility of using auxiliary routes permits, particularly for small groups, an increase in the permissible occupation time. In practice such routes are very rare in the international service.

Capacity tables of circuit groups

Number of circuits	Table A		Table B	
	Percentage of circuit usage (Definition in Volume II, Recommendation E.1, para. 21)	Minutes of circuit usage possible in the busy hour	Percentage of circuit usage (Definition in Volume II, Recommendation E.1, para. 21)	Minutes of circuit usage possible in the busy hour
1	65.0	39	—	—
2	76.7	92	46.6	56
3	83.3	150	56.7	102
4	86.7	208	63.3	152
5	88.6	266	68.3	205
6	90.0	324	72.0	259
7	91.0	382	74.5	313
8	91.7	440	76.5	367
9	92.2	498	78.0	421
10	92.6	556	79.2	475
11	93.0	614	80.1	529
12	93.4	672	81.0	583
13	93.6	730	81.7	637
14	93.9	788	82.3	691
15	94.1	846	82.8	745
16	94.2	904	83.2	799
17	94.3	962	83.6	853
18	94.4	1020	83.9	907
19	94.5	1078	84.2	961
20	94.6	1136	84.6	1015

Remark — Tables A and B can be extended for groups comprising more than 20 circuits by using multiples of the values given for 20 circuits.

RECOMMENDATION Q.82 *

DETERMINATION OF THE NUMBER OF CIRCUITS NECESSARY TO CARRY A GIVEN TRAFFIC FLOW IN SEMI-AUTOMATIC** OPERATION

Tables A and B mentioned in Recommendation Q.81 were established principally for the calculation of the number of manually operated circuits.

For reasons of uniformity and convenience, it is preferable, in order to determine the number of circuits required to carry a given traffic in semi-automatic operation, to refer to a formula which is widely used and for which there exist easily obtainable tables and curves.

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* This Recommendation dates from the XVIIth Plenary Assembly of the C.C.I.F. (Geneva, 1954) and has not been revised in substance since. In particular, the indications given in the first and second cases may require further consideration. Also both-way working was not considered at that time. This Recommendation also appears as Recommendation E.92 in Series E (Telephone operation, Volume II of the *Blue Book*) of the C.C.I.T.T. Recommendations.

** For groups of circuits carrying both semi-automatic and automatic traffic see Recommendation Q.84.

In determining the number of circuits necessary in semi-automatic working, the C.C.I.T.T. therefore recommends that Administrations:

1. use, as a basis of calculation, the classical Erlang loss formula (Erlang formula = $E_{1, n}(y)$, also called Erlang B formula, see in Supplement No. 8 of this volume the table and in Supplement No. 9 the two associated graphs giving, for various loss probabilities, the number of circuits corresponding to a given traffic flow according to this formula);

2. adopt for each of the three cases envisaged the loss probabilities defined below;

3. do not attach too rigorous a value, nevertheless, to these loss probabilities, because with semi-automatic operation, assisted by operators who smooth the traffic to a certain extent, it is not possible to determine precisely (by a simple mathematical formula) the number of circuits as a function of a loss probability. Moreover, the conditions in which calls which fail (because of lack of circuits) are later completed are more or less beyond the hypotheses upon which the Erlang loss formula is based. These values, recommended for adoption for the "loss probability", should rather be considered as serving to determine the value of the parameter p indicating the column of the numerical table or the curve it is desirable to use.

First case. — Direct routes without the possibility of using secondary routes and used solely for terminal traffic.

The table or the graph corresponding to a value of the parameter p (loss probability) equal to 5% will be used.

However, in the case where the operators have direct access to the international circuits, or access by means of automatic switches or by selectors which search continuously for a certain time, Table B (Recommendation Q.81) can provisionally continue to be accepted for use in determining the number of circuits necessary to carry a given traffic; the numbers in this table approximate sufficiently closely to a loss probability of 5%.

Second case. — Route on which it is necessary to pass through a transit exchange without the possibility of using secondary routes.

The table or the graph corresponding to a value of the parameter p (loss probability) equal to 3% will be used for each of the groups of circuits constituting a link in the international route.

Third case. — Direct routes (without the possibility of using secondary routes) for which there exist concurrently:

- a group of circuits used for terminal traffic, and
- a group of circuits used for transit traffic (with overflow from the first group to the second).

In this case it is not possible to define a perfect mathematical solution for calculating the number of circuits required. The problem can be considered as a special case such as the one in Recommendation E.93 *bis*, Volume II of the *Blue Book*. Methods can be used which give quick though not very accurate answers. Such a method is described on pages 135 and 136 of Volume VI of the C.C.I.F. *Green Book* (Geneva, 1954).

RECOMMENDATION Q.83 *

CALCULATION OF THE NUMBER OF CIRCUITS IN A GROUP CARRYING OVERFLOW TRAFFIC

Calculation of the number of circuits when there are alternative routes could be based on the methods advocated in Recommendation E.93 *bis* (Volume II of the *Blue Book*). These methods, which approach the problem from the theoretical and mathematical standpoint, are entirely suitable as the basis for a precise economic study of an entire network and particularly for the determination of the best arrangement. Nevertheless they are not entirely appropriate for current usage, when the problem is merely to determine the number of circuits required for a specific flow of traffic with a given grade of service. In these circumstances the C.C.I.T.T. considers that a simplified method for calculating the number of circuits required on overflow systems could be adopted. This simplified method consists of applying the methods described in Recommendations Q.82 and Q.84 as appropriate, using for purposes of calculation the overflow traffic values increased by 2% to 4%.

RECOMMENDATION Q.84 **

DETERMINATION OF THE NUMBER OF CIRCUITS NECESSARY TO CARRY A GIVEN TRAFFIC FLOW WITH AUTOMATIC OPERATION OR WITH BOTH SEMI-AUTOMATIC AND AUTOMATIC OPERATION ON THE SAME GROUP OF CIRCUITS

1. General method

The C.C.I.T.T. recommends that the number of circuits needed for a group should be read from tables or curves based on the classical Erlang loss formula (Erlang formula = $E_{1,n}(y)$, also called Erlang B formula, see Supplements Nos. 8 and 9 in the Documentary Part of this volume). For automatic operation the loss probability should be based on 1% during the mean busy hour. Recommended methods for traffic determination are indicated in Q.80.

In order to provide a satisfactory grade of service both for the mean busy hour traffic and for the traffic on exceptionally busy days, it is recommended that the proposed number of circuits should, if necessary, be increased to ensure that the loss probability shall not exceed 7% during the mean busy hour for the average traffic estimated for the *five busiest days*. This recommendation applies to all circuit groups and may prevent full advantage being taken of the relaxation concerning the computation of the number of circuits in the case of small intercontinental groups described in section 3.

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* This Recommendation also appears as Recommendation E.93 in Series E (Telephone operation, Volume II of the *Blue Book*) of the C.C.I.T.T. Recommendations.

** This Recommendation also appears as Recommendation E.95 in Series E (Telephone operation, Volume II of the *Blue Book*) of the C.C.I.T.T. Recommendations.

2. Groups carrying both automatic and semi-automatic traffic

Semi-automatic traffic using the same circuits as automatic traffic is to be added to the automatic traffic and the same loss probability should be used for the total traffic.

3. Small intercontinental groups

The C.C.I.T.T. considers that on small groups of long intercontinental circuits some relaxation could be made in respect to loss probability. It is envisaged that such circuits would be operated on a both-way basis and that a reasonable minimum for automatic service would be a group of six circuits. A table providing relaxation is annexed and is based on a loss probability of 3% for six circuits, with a smooth progression to 1% for 20 circuits. The general provision for exceptional days remains unchanged.

For exceptional circumstances in which very small groups (less than six circuits) are used for automatic operation, dimensioning of the group should be based on the loss probability of 3%.

4. Time differences

Time differences at the two terminations of intercontinental circuits are likely to be much more pronounced than those on continental circuits. In order to allow for differences on groups containing both-way circuits it will be desirable to acquire information in respect to traffic flow both during the mean busy hour for both directions and during the mean busy hour for each direction.

It is possible that in some cases overflow traffic can be accepted without any necessity to increase the number of circuits, in spite of the fact that this overflow traffic is of a peaky nature. Such circumstances may arise if there is no traffic overflowing from high-usage groups during the mean busy hour of the final group.

5. Both-way circuits

With the use of both-way circuits there is a danger of simultaneous seizure at both ends; this is particularly the case on circuits with a long propagation time. It is advisable to arrange the sequence of selection at the two ends so that such double seizures can only occur when a single circuit remains free.

When all the circuits of a group are operated on a both-way basis, time differences in the directional mean busy hours may result in a total mean busy hour traffic flow for the group which is not the sum of the mean busy hour traffic loads in each direction. Furthermore, such differences in directional mean busy hour may vary with seasons of the year. However, the available methods of traffic measurement can determine the traffic flow during the mean busy hour for this total traffic.

Some intercontinental groups may include one-way as well as both-way operated circuits. It is recommended that in all cases the one-way circuits should be used, when free, in preference to the both-way circuits. The number of circuits to be provided will depend upon the one-way and total traffic.

As the total traffic will need to be determined for its mean busy hour, no time or seasonal differences will be applicable. In the cases where the number of one-way circuits is approximately equal for each direction, no special procedure is necessary, and the calculation can be treated as for a simple two-group grading*.

If the number of one-way circuits is quite different for the two directions, some correction may be needed for the difference in randomness of the flow of calls from the two one-way circuit groups to the both-way circuit group. The general techniques for handling cases of this type are quoted in Recommendation Q.83.

ANNEX

(to Recommendation Q.84)

The following table may be applied to small groups of long intercontinental circuits. The values in column 2 are suitable for a random offered traffic with full availability access. The techniques quoted in Recommendation Q.83 are suitable for final groups and can be used in conjunction with the values in column 2.

For groups requiring more than 20 circuits the table quoted in Supplement No. 8 in the documentary Part for loss probability of 1% should be used.

The table is based on a loss probability of 1% for 20 circuits and increases progressively to a loss probability of 2% at 9 circuits and 3% at 6 circuits. Calculations are based on the Erlang loss formula. (The traffic flow values shown, obtained from a smoothing curve, coincide very nearly with those determined by equal marginal utility theory, i.e. an improvement factor of 0.05 erlang for an additional circuit.)

Number of circuits	Traffic flow (in erlangs)		
	Offered	Carried	Encountering congestion
(1)	(2)	(3)	(4)
6	2.54	2.47	0.08
7	3.13	3.05	0.09
8	3.73	3.65	0.09
9	4.35	4.26	0.09
10	4.99	4.90	0.09
11	5.64	5.55	0.10
12	6.31	6.21	0.10
13	6.99	6.88	0.10
14	7.67	7.57	0.10
15	8.37	8.27	0.11
16	9.08	8.96	0.11
17	9.81	9.69	0.11
18	10.54	10.43	0.11
19	11.28	11.16	0.12
20	12.03	11.91	0.12

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* See article by I. Taange: "Optimal use of both-way circuits in cases of unlimited availability", *TELE*, English Edition, No. 1, 1956.

RECOMMENDATION Q.85 *

AUTOMATIC TRAFFIC-RECORDING DEVICES

Greater use should be made of automatic methods of recording and analysing traffic data because it would appear inevitable that more information regarding the traffic will be required as the continental and intercontinental networks are expanded. Therefore automatic methods, in addition to being more efficient, may well be the only economical ones to use. It is emphasized that, whilst any automatic equipment should not be unduly complicated, it should nevertheless be able to provide output information in a form which will be readily acceptable to an automatic data-processing system.

Attention of Administrations is drawn to the following features given in the Annex for the design of traffic-recording machines; these features cover arrangements which might be made and facilities which might be incorporated.

ANNEX

(to Recommendation Q.85)

Features for automatic traffic-recording machines

1. Basic automatic traffic-recording equipment

1.1 *Purposes*

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.

It is the main purpose of the equipment that measurements may be made, sometimes over extended periods, with the minimum 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 measurements should be printed out or recorded on tape. A typical instruction would 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 would print out and/or record the results on a tape.

1.2 *Measurement period*

It is required that the traffic-recording equipment should be capable of making traffic comparisons either for a single busy hour or for a number of periods during a day.

Until the traffic characteristics of a group of circuits have been established it will be desirable to make daily measurements throughout the year. Such measurements will indicate the busy seasons and the distribution of the busy days. It is recognized that many of the measurements relating to slack days have no lasting value and it is therefore advantageous to consider whether the traffic-recording equipment cannot be designed with facilities such that the output is inhibited

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* This Recommendation also appears as Recommendation E.97 in Series E (Telephone operation, Volume II of the *Blue Book*) of the C.C.I.T.T. Recommendations.

for those days on which the traffic does not exceed some predetermined minimum. As each group would need to have its own predetermined value, the machine would need to have means for storing the reference value for each group.

1.3 *Traffic data necessary to plan for a specified grade of service*

The amount of information necessary for planning will not be identical for all groups of circuits and for all relations *, as some groups of circuits will provide for several relations whereas the traffic for some relations may be divided between different routes. It is desirable that the traffic machine should be designed to measure:

a) carried traffic flow,

b) number of call attempts (including repeated attempts and call attempts not gaining access to a group of international circuits),

c) duration of the periods during which no circuits are available,

d) number of call attempts experiencing congestion.

It is intended that the holding time when needed could be deduced from items *a)* and *b)*. For groups with an adequate number of circuits any measurements under *c)* and *d)* are likely to be of little value.

As congestion increases, the *b)*, *c)* and *d)* measurements become much more important for the following reasons:

i) Measurements of carried traffic will not include calls experiencing congestion. Repeated attempts may result from such calls.

ii) Circuits blocked by the maintenance staff may lead to much more serious congestion than might be expected from the carried-traffic flow.

iii) Although the number of calls experiencing congestion, *d)*, provide more information than the congestion-time measurements, *c)*, complications arise in the case of both-way circuits because the *d)* measurements have to take place in both terminations, and this may result in delay in obtaining access to the full statistics.

1.4 *Traffic measurements for different groups of circuits*

a) The traffic-recording machine is required particularly to collect carried-traffic statistics as defined in Recommendation Q.80. As a general rule, carried-traffic measurements will refer to the whole of a group of circuits between two centres. Such circuits may carry one-way or both-way traffic.

b) Measurement of traffic for particular relations (e.g. between two different countries):

1. *Direct (point-to-point) circuits*

In some cases the traffic for a particular relation will use an independent group of direct circuits (without overflow facilities) and the traffic measurement should be made according to section 1.3.

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* The word "relations" is used to describe the traffic from one particular country to another particular country.

2. *High-usage and final routes*

Some relations will be served by direct high-usage circuits and by overflow facilities. In such cases the direct high-usage group of circuits can be measured according to section 1.3. Such measurements only provide an indication of the traffic flow because the day-to-day fluctuations will be more apparent on the overflow than on the high-usage group.

The arrangement described in the following section 3 indicates means whereby more detailed information can be collected. It should be observed that holding-time statistics are available on the high-usage group, and the traffic machine should be capable of measuring these values directly or by measuring the traffic flow and the corresponding number of calls.

3. *No direct or high-usage circuits*

The traffic for many relations may be combined and switched through a transit centre; in such cases the normal form of measurement cannot provide complete information and reference needs to be made to registers or markers which are aware of call destinations. The C.C.I.T.T. No. 4 and No. 5 signalling systems do not provide facilities to enable transit or incoming calls to be identified by their country of origin and, for the time being, it is possible to make measurements only at the outgoing international exchange. Such measurements should indicate the number of offered calls and the number of calls experiencing congestion. These measurements will not indicate holding time and it does not seem justified to complicate the equipment in order to allow such measurement to be made. It is thought to be sufficient to provide facilities to measure the mean holding time on each group of circuits serving a number of relations. A check can be made of the holding time for any relation by reference to the statistics collected for international accounting. (See Recommendation Q.50.)

It is expected that traffic measurements for particular relations can be taken on a non-continuous basis and that it will be unnecessary to provide facilities for measuring many relations simultaneously. Nevertheless, it must be recognized that the determination of the busy season for a relation may not be easy if the traffic for several relations uses the same group of circuits. Full traffic statistics for a relation can always be measured in special cases by routing the traffic through an additional switching stage at the outgoing centre so that independent measurements can be made.

In many cases the need for information about relations with a small amount of traffic will be limited to ascertaining the advisability of introducing high-usage (direct) circuits. This situation will become evident from statistics for international accounting.

1.5 *Indication of traffic congestion*

A traffic machine which runs continuously has the valuable asset of being able to indicate abnormal congestion quickly.

As a consequence it is recommended that, besides measuring traffic carried on a group of circuits, the machine should be able to recognize when there is congestion and indicate this fact so that immediate action can be taken.

1.6 *Indication of results*

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 to the measuring equipment from the circuits under measurement should be given in the same way for both types of call.

In applications in which it is desired to separate the semi-automatic and automatic call statistics separate indications must be given by the circuits to the measuring equipment.

Facilities should be provided for simultaneous measurement of the four traffic characteristics listed in section 1.3 on any specified group of circuits. It should be possible to give varying instructions to the machine indicating when to make measurements. The individual 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 the circuit group, while the total number of calls and the number of calls experiencing congestion may also be referred to one of several relations served by a circuit group or to a relation served by a number of routes.

The indications for the traffic characteristics in section 1.3 may be given from the individual circuit equipments and/or from common equipment such as markers or registers. It is desirable that the indications follow a given standard.

The number of groups of circuits for which simultaneous measurements are required should be specified separately.

1.7 *Examples of measurements which may be provided by the automatic measuring equipment*

Examples of measurements that may be desired are shown below in section 1.8. In order to indicate the importance these different measurements may be expected to have, the different items have been given the signs I or II having the following meanings:

(I) Measurements expected to be made on all routes for supervision of the network, including its long-term planning.

(II) Measurements expected to be made occasionally on a few routes at the same time, provided that the inclusion of the facilities does not noticeably increase the cost of the equipment.

1.8 *Facilities*

a) Facilities should be provided for measuring the carried traffic flow for a group for any specified period. (I).

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 congestion exceeds a specified limit. (I).

c) Facilities should be provided for measuring and for printing out or recording on tape the total traffic carried during each 15-minute period, so that the mean busy hour may be determined. (I).

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 call attempts 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 counting call attempts 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 call attempts to a specified country during the sample busy hour. (I).

iii) To determine the number of call attempts switched over a direct route to a specified country. (I or II).

iv) To determine the number of call attempts switched over one or more overflow routes to a specified country. (I or II).

v) To determine the number of call attempts to a specified country which are ineffective due to equipment or signalling failures. Such failures might upset the accuracy of traffic measurement in a similar way to congestion. (I or II).

vi) To determine the number of call attempts 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 call attempts on a given route. (II).

viii) To determine the number of subscriber-dialled call attempts on a given route. (II).

1.9 *Control*

It is intended that in principle the recording equipment should be operated in response to processed instructions, for example a message on tape. It is desirable that the arrangement should be of such a form that remote control can easily be arranged.

2. **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 features listed in section 1 are generally needed for this equipment also, there is a basic difference. For the supplementary equipment a typical instruction will be to measure whether the traffic characteristics on a group of circuits between, say, 10 a.m. and 11 a.m. exceeds a predetermined value. If there should be an excess, it is required that an output equipment should be connected at 11 a.m. and that this equipment shall then print out and/or record the resulting information.

2.2 *Traffic characteristics to be recorded*

These requirements are similar to those in section 1 but differ because an average traffic-flow value is not required for every sample period but the value should be passed to output equipment when it exceeds a predetermined figure.

2.3 *Output recording equipment*

This equipment forms the subject of section 3. If a common output is used, then the route must be recorded. It is sufficient to insert the date only once per day.

2.4 *Measurement period*

Traffic-recording equipment should be capable of making traffic comparisons either for a single busy hour or for a number of periods during a day.

3. Central analysing equipment

Central analysing equipment is required to examine the traffic records which have been accumulated. It is assumed that the necessary measurement statistics have been recorded on some medium which can be read by machine (e.g. paper tape).

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 reference is given to Supplements No. 13 and No. 14 in the Documentary Part of this volume. In Supplement No. 13 the table shows 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 month of the 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 new values from the preceding month.

It is expected that, in addition to the analysis which will be needed when planning an extension period, reviews will be advisable to check the rate of growth; such checks may be satisfied by extracting the busiest season and the mean busy-hour traffic for the 5 and 30 highest days. For a more complete analysis it would be interesting to extract such averages for each month and to establish any relationship between these averages.

Although the table in Supplement No. 13 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 table 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.

SPECIFICATIONS
FOR STANDARDIZED INTERNATIONAL SIGNALLING AND SWITCHING EQUIPMENT

INTRODUCTION

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

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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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PART VII

COMMON CLAUSES FOR ALL STANDARD SYSTEMS

CHAPTER I

General

RECOMMENDATION Q.101

1.1 FACILITIES PROVIDED IN INTERNATIONAL SEMI-AUTOMATIC WORKING

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

a) *outgoing* operators,

b) *incoming* operators,

c) *delay* operators,

d) *assistance* operators,

e) information or special service operators*.

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

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

a) subscribers;

b) incoming operators at the incoming international exchange;

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

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* mentioned only in the Instructions for the Intercontinental Telephone Service.

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

e) information or special service operators*.

The outgoing operator should be able to recall incoming and delay operators on calls set up via these operators, by sending a forward-transfer signal as defined under Q.120 and Q.140.

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

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

— any of the operators of this category

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

With respect to the direction in which a required call is set up, the delay operator may be at the outgoing international exchange and may be called by an operator at the incoming international exchange. From the technical point of view and as far as signalling is concerned, however, the delay operator at the outgoing international exchange 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 incoming and delay operators:

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

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

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

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

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* mentioned only in the Instructions for the Intercontinental Telephone Service.

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

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

The assistance operator must be able:

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

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

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

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

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

RECOMMENDATION Q.102

1.2 FACILITIES PROVIDED IN INTERNATIONAL AUTOMATIC WORKING

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

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* mentioned only in the Instructions for the Intercontinental Telephone Service.

** For information operators, see Recommendation E.34 reproduced hereafter in the Annex. Technical arrangements of the same nature as the ones described in paragraph 3 of the Annex could be considered for barring access, in the incoming country, to incoming or delay operators when they are reached not by codes 11 or 12 but by special numbers.

He can have direct dialling access to manual exchanges in the incoming country only subject to certain conditions (these conditions are defined in Recommendation Q.28, para. 2, and in Recommendations Q.120, paras. 1.7 and 1.8, and Q.140, para. 1.8).

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 numerical signals sent. This digit is sent, in order to indicate that the call is automatic, over the international circuit in place of the language digit sent in a semi-automatic call. 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.51;
- enables therefore incoming registers to serve both automatic and semi-automatic service;
- in system No. 4, informs the register in the international incoming exchange that it has not to rely on an end-of-pulsing signal (see Recommendation Q.106);
- enables the equipment in the incoming international exchange to prevent automatic calls from having access to certain destinations (special services, for example).

ANNEX

(to Recommendation Q.102)

Access to a telephone information operator in a foreign country *

1. In the international *automatic* service:

1.1 A subscriber desiring to inquire about a subscriber's number, or to make any general telephone inquiry in another country, must appeal to a special service in his own country, which will obtain the information for him if it is not to hand.

1.2 Technical arrangements should, so far as practicable, bar access by a subscriber in a foreign country to an operator of the telephone information service of another country.

Note. — If it is impossible to prevent subscribers having free access to information operators in a foreign country, there would generally be timing to clear down the call when no answer signal is forthcoming, and the access time to the information service would thus be automatically limited.

1.3 On no account should the numbers or codes giving access to the telephone information services in other countries be included in published dialling code information.

2. *In semi-automatic international service:*

Outgoing operators should be able to get in touch with the information services of foreign countries. It was considered advantageous, and even essential, where big countries were concerned,

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* This text appears in Volume II of the *Blue Book* as Recommendation E.34.

that an operator should be able to obtain information about subscriber numbers from the source, that is to say, from any decentralized services there might happen to be in the foreign country, and not just from some single information bureau in that country.

Provision should be made for access to a centralized service in the country of destination, for the purpose of acquiring information about subscriber numbers, even when direct access to decentralized information services is possible, since the outgoing operator might fear language difficulties, or may not know the number to dial to obtain the regional information service.

3. There are various possible ways whereby operators could be ensured access to the information operators in other countries, and whereby such access could be prohibited to subscribers.

3.1 Automatic calls might be distinguished from semi-automatic ones on arrival. Automatic calls to information services, characterized by the few number of the digits in their call numbers, could be blocked.

3.2 Outgoing operators might be told to get in touch with information operators in a foreign country via incoming operators (so-called code-11 operators). Access to information services would then be blocked for all calls coming from international circuits.

RECOMMENDATION Q.103

1.3 NUMBERING USED

1.3.1 *International prefix*

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

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

1.3.2 *Country code*

Information about country codes will be found under 5.2 in Recommendation Q.11. In the international outgoing exchange, the country code is needed:

a) in automatic working in all cases (for the purpose of giving access to outgoing circuits and to be sent out on these circuits in the case of transit calls);

b) in semi-automatic working in the cases:

- when it is required to give outgoing operators in the outgoing international exchange access to the circuit by means of selectors;
- of transit working.

RECOMMENDATION Q.104

1.4 LANGUAGE DIGIT OR DISCRIMINATING DIGIT

1.4.1 *Language digit*

1.4.1.1 The language digit defined under 1.1.5 indicates the *service language* to be used between operators in the international service, that is to say, the language to be spoken in the incoming international exchange by the incoming, delay and assistance operators when they come on the circuit (Article 33 of the International Instructions and Article 34 of the Intercontinental Instructions). The language digit must be sent on *all* semi-automatic calls.

1.4.1.2 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 1.4.2.2)

1.4.1.3 The sending of the language digit on the international circuit immediately precedes the sending of the national (significant) number*; it is the first digit received by the register in the incoming international terminal 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 national (significant) number of the called subscriber;

or:

— sent automatically by the outgoing register.

1.4.2 *Discriminating digit*

1.4.2.1 In all automatic calls, the position in the sequence of numerical signals occupied by the discriminating digit 0 is that occupied by the language digit in semi-automatic calls (see Recommendation Q.102).

1.4.2.2 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**.

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[*] See definition in Recommendation Q.10.

[**] For example, it might be thought useful to have an additional discriminating digit when a distinction has to be made between:

a) automatic calls and

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

Such a distinction might be necessary because:

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

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

1.4.2.3 Combination No. 13 in the signal code of system No. 4 serves as a discriminating digit in calls to automatic testing equipment (see Recommendation Q.133).

1.4.2.4 *Insertion of the discriminating digit 0*

On all automatic calls the sequence (see Recommendation Q.107) of:

- the discriminating digit 0 and
- the national (significant) number*

must be sent over the international circuit by the country of origin of the call, and this country has to arrange for the insertion of the discriminating digit 0.

RECOMMENDATION Q.105

1.5 NATIONAL (SIGNIFICANT) NUMBER

1.5.1 In automatic working, the subscriber sends the called subscriber's national (significant) number* by means of a dial, keyset, or automatic dialling device.

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

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

RECOMMENDATION Q.106

1.6 THE SENDING-FINISHED SIGNAL

In semi-automatic working, when the international outgoing operator has finished keying or dialling, she operates a special button on her keyboard or a key so that, after the number, a local signal which is called a "sending-finished" signal is sent to the outgoing 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 this signal does not apply.

Remark. — 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. In some cases also in automatic working, when the outgoing register decides that there are no more digits to follow, an end-of-pulsing signal is sent on the international circuit, for example in the ST condition of system No. 5 (see Recommendation Q.152).

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* See the definitions in Recommendation Q.10.

RECOMMENDATION Q.107

1.7 SENDING SEQUENCE OF NUMERICAL SIGNALS

The sequence of numerical signals sent from the operator, calling subscriber or test equipment 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*.

1.7.1 *Semi-automatic working*

1.7.1.1 for a call to a subscriber:

- i) the country code[1]**,
- ii) the language digit[2],
- iii) the national (significant) number of the called subscriber,
- iv) the sending-finished signal;

1.7.1.2 for a call to an incoming operator, or to any delay operator:

- i) the country code[1],
- ii) the language digit[2],
- iii) *a)* code 11[3] or code 12[3], or
  b) a special number,
- iv) the sending-finished signal;

1.7.1.3 for a specific delay operator, or a delay operator in a particular group of positions:

- i) the country code[1]
- ii) the language digit[2],
- iii) *a)* code 12[3] followed by the number of the operator's position (the number given to the operator asked to ring back) or of the group of positions, or

  b) a special number which includes the number of the operator's position or of the group of positions,
- iv) the sending-finished signal;

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

- i) the country code[1],
- ii) the language digit[2],

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* It should be noted that in system No. 5 the sequence of numerical signals sent over the international circuit must be preceded by a KP signal (KP1 or KP2), see Recommendation Q.140.

** For the reference numbers [1], [2], [3], [4], [5], see the notes at the end of this Recommendation.

iii) the code of the required manual exchange in the national numbering plan,

iii) *bis* possibly the called subscriber's number if, in the incoming country, this number is required for routing the call to the manual exchange,

iv) the sending-finished signal;

1.7.1.5 for a call to an information or special service operator in the country of destination:

i) the country code [1],

ii) the language digit [2],

iii) a special number,

iv) the sending-finished signal;

1.7.2 *Automatic working for a call to a subscriber:*

i) the international prefix [4],

ii) the country code [1],

iii) the called subscriber's national (significant) number [5].

1.7.3 *Test calls from test equipment*

See Recommendation Q.133.

Notes:

1) The country 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 1.4.1.3, the operator may not have to send the language digit.

3) When a country has more than one incoming international exchange, code 11 or code 12 may be preceded by one extra digit designating the incoming exchange.

4) The international prefix will not usually be received by the outgoing international register. Obviously, it will not be sent over the international circuit.

5) On the international circuit, the outgoing register will send the discriminating digit 0, followed by the national (significant) number and in some cases then followed by the end-of-pulsing signal.

RECOMMENDATION Q.108

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

1.8.1 *One-way operation of systems No. 3 and No. 4*

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

1.8.2 *Both-way operation of system No. 5*

1.8.2.1 These advantages of one-way operation naturally hold good in the case of long international (intercontinental) circuits. However, for these circuits the following considerations have been determining factors in providing both-way circuit operation in the design of system No. 5 in 1960-1964:

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

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

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

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

1.8.2.3 Attention is drawn to the conditions which should be introduced to avoid double seizing and false blocking on both-way international circuits of system No. 5. In addition attention is drawn to the fact that in semi-automatic working, as in automatic working, access to the circuits at both ends should be automatic.

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

The necessary arrangements have been made in the specifications of system No. 5 concerning simultaneous seizing in both-way operation. (See Recommendation Q.142.)

RECOMMENDATION Q.109

1.9 TRANSMISSION OF THE ANSWER SIGNAL IN INTERNATIONAL EXCHANGES

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

— the conversion of the national answer signal into the international answer signal and vice versa, and

— the transmission of the international answer signal over the international part of the connection,

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

CHAPTER II

Transmission clauses for signalling

CLAUSES COMMON TO SIGNAL RECEIVERS (AND SENDERS) FOR BOTH SIGNALLING SYSTEM No. 4 AND SIGNALLING SYSTEM No. 5

RECOMMENDATION Q.112

2.1 SIGNAL LEVELS AND SIGNAL RECEIVER SENSITIVITY

2.1.1 *Standardized transmitted power*

The standardized transmitted power is defined in paragraphs 3.1.2 of Recommendation Q.122 (system No. 4), 2.3.2 of Recommendation Q.143 and 3.3.2 of Recommendation Q.153 (system No. 5). 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, for example when static modulators are used for signal transmission, should be at least 50 decibels (5.8 nepers) below signal-level per frequency.

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

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

1. the over-all loss and the variation with time of this loss of the international circuit (system No. 5) or of the chain of international circuits (system No. 4) at 800 c/s,

2. the variation with frequency of the over-all loss of these circuits, in relation to the nominal value at 800 c/s,

3. the tolerance on the transmitted absolute power level in relation to the nominal value.

The operate level range of the signal receivers about a nominal value should take account of these three factors. In system No. 4, the operate range (± 9 db (± 1 neper), see 3.2.1 in Recommendation Q.123) is appropriate for end-to-end signalling. The maximum number of circuits in the end-to-end signalling situation is normally three but more may be possible depending upon the actual conditions. In system No. 5, the operate range (± 7 db (± 8 dN), see 2.4.1 in Recommendation Q.144 for line signals and 3.4.1 in Recommendation Q.154 for register signals) is appropriate for each circuit in link-by-link signalling.

2.1.3 *Maximum sensitivity of the signal receiver*

It is desirable to limit the maximum sensitivity of the signal receiver (see 3.2.2 *b*) in Recommendation Q.123 for system No. 4, 2.4.2 *b)* and 3.4.2 *a)* in Recommendations Q.144 and Q.154 for system No. 5) particularly in view of the fact that the lower limit fixed for the crosstalk ratio between the GO and RETURN paths of a four-wire circuit is only 35 decibels (4 nepers).

RECOMMENDATION Q.113

2.2 CONNECTION OF SIGNAL RECEIVERS IN THE CIRCUIT

2.2.1 The line signal receiver is connected permanently to the four-wire side of the circuit. The register signal receiver in system No. 5 is connected to the four-wire side of the circuit when the register is associated with the circuit for the setting-up of the call.

2.2.2 The line 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 line signal receiver is connected, these disturbing currents are of such a level that they cannot:

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

The additional attenuation introduced should in consequence take account of:

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

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

–18 + *n* db (–21 + *n* dN) in the case of system No. 4 (see 3.2.1 in Recommendation Q.123)
–16 + *n* db (–18 + *n* dN) in the case of system No. 5 (see 2.4.1 in Recommendation Q.144);

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 dbm0 (+11 dNm0) in the direction *opposite* to that of the signals. The nature of the switching noises depends on the national systems used;

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

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

(Q.113)

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

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

RECOMMENDATION Q.114

2.3 TYPICAL TRANSMISSION REQUIREMENTS FOR SIGNAL SENDERS AND RECEIVERS

2.3.1 The following clauses 2.3.2 to 2.3.7 concerning line signal receivers (including the buffer amplifier or equivalent device) apply only in the case where the signal receiver is a four-terminal device ("quadripole") and where the nominal circuit impedance is 600 ohms.

2.3.2 *Input and output impedance*

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

Z_E and Z_S, which are respectively the measured values of the input and output 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.

2.3.3 *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:

$$A \pm 0.5 \text{ decibel (or } A \pm 0.05 \text{ neper)}$$

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

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

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

$$1.55 \cdot e^{n} \text{ volts, if } n \text{ is expressed in nepers}$$

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

2.3.4 *Attenuation distortion*

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

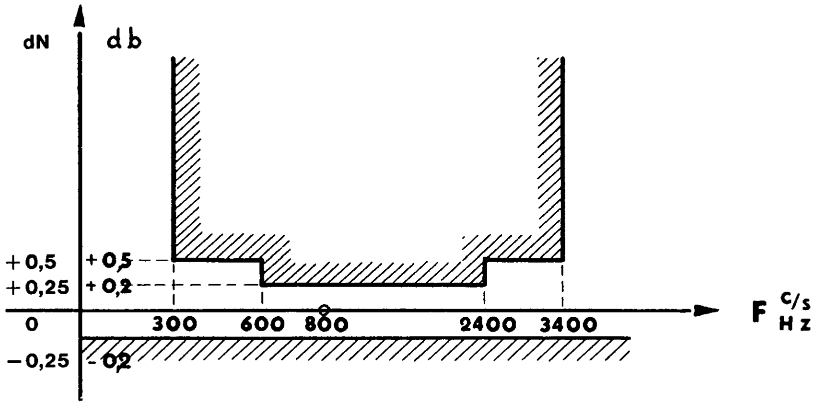


FIGURE 1

As in certain cases system No. 5 may be applied to circuits in transmission systems with a channel spacing of less than 4 kc/s, the 300-c/s lower limit shown above may be replaced by 200 c/s for system No. 5.

2.3.5 *Non-linear distortion*

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

2.3.6 *Balance*

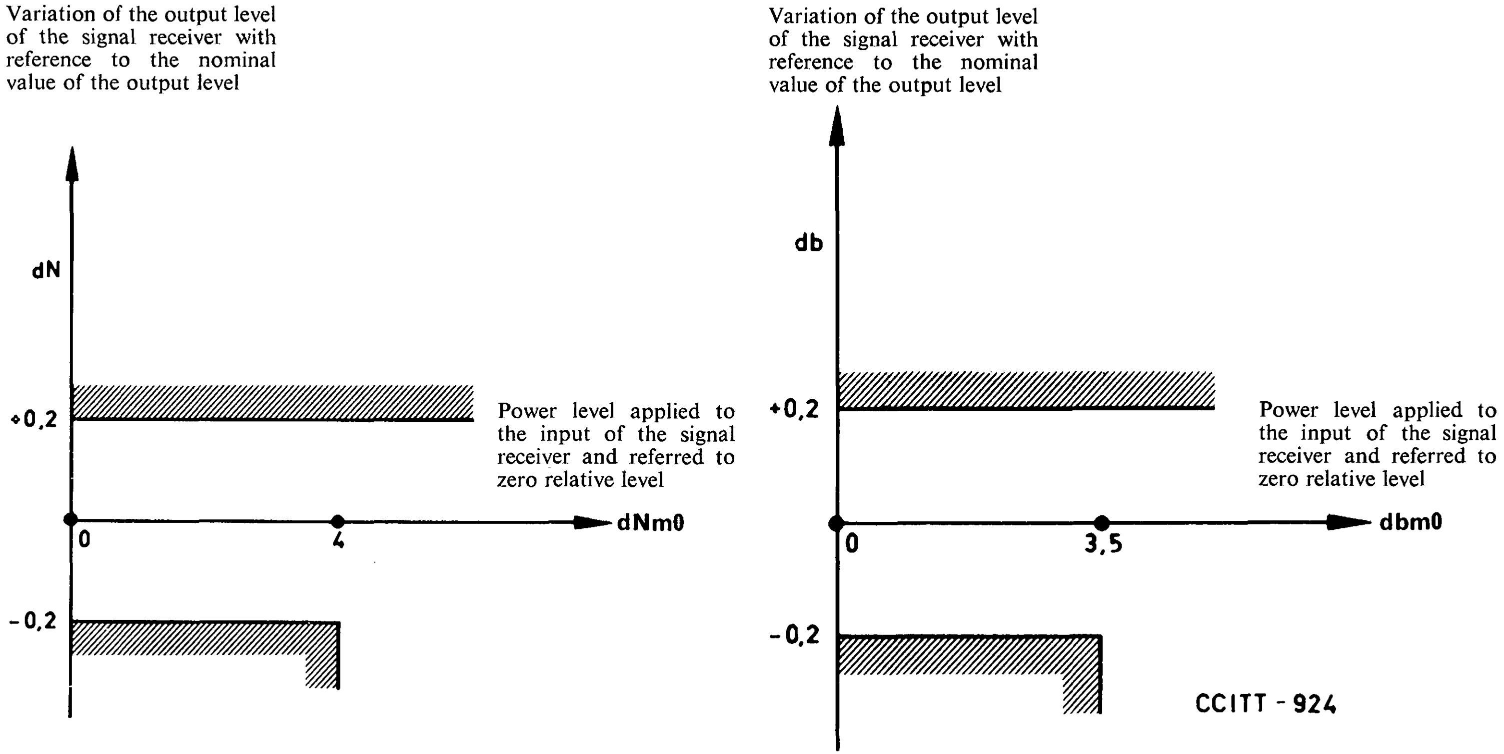
The input and output of the signal receiver should have a high degree of balance to earth, the admittance of each terminal to earth being very low.

The same clause should apply to the signal sender.

2.3.7 *Crosstalk between adjacent signal receivers*

The crosstalk ratio between two adjacent signal receivers should not be less than 74 db (8.5 nepers) in the relevant frequency band.

2.3.8 During the register signalling period no speech transmission takes place. It is not essential therefore for the register signalling equipment of system No. 5 to take account of clauses 2.3.2 to 2.3.7 but it is desirable to adopt appropriate clauses for efficient signalling performance.



Graph with decineper scale

Graph with decibel scale

FIGURE 2. — **Limits for non-linear distortion due to the insertion of the signal receiver**

RECOMMENDATION Q.115

2.4 CONTROL OF ECHO SUPPRESSORS

a) Arrangements should be incorporated in the switching equipment to prevent echo suppressor action disturbing simultaneous forward and backward signalling. Typical arrangements are:

i) Locating the echo suppressors on the switching side of the signalling equipment;

ii) Inhibiting the action of echo suppressors located on the line side of the signalling equipment by means of an appropriate condition extended from the signalling equipment to the echo suppressor while signalling is in progress.

b) Arrangements should be incorporated at a transit exchange to disconnect, for the duration of a call, the incoming and outgoing half-echo suppressors should these be present on the two circuits switched in tandem.

This echo-suppressor disconnect feature shall not apply when the two circuits switched in tandem have:

i) an incoming or an outgoing half-echo suppressor only,

ii) an incoming or an outgoing full-echo suppressor only, or

iii) a half-echo suppressor on one circuit and a full-echo suppressor on the other.

CHAPTER III

Abnormal conditions

RECOMMENDATION Q.116

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

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

The tables in Annex 2 for system No. 4 and in Annex 2 for system No. 5 give details of the signals that are received at the outgoing exchange when abnormal conditions occur in setting up a call; see also Recommendation Q.127 (for system No. 4) and Recommendation Q.156 (for system No. 5). Each Administration will decide how these signals are to be translated into appropriate indications for outgoing operators or calling subscribers.

RECOMMENDATION Q.117

3.2 ALARMS FOR TECHNICAL STAFF AND ARRANGEMENTS IN CASE OF FAULTS

3.2.1 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.

3.2.2 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.

3.2.3 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.

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

RECOMMENDATION Q.118

3.3 SPECIAL RELEASE ARRANGEMENTS

3.3.1 *Answer signal not received by an outgoing exchange after receiving a number-received signal (system No. 4) or after transmitting the ST signal (system No. 5)*

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

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

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

In automatic working arrangements must be made to clear the international connection and stop the charging if, between one and two minutes after receipt of the clear-back signal, 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.

3.3.3 *Clear-forward signal not received by the incoming exchange after sending a clear-back signal*

The incoming circuits at the incoming international exchange should include an arrangement for releasing the national part of the connection if, after sending a clear-back signal, a clear-forward signal is not received within 2 to 3 minutes (provided that a similar arrangement is not already made in the national network of the incoming country). This arrangement avoids indefinite blocking of the national circuits of the country of destination or of the subscriber's line in the case of interruptions of the line or equipment faults.

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PART VIII

RECOMMENDATION Q.119

C.C.I.T.T. SYSTEM No. 3

C.C.I.T.T. system No. 3 was studied between 1946 and 1949, subject to field trials from 1949 to 1954, and standardized by the C.C.I.F. in 1954 as the "one-frequency system". Detailed specifications for this system were drawn up in 1955 and underwent minor amendments during the revisions made in 1956 and 1960. The study of the system, which is applicable in semi-automatic and automatic working, was not carried beyond the stage of terminal traffic operation. It is used only for that purpose on the European continent, and the C.C.I.T.T. therefore decided in 1964 that, in principle, it should not be used in new international connections.

The system uses the frequency 2280 c/s for transmitting line and register signals and provides for one-way circuits only.

The specification of signalling system No. 3 is described in Part 5 of Volume VI of the *Red Book* (New Delhi, 1960). The clauses which relate specifically to this system (Recommendations Q.76 to Q.79) appear in Chapter V (pages 116 to 125) of the *Red Book*.

Section 5.2.3 (Efficiency of the guard circuit) (page 117 in Volume VI of the *Red Book*) should, however, be amended according to a decision of the IIIrd C.C.I.T.T. Plenary Assembly (Geneva, 1964) by inserting the following text between the first and second paragraphs:

"To minimize signal imitation by speech currents it is advisable that the guard circuit be tuned.

To minimize signal interference by low frequency noise it is advisable that the response of the guard circuit falls off towards the lower frequencies and that the sensitivity of the guard circuit at 200 c/s be at least 10 db (or 12 dN) less than that at 1000 c/s."

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PART IX

SIGNALLING SYSTEM No. 4

CHAPTER I

Definition and function of signals

RECOMMENDATION Q.120

1. DEFINITION AND FUNCTION OF SIGNALS

1.1 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 the call to the national network of the incoming country;

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

1.2 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 signals.

In system No. 4 two different proceed-to-send signals are provided:

a) the *terminal* proceed-to-send signal, used to invite the sending of the language digit * (or the discriminating digit *) plus the national (significant) number *;

b) the *transit* proceed-to-send signal, used to invite the sending of only those numerical signals (beginning with the first digit of the country code *) necessary for routing the call through the international transit exchange towards the incoming international exchange or to another international transit exchange.

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* For definitions, see Recommendations Q.10 and 104.

1.3 **Numerical 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 numerical signals sent.

1.4 **End-of-pulsing signal,** also called for system No. 4 "code 15" (sent in the forward direction)

This numerical type signal is sent from the international outgoing exchange to show that there are no more numerical signals to follow. In semi-automatic working this signal is always sent. In automatic working this signal *may* be sent, viz., when, in the outgoing international exchange, it is known that there are no more digits to follow.

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

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

Purpose of the signal

1.5.2 In semi-automatic working, the number-received signal may be used to inform the outgoing operator that the international switching operations have been completed.

1.5.3 In automatic working, this signal is 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.

Generation of the signal

1.5.4 In semi-automatic working, the incoming register (or associated equipment) sends back the number-received signal after reception of the end-of-pulsing signal.

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

1.5.5.1 by the receipt of the end-of-pulsing signal; or

1.5.5.2 *a)* by checking the number of digits received, in countries where the national (significant) number * is always made up of the same number of digits; or

b) in countries where this is not so:

i) by the receipt of the maximum number of digits, used in the numbering plan of the country; or

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* See definition in Recommendation Q.10.

** See Recommendation Q.180 for the case of interworking from system No. 4 to system No. 5 (ST signal).

ii) by analysing the first digits in the national (significant) number * to decide how many digits there are in the subscribers' numbers in the particular national numbering zone; or

iii) by using a national end-of-selection signal or national "electrical" ringing-tone signal; or

iv) exceptionally, by observing that 4 to 10 (for new equipment 4 to 6) 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.

1.6 **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 or on the appropriate outgoing routes.

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 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 optional because there are several countries that do not send it from their national networks.

Note. — The receipt of the busy-flash signal at the outgoing exchange will cause:

— an appropriate indication to be given to the outgoing operator or to the calling subscriber; and

— in automatic working, 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).

1.7 **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.

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* See definition in Recommendation Q.10.

** 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.

1.8 **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 open the speech path at the outgoing international exchange.

In automatic working, arrangements must be made to clear the international connection, stop the charging and stop the measurements of call duration 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

1.8.1 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 not always be able 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.

1.8.2 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.

1.8.3 NOTE 3. — 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 an incoming or a delay 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:

- an incoming or a delay operator at the international exchange, and
- an operator at a national manual exchange.

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

c.2) The international 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 or the delay 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.

1.9 Clear-forward signal (sent in the forward direction)

1.9.1 This signal is sent in the forward direction at the end of a 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 3.3.1 and 3.3.2 in Recommendation Q.118 and Recommendation Q.131.

In semi-automatic working there may be forced release in the case of paragraph 3.3.1 of Recommendation Q.118.

1.9.2 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.

1.9.3 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.

1.10 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 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.

1.11 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.

1.12 **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 the circuit if the call is automatically set up at that exchange. When a call is completed via an operator (incoming operator or delay operator) at the incoming international exchange, the signal will cause this operator to be recalled.

1.13 Diagrams showing signal sequence

The sequence of signals in semi-automatic and automatic working is shown in Tables 1 and 2 of Annex 1 (see p. 194 *et seq.*). Tables of Annex 2 (see p. 201 *et seq.*) give a description of the operations corresponding to the various normal and abnormal conditions which may arise in setting up a call.

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* See the definition of assistance operator in paragraph 1.1.6 of Recommendation Q.101.

CHAPTER II

Signal code

RECOMMENDATION Q.121

2. SIGNAL CODE

2.1 General

The signals of system No. 4 are:

- — signals called "line signals" for the so-called supervisory functions,
- — signals (binary code signals and their acknowledgement signals) used for the transmission of numerical information.

2.2 Transit working

In transit operation, the line equipment at the transit exchange shall keep memory that the condition is transit; this will facilitate, in particular, the parallel reception of the clear-forward signal at the transit and incoming international exchanges. (See Recommendation Q.120, item 1.9.)

2.3 Line signals

2.3.1 *Line signal code*

The line signal code is given in Table 1.

The use of two frequencies in this code makes it possible to form a characteristic *compound 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 compound 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 at the receiving end 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 1 have the following significance:

Prefix signal element	P	prefix signal constituted by two frequencies x and y compounded
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 1

Code for signalling system No. 4

List No.	Name of signal	Code
(See Rec. Q.120)	FORWARD SIGNALS	
1	*a)* Terminal seizing — *Prise terminale*	**PX**
	b) Transit seizing — *Prise pour transit international*	**PY**
3	Numerical signals — *Signaux de numérotation*	Binary code (See Table 2)
4	End-of-pulsing signal — *Signal de fin de numérotation*	
9	Clear-forward — *Signal de fin*	**PXX**
12	Forward transfer — *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 — *Numéro reçu*	**P**
6	Busy-flash — *Occupation*	**PX**
7	Answer — *Réponse*	**PY**
8	Clear-back — *Raccrochage du demandé*	**PX**
10	Release-guard — *Libération de garde*	**PYY**
11	Blocking * — *Blocage*	**PX**
—	(Unblocking) *(Déblocage)* = use of signal 10 of the list	**PYY**

* In addition to the blocking which results from 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 (see Recommendation Q.73) given to the maintenance staff stipulate that such an occupation of a circuit should be as short as possible and in any case less than 5 minutes.

2.3.2 *Sending duration of line signal elements*

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

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 instants 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.

2.3.3 *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 over-all 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 recognize a signal only after 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 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.

2.4 Numerical signals

2.4.1 *Binary numerical signal code*

The numerical signal code is given in Table 2. This code is a binary code of four elements each separated from the next by a short interval of silence *s*; each element consists of the sending of one or other of the signalling frequencies.

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* See definition of recognition time in 2.5 hereafter.

The symbols used in Table 2 and in Figure 2 have the following significance:

x short element of the single frequency x
y short element of the single frequency y

TABLE 2

Binary code of system No. 4

Signal	Combination				
	Number	Elements			
		1	2	3	4
Digit 1	1	y	y	y	x
,, 2	2	y	y	x	y
,, 3	3	y	y	x	x
,, 4	4	y	x	y	y
,, 5	5	y	x	y	x
,, 6	6	y	x	x	y
,, 7	7	y	x	x	x
,, 8	8	x	y	y	y
,, 9	9	x	y	y	x
,, 0	10	x	y	x	y
Call operator code 11	11	x	y	x	x
Call operator code 12	12	x	x	y	y
Spare code (except case envisaged under 1.4.2.3 of Q.104)	13	x	x	y	x
Spare code	14	x	x	x	y
End-of-pulsing	15	x	x	x	x
Spare code	16	y	y	y	y

The relation between the transmitted digits and the different combinations of the binary code is arrived at by giving the value 8, 4, 2 or 1 to the presence of an element x depending on whether this element x constitutes the 1st, 2nd, 3rd or 4th element of the numerical code.

2.4.2 *Sending duration of the signal elements x and y*

The sending duration of the signal elements x and y to line, as voice-frequency signals, shall be:

$$35 \pm 7 \text{ ms.}$$

The sending duration of the interval of silence s between signal elements of the same digit shall have the same value of 35±7 ms.

(The maximum duration of the signal elements and intervals of silence is not a critical factor in the design of the system but is specified in order that the speed of signalling is not unduly slow.)

2.4.3 *Recognition time * of the x, y and s elements at the receiving end*

The recognition time by the incoming switching equipment:

a) of the direct-current signal elements x and y,

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* See definition of the " recognition time " in 2.5 under *d*).

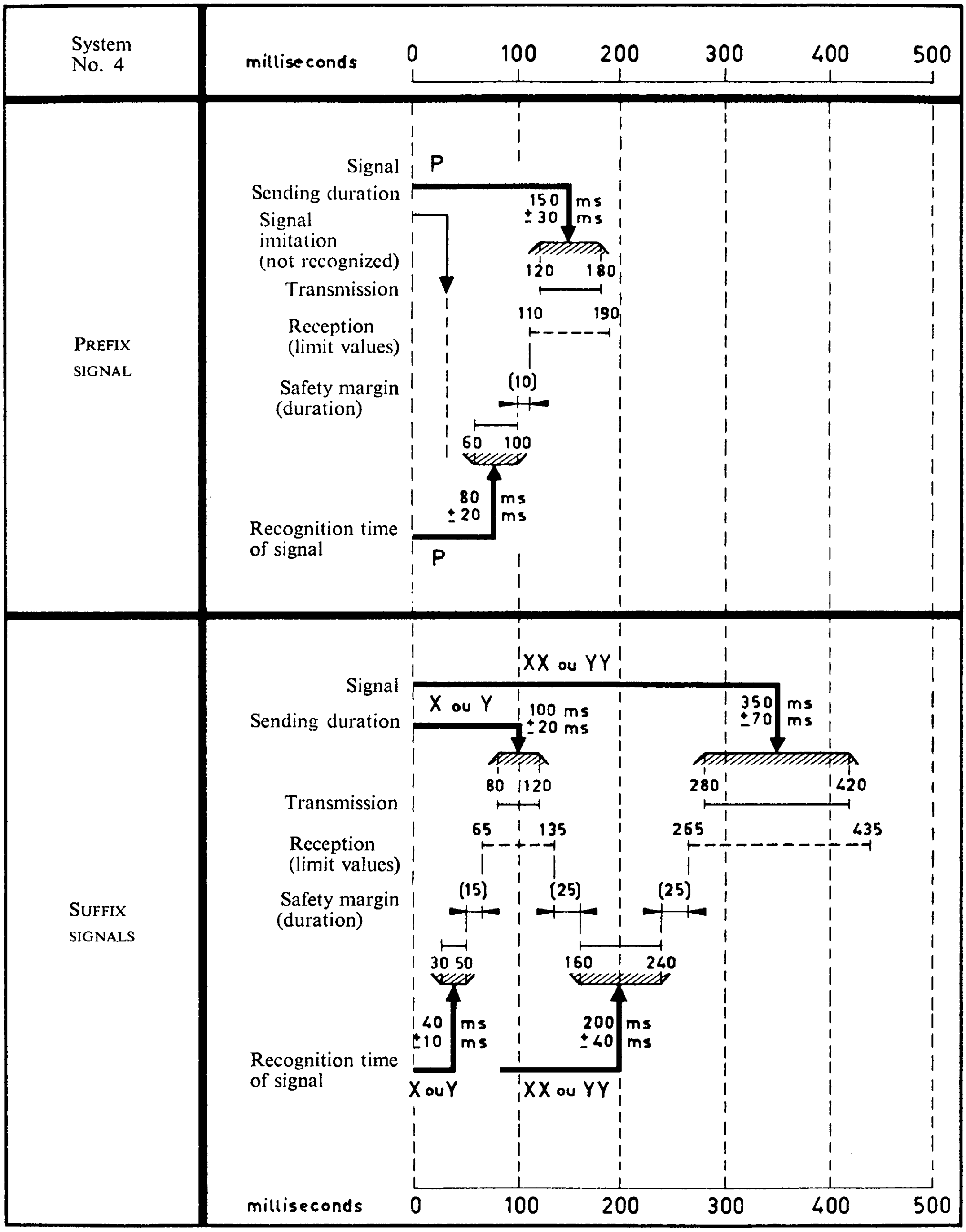

FIGURE 1. — **Duration of line signal elements**

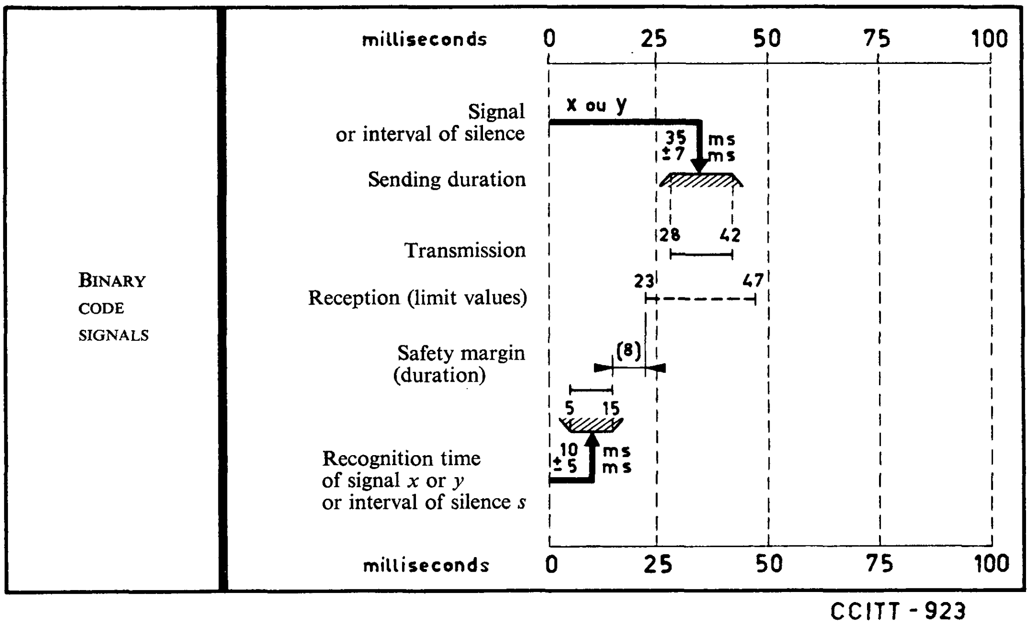

FIGURE 2. — **Numerical signal elements**

Legend to Figures 1 and 2

Signalling timing diagrams

Figures 1 and 2 give diagrams showing for line signal elements (Figure 1) and for numerical signal elements x and y (Figure 2):

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 (which assumes an operating margin) of the receiving 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.*

b) of intervals of silence *s*

received from the output of the signal receiver is:

10±5 ms.

2.4.4 *Acknowledgement signals*

Incoming international and international transit exchanges shall return an acknowledgement signal to the outgoing international exchange *at the end of the reception* of the 4th element of a numerical signal.

At the outgoing international exchange a numerical signal will be sent only 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 is recognized.*

Two types of acknowledgement signals are provided, one constituted by the signal element *x* defined above and the other constituted by the signal element *y* defined above.

The acknowledgement signal *x* has two meanings:

- after a terminal proceed-to-send signal has been received by the outgoing register: "digit received; send next digit"
- after a transit proceed-to-send signal, but before a terminal proceed-to-send signal has been received: "digit received; stop the sending of digits".

The acknowledgement signal *y* has one meaning only, i.e. after a transit proceed-to-send signal has been received: "digit received; send next digit".

2.5 Signalling timing diagrams

Figures 1 and 2 give diagrams showing for line signal elements (Figure 1) and for numerical signal elements *x* and *y* (Figure 2):

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 of the receiving switching equipment; this time assumes an operating margin and 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.*

2.6 General note on the operation of signalling and switching equipment

The tolerances defined in sections 2.3 and 2.4 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 III

Signal sender and signal receiver

RECOMMENDATION Q.122

3.1 SIGNAL SENDER *

3.1.1 *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.

3.1.2 *Absolute power level transmitted*

The absolute power level of the unmodulated signal frequencies at a zero relative level point shall be −9 dbm (−10 dNm) with a tolerance of ± 1 db or ± 1 dN.

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 0.5 db or 0.5 dN.

Note. — The level of the leak current which might be transmitted to line, for example when static modulators are used for signal transmission, should be at least 50 db (5.8 nepers) below signal level per frequency.

RECOMMENDATION Q.123

3.2 SIGNAL RECEIVER *

3.2.1 *Operating limits of the signal receiver*

The signal receiver shall operate in the conditions specified under 3.2.5 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

$$-18 + n \leqslant \mathrm{N} \leqslant n \text{ dbm} \quad \text{or} \quad -2 + n \leqslant \mathrm{N} \leqslant n \text{ Nm}$$

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

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* See also Recommendation Q.112.

These limits give a margin * of ± 9 db (± 10 dN) 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 3 db (3.5 dN) above, nor more than 6 db (7 dN) below 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.

3.2.2 *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 3.2.1 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 $(-26-9+n)$ dbm or $(-3-1+n)$ Nm, n being the relative power level at this point.

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

3.2.3 *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 is long enough to be recognized as signals by the switching equipment),

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

To minimize signal imitation by speech currents it is advisable that the guard circuit be tuned.

To minimize signal interference by low-frequency noise, it is advisable that the response of the guard circuit falls off towards the lower frequencies and that the sensitivity of the guard circuit at 200 c/s be at least 10 db (12 dN) less than that at 1000 c/s.

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

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* See 2.1.2 of Recommendation Q.112.

signalling frequencies lasting more than 55 ms (the minimum recognition time of a compound signal element is 60 ms),

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.

3.2.4 *Guard circuit limits*

A. *Steady noise*

Considering

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

b) that unweighted noise of a level −40 dbm0 (−4.6 Nm0) (100 000 pW) and uniform spectrum energy may arise during end-to-end signalling over a multilink chain of system No. 4 circuits,

it is recommended that, for either one or two signalling currents (each being within the limits of level specified in paragraph 3.2.1) the signal receiver should satisfy the conditions indicated in paragraph 3.2.5 for the distortion of signals in the presence of noise of a level of −40 dbm0 (−4.6 Nm0) and uniform spectrum energy over the frequency range 300 to 3400 c/s.

B. *Surges*

A guard circuit with an excessive hangover 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 $(-10+n)$ dbm or $(-12+n)$ dNm 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 3.2.1, the lengths of the received signals must remain within the limits specified in paragraph 3.2.5.

3.2.5 *Distortion of received signals*

When the signal frequencies and levels are within the limits specified in paragraph 3.2.1, 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 3.2.4 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 the 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.

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* See the definition of prefix and suffix signals under paragraph 2.3.1 of Recommendation Q.121.

CHAPTER IV

Switching conditions

RECOMMENDATION Q.124

4.1 SPLITTING ARRANGEMENTS *

Sending line split

4.1.1 According to Recommendation Q.25, section B, sending split arrangements have to be provided.

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

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

Receiving line split

4.1.4 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.

The splitting time of 55 ms may be reduced by each Administration concerned, in in order to help to protect 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 impair speech transmission.

4.1.5 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 paragraph 3.2.5.1 *b)*.

4.1.6 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 for setting up an international call.

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* See Recommendation Q.25.

RECOMMENDATION Q.125

4.2 SPEED OF SWITCHING IN INTERNATIONAL EXCHANGES

4.2.1 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.

4.2.2 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.

4.2.3 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.

4.2.4 At international exchanges, use may 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, at incoming and transit exchanges, 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 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 receipt, at an incoming exchange, of the information necessary for determining the required route, if congestion is encountered;
- a maximum delay of 10 seconds following receipt of the digits necessary to determine the routing at a transit exchange, if congestion is encountered.

RECOMMENDATION Q.126

4.3 ANALYSIS AND TRANSFER OF DIGITAL INFORMATION

4.3.1 *General requirements for the transit exchange*

In an international transit exchange an analysis of some of the digits is required to determine the routing * to the desired international incoming exchange or to another

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* See Recommendation Q.11, paragraph 1.2.

international transit exchange. As a general rule the country code of the destination country is subject to this analysis. In some cases an analysis of more or fewer digits may be required (see Annex hereafter).

The transit exchange decides how many digits it needs for this analysis and asks for the sending of these digits from the outgoing register by means of the acknowledgement signals as indicated in the Annex.

4.3.2 *Maximum number of digits transmitted to an international transit exchange*

1. The *maximum* number of digits which has to be transmitted to a transit exchange to determine the routing at this exchange is as follows:

$I_1 \quad Z \quad N_1 \quad N_2 \quad N_3$

$I_1 \quad I_2 \quad Z \quad N_1 \quad N_2$

$I_1 \quad I_2 \quad I_3 \quad Z \quad N_1 \quad N_2$

where I_1, I_2, I_3 = digits of the country code

Z = characteristic digit, i.e. discriminating digit (D) or language digit (L), and

N_1, – – –, N_n = digits of the national (significant) number.

Note. — In the case of countries with more than one incoming international exchange where code 11 or code 12 traffic requires for routing in the transit exchange a digit analysis beyond the country code, N_1 is the extra-digit designating the incoming international exchange.

2. Accordingly, the *maximum* number of digits that has to be analysed at an international transit exchange is six, which number includes the language or the discriminating digit.

4.3.3 *Digital analysis for routing at the outgoing international exchange*

The *maximum* number of digits which has to be analysed in the outgoing international exchange to determine the routing is also six, as in paragraph 4.3.2.2 above for the transit exchange. This number of six digits includes the language or the discriminating digit.

4.3.4 *Digital analysis for inserting (or detecting) the language or the discriminating digit*

1. In semi-automatic working in the case where the language digit is not sent by the operator and in automatic working, it is necessary to determine in the outgoing international exchange the position where the language or discriminating digit should be automatically inserted (immediately after the country code). This position is determined by an analysis of the first or the first two digits of the country code.

2. In an international transit exchange an analysis, effective on the first or the first two digits of the country code, determines the number of digits in the country code. The position of the language or the discriminating digit which in the sequence of numerical information follows immediately the country code is thus determined.

4.3.5 *Use of acknowledgement signals x and y for controlling the transfer of digits*

In order to reduce the digit transfer to the minimum, the transit register shall decide how many digits it needs for routing a call. Thus the translator intelligence with regard to routing which has to be available in any one exchange will only have to include those routes directly accessible by this exchange.

The transfer of digits to a transit or to a terminal exchange is controlled by backward signals. The interpretation of these backward signals is as follows:

Backward signal	Name of the signal	Interpretation at the outgoing exchange
X	Terminal proceed-to-send	Send discriminating (or language) digit (Z)
Y	Transit proceed-to-send	Send first digit (I_1) of country code
x	Acknowledgement x	Acknowledgement of digit received with the alternative meaning according to the type of the last proceed-to-send signal received *a)* after signal X, " send next digit ", *b)* after signal Y, " stop the sending of digits "
y	Acknowledgement y (used only after a transit proceed-to-send signal Y)	Acknowledgement of digit received; send the next digit.

Remark. — According to the design of the transit register the acknowledgement signal y can be sent back by the register:

— either after a digit-by-digit consultation of the routing translator by the register, or

— immediately after reception of each digit, and this until a sufficient number of digits has been received.

ANNEX

(to Recommendation Q.126)

Examples of digit transfer control by a transit exchange

A list of possible cases for the digit transfer control by a transit exchange is the following (the letters given to the international exchanges correspond to the figure and the letters given to the digits correspond to paragraph 4.3.2 of this Recommendation):

1. Transit traffic via C in one country routed to two exchanges M or R in another country according to the first digit (s) of the national (significant) number.

a) Automatic and semi-automatic calls with normal national numbers.

Example: $I_1\ \ I_2\ \ Z\ \ N_1\ \ N_2$

b) Semi-automatic calls to code 11 or code 12 operators.

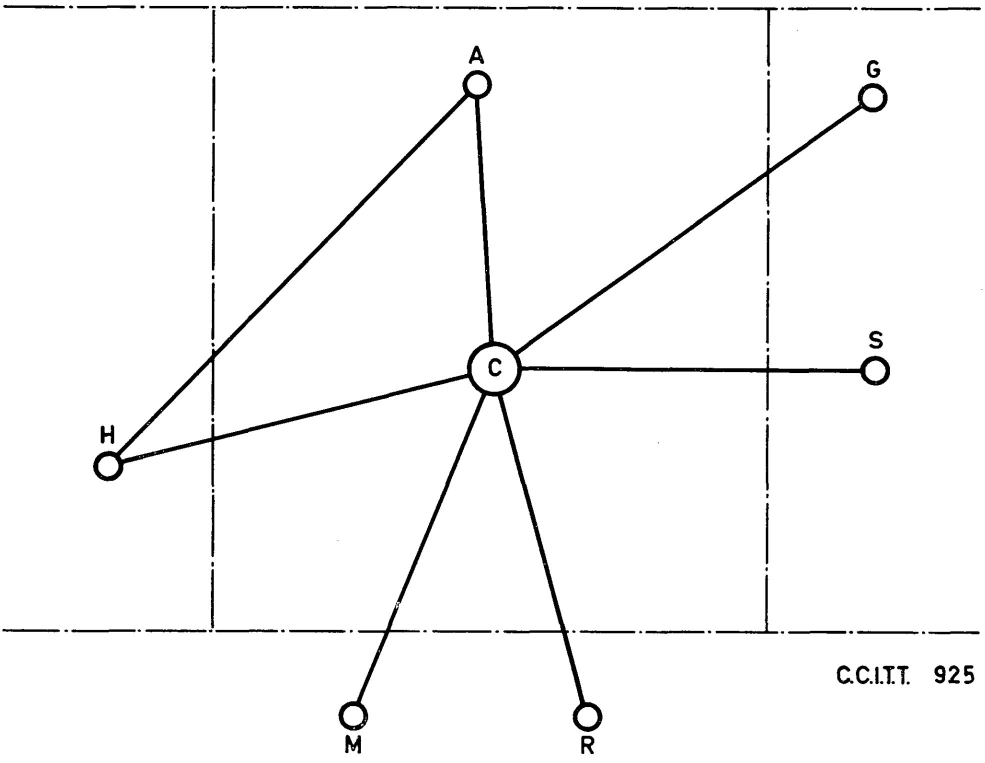
Examples: $\underbrace{I_1\ \ I_2\ \ L\ \ N_1}_{\text{analysed}}\ \ C_{11}$ or $\underbrace{I_1\ \ I_2\ \ L\ \ N_1}_{\text{analysed}}\ \ C_{12}$

2. Transit traffic via *C* in one country routed to *G* or *S* in another country with semi-automatic traffic to *S* and automatic traffic to *G* according to the presence of the language digit *(L)* or the presence of the discriminating digit *(D)*.

Examples: $I_1 \ I_2 \ D$ or $I_1 \ I_2 \ L$

3. Terminal traffic incoming to an international exchange *C* in a country and which is to be routed to code 11 or code 12 operators in another international exchange *A* in the same country according to the extra digit N_1.

Examples: $\underbrace{L \ N_1}_{\text{analysed}} \ C_{11} \ C_{15}$ or $\underbrace{L \ N_1}_{\text{analysed}} \ C_{12} \ X \ X \ C_{15}$



. ———— . ———— . Boundaries of countries

FIGURE 3. — **Examples of digit transfer control by a transit exchange**

RECOMMENDATION Q.127

4.4 RELEASE OF REGISTERS

4.4.1 **Outgoing register**

4.4.1 (1) *Normal release conditions*

The outgoing register shall release in either of the following two cases:

Case 1. — The register has sent forward all the numerical signals *and* has received a local sending-finished 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 (this assumes that a busy-flash signal does not initiate re-routing *).

4.4.1 (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 local sending-finished 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,
- not all the digits necessary to determine the routing received,
- correct number of digits to determine the routing received, but no further digit from the calling subscriber,
- no busy-flash or a number received signal has been received although the complete national (significant) number or part of it has been sent.

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

In the last two cases, release of the outgoing register is made to accompany 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. (See also Recommendation Q.129.)

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.

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* See definition of " re-routing " in Recommendation Q.12.

b) Numerical information received for which no routing has been provided.

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

— 10 to 30 seconds following the sending of a seizing signal,

— 15 to 30 seconds following the sending to a transit centre of the digits necessary to determine the routing,

d) An acknowledgement signal not received within 5 to 10 seconds following the sending of a digit.

e) More than the appropriate number of transit proceed-to-send signals is received (see 2.1.2, Recommendation Q.112).

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

4.4.2 **Transit register**

4.4.2 (1) *Normal release conditions*

The transit register shall release as soon as it has selected an outgoing circuit and sent forward a seizing signal on the circuit.

However, a different procedure may be used, in which 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 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.

4.4.2 (2) *Abnormal release conditions*

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

a) the digits necessary for determining the routing not received within 5 to 10 seconds following the sending of a proceed-to-send signal to the outgoing exchange;

b) numerical information received for which no routing has been provided.

On the other hand, if release of the transit register is deferred until a proceed-to-send signal is received, in accordance with the alternative method mentioned in paragraph 4.4.2 (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.

4.4.3 **Incoming register**

4.4.3 (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 national (significant) number has been received under the conditions defined in Recommendation Q.120, paragraph 1.5.5.

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

4.4.3 (2) *Abnormal release conditions*

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

a) No further digit is received after a delay of 30 to 60 seconds from receipt of the last digit and it is not possible to determine by one of the methods described in paragraph 1.5 of Recommendation Q.120 that the number which is received is a complete number.

b) No digit is received within 5 to 10 seconds following the return of a proceed-to-send signal.

c) A number is received for which no routing exists, or an incomplete number is received followed by an end-of-pulsing signal (code 15).

In cases *a)* and *b)* no signal is returned 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, 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.128

4.5 SWITCHING TO THE SPEECH POSITION

4.5.1 *Outgoing international exchange*

The circuit shall be switched to the speech position when the outgoing register releases (see 4.4.1).

4.5.2 *International transit exchange*

The circuit shall be switched to the speech position immediately the transit register has sent the seizing signal (see 4.4.2).

4.5.3 *Incoming international exchange*

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

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

— or has sent back the busy-flash signal,

or, if these signals are not sent, when the register releases under abnormal conditions (see 4.4.3 (2)).

RECOMMENDATION Q.129

4.6 INDICATION OF CONGESTION CONDITIONS AT TRANSIT EXCHANGES

In the case of congestion at a transit exchange, the following conditions apply concurrently:

1. The busy-flash signal shall be returned (see paragraph 1.6 for the definition of this signal) to indicate that there is equipment congestion in the exchange or that no free outgoing circuit is available. In cases where continuous hunting is used, the busy-flash signal should be returned within the period specified in paragraph 4.2.4.

As mentioned in paragraph 1.6 of Recommendation Q.120, in automatic working, the receipt of the busy-flash signal by the outgoing exchange will give a suitable indication to the calling subscriber (unless re-routing is used) and will cause the clear-forward signal to be sent so as to release the international connection.

2. Connection should be made to a recorded announcement giving the name of the exchange at which congestion has occurred.

In semi-automatic operation the busy-flash signal and the recorded announcement will be used at the outgoing exchange in the manner judged most suitable by the Administration of the country concerned *.

RECOMMENDATION Q.130

4.7 SPECIAL ARRANGEMENTS IN CASE OF FAILURES IN THE SEQUENCE OF SIGNALS

4.7.1 *Blocking an outgoing circuit*

Installations should provide the following facilities for blocking outgoing circuits. These facilities will be used or not according to the maintenance instructions which will be promulgated.

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* The succession of proceed-to-send signals (transit or terminal) could be used to provide, either with lamps or with indicators, a visual indication of the exchange at which the congestion has occurred.

An Administration which desires to make use of recorded announcement must not, of course, convert the busy-flash signal which precedes an announcement into an audible tone signal.

1. If, after sending a seizing signal, a proceed-to-send signal or a busy-flash signal is not received within 10 to 30 seconds, the outgoing circuit should be blocked and an alarm given *.

2. The outgoing circuit should be blocked and an alarm given * if a proceed-to-send signal or a busy-flash signal is not received within 15 to 30 seconds of the sending to a transit exchange of the digits necessary to determine the routing.

3. If, after sending a clear-forward signal, a release-guard signal is not received within 5 to 10 seconds, the outgoing end of the circuit should be blocked and an alarm given *.

At the incoming end of the circuit the clear-forward signal should be recognized at any time even if the circuit is in the idle state; the incoming line circuit must therefore be able to recognize a clear-forward signal and to return a release-guard signal even if the clear-forward signal has not been preceded by a seizing signal.

4.7.2 *Abnormal recognition of a release-guard signal at an international transit exchange*

In the case where a release-guard signal is recognized at an international 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.131

4.8 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 the digits necessary to determine the routing, the outgoing register receives no further digit within a period of 15 to 30 seconds;

b) if no busy-flash or number-received signal is received by the outgoing register within a period of 15 to 30 seconds although the national (significant) number (or part of it) has been sent.

The release of the outgoing register under these abnormal conditions is dealt with in paragraph 4.4.1 (2).

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* The alarm may be immediate or delayed depending upon the desire of the Administration concerned.

RECOMMENDATION Q.132

4.9 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 V

Testing arrangements

RECOMMENDATION Q.133

5.1 NUMBERING FOR ACCESS TO AUTOMATIC TRANSMISSION MEASURING AND TESTING DEVICES

5.1.1 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 in Recommendation Q.75 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. Combination 51 to combination 59 are allocated to automatic transmission measuring devices standardized by the C.C.I.T.T. for international repeater stations. Combination 00 is used for access to the automatic testing device in the I.M.C.s (Recommendation Q.137).

RECOMMENDATION Q.134

5.2 ROUTINE TESTING OF EQUIPMENT (LOCAL MAINTENANCE)

5.2.1 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.

5.2.2 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 Recommendation Q.132).

RECOMMENDATION Q.135

5.3 PRINCIPLES OF RAPID TRANSMISSION TESTING EQUIPMENT

Rapid transmission tests can be made by two methods:

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 Recommendation Q.136.

The second method assumes the existence of rapid transmission testing equipment in all exchanges between which this method is used. This testing equipment must be designed in accordance with Recommendation Q.137.

Note. — The first method provides over-all 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.

RECOMMENDATION Q.136

5.4 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.137

5.5 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 this 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:

5.5.1 *Incoming testing equipment*

(1) Connection to incoming testing equipment:

The incoming testing equipment will normally be connected in the four-wire part of the circuit.

Access to this equipment from an outgoing international exchange will be obtained by sending successively on the international circuit, according to Recommendation Q.133:

a) terminal seizing signal,

b) code 13 replacing the language digit,

c) code 12,

d) three digits 000, the last two being the combination 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 prompts 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 db or ± 1 dN.

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 ± 4.6 dN 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 4.6 dN 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 ± 0.5 db or ± 0.5 dN.

If, due to the non-reception of a clear-forward signal, the test signal is transmitted for a period of 1-2 minutes, the incoming testing equipment will stop transmitting this test signal and a clear-back signal will be sent. The release of the incoming testing equipment will then be carried out in accordance with the provisions of Recommendation Q.118, paragraph 3.3.3.

(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.

5.5.2 *Outgoing testing equipment*

(1) Connection to the outgoing testing equipment:

The outgoing testing equipment will be designed to automatically send the numerical information mentioned under (1) in paragraph 5.5.1 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 ± 0.5 db or ± 0.5 dN.

(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.138

5.6 INSTRUMENTS FOR CHECKING EQUIPMENT AND MEASURING SIGNALS

5.6.1 *General*

For local checks of correct equipment operation and for readjusting the equipment, international exchanges should have available instruments of the following two types:

a) calibrated signal generator,

b) signal measuring apparatus.

These instruments should have the following characteristics:

5.6.2 *Calibrated signal generator*

Duration of sent signals to be adjustable between the extreme limits given in the equipment Specifications, i.e.: 3 to 500 ms.

The accuracy required in the duration of sent signals should be the higher of the following two values:

± 1 ms or ± 1% of the nominal value of the sent signal.

Frequency:

The sent frequency shall not differ by more than ± 5 c/s from the nominal value and shall not vary during the time required for testing.

Level of the sent signals 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 db or ± 0.2 dN.

5.6.3 *Signal-measuring equipment*

Duration of signals to be measured to be between the extreme limits given in the equipment Specifications, i.e.: 3 to 500 ms.

The accuracy required in the duration of the measured signals should be the higher of the following two values:

± 1 ms or ± 1 % of the nominal value of the received signal.

Signal frequency 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 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 db or ± 0.2 dN.

ANNEXES TO SIGNALLING SYSTEM No. 4 SPECIFICATIONS

ANNEX 1

SIGNALLING SEQUENCES

ANNEX 2

DESCRIPTION OF THE OPERATIONS CORRESPONDING TO THE VARIOUS NORMAL AND ABNORMAL CONDITIONS WHICH MAY ARISE IN SETTING UP A CALL

ANNEX 1

TABLE 1. — SEMI-AUTOMATIC (SA) AND AUTOMATIC (A) TERMINAL TRAFFIC

Outgoing international exchange		Incoming international exchange
	CALL TO A FREE SUBSCRIBER	
Terminal seizing signal is sent forward.	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, national (significant) number of the called party followed by the end-of-pulsing signal. A: Discriminating digit, national (significant) number of the called party.	← X	
	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 an operator.
	← x = acknowledgement of the reception of a digit	
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 SA: an indication is given to the operator that the international selection operations have been accomplished.	← 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.	← PY	Called party answers; answer signal is returned.

ANNEX 1. — *Table 1* (continued)

Outgoing international exchange		Incoming international 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.	← 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 ceased.	← 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.	PXX →	Releases the connection at 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.	← PYY	

CALL TO A BUSY SUBSCRIBER (OR CONGESTION)

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.	← 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.	← 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 1. — *Table 1* (concluded)

Outgoing international exchange		Incoming international exchange
The operator and/or 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.	PYY ————▶	Causes an assistance operator to intervene at the incoming terminal exchange on an established connection completed automatically.
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.	PYY ————▶	Recalls the incoming operator on calls completed via an operator at this exchange.
This signal causes a guarding condition to be applied to block further traffic.	◀———— PX (or continuous frequency)	Engineering personnel wish to busy the international circuit at the outgoing end; a blocking signal is sent.
Guarding condition removed on cessation of continuous frequency.	◀············	Following the continuous frequency, the guarding condition is removed when this signal is disconnected.
This signal removes the guarding condition at the outgoing end.	◀———— PYY	Following the PX-signal, a release guard signal is sent when the blocking condition is disconnected at the incoming end.

ANNEX 1

TABLE 2. — SEMI-AUTOMATIC (SA) AND AUTOMATIC (A) TRANSIT TRAFFIC

Outgoing international exchange	International transit exchange	International transit exchange	Incoming international exchange
CALL TO FREE SUBSCRIBER			
Transit seizing signal sent forward. PY →	Causes transit register to be connected.		
Causes the necessary digits to determine the routing to be sent forward. ← Y	Transit proceed-to-send signal is returned.		
Binary code →	Received in the transit register.		
y = acknowledgement of a digit x = acknowledgement after last digit required ←			
	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 proceed-to-send signal is returned.	
Causes the necessary digits to determine the routing to be sent forward.	Binary code →	Received in the transit register.	
←	y = acknowledgement of a digit x = acknowledgement after last digit required		

ANNEX 1 — *Table 2* (continued)

Outgoing international exchange	International transit exchange	International transit exchange	Incoming international exchange
		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 following digital information to be sent: ← SA: Language digit, national (significant) number of the called party followed by the end-of-pulsing signal. A: Discriminating digit, national (significant) number of the called party. →	Binary code		X Terminal proceed-to-send signal is returned. → Received in the incoming register.
SA: The register then releases and establishes the speech path. ←		x = acknowledgement 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 an operator.
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 Number-received signal returned when the incoming register has completely received the national (significant) number.

ANNEX 1 — *Table 2* (continued)

Outgoing international exchange	International transit exchange	International transit exchange	Incoming international 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 is given to the ◀ controlling operator. A: The charging of the subscriber and the measurement of call duration start.			PY Called party answers: answer signal returned.
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 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 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

ANNEX 1 — *Table 2* (concluded)

Outgoing international exchange	International transit exchange	International transit exchange	Incoming international exchange
CALL TO A BUSY SUBSCRIBER (OR CONGESTION) The conditions are the same as those described on page 195			
SPECIAL CONDITIONS			
SA: Visual or audible indication given to controlling operator. A: Audible indication given to the calling subscriber. Automatic release of the international connection. ◀	◀—— PX Congestion of links, registers or outgoing circuits. Busy-flash signal returned followed by a verbal announcement.		
◀	——————	◀—— PX Congestion of links, registers or outgoing circuits. Busy-flash signal returned followed by a verbal announcement.	
◀	——————	——————	◀—— PX Congestion of links, registers or immediate outlets. Busy-flash signal returned. *Note.* — Congestion conditions in the national network may be indicated by audible tones or verbal announcements, or by a national busy-flash signal.
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.
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 an operator at this exchange.

ANNEX 2

TABLE 1. — OUTGOING EXCHANGE — NORMAL CONDITIONS

<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 **</th></tr>
<tr><th colspan="2">The busy-flash signal</th><th colspan="2">Incoming exchange</th><th rowspan="2">1st transit exchange</th></tr>
<tr><th>is not provided</th><th>is provided</th><th>Terminal traffic</th><th>Transit traffic</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 position</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 style="display:none"><td></td></tr>
<tr><td rowspan="3">Information received from 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="2">1.5
4.4.1 (1)</td><td colspan="4">1.6
4.4.1 (1)</td><td colspan="2">1.6
Q.12
4.4.1 (1), 4.6</td></tr>
</table>

SA — Semi-automatic service } When there is no specific indication, the clause is applicable to both services.
A — Automatic service }

* — Not applicable if automatic re-routing is provided.

** — Similarly for congestion of the common equipment of a 2nd or subsequent transit exchange.

*** 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 2

TABLE 2. — OUTGOING EXCHANGE — ABNORMAL CONDITIONS

<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 unused numerical information</th><th rowspan="2">Non-receipt of a backward signal after sending the seizing signal</th><th rowspan="2">Non-receipt of an acknowledgement 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 routing-digits to a transit exchange</th><th rowspan="2">Receipt of too many transit proceed-to-send signals</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 seizing 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 required digits</td><td>After receipt of the third signal</td></tr>
<tr><td>Speech position</td><td colspan="4"></td><td colspan="2">After release of the register</td><td colspan="2"></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 colspan="3"></td><td>Possible blocking of the circuit</td><td></td></tr>
<tr><td>SA- 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>A - Indication given to the subscriber</td><td colspan="8">Appropriate audible indication</td></tr>
<tr><td rowspan="2">Information received from the international circuit</td><td>Signals received</td><td colspan="4"></td><td colspan="2">Number received</td><td colspan="2"></td></tr>
<tr><td>Tone received</td><td colspan="4"></td><td colspan="2">If possible, national number-unobtainable tone, or verbal announcement</td><td colspan="2"></td></tr>
<tr><td colspan="2">References</td><td>4.4.1 (2) a</td><td>4.4.1 (2) b</td><td>4.7.1
4.4.1 (2) c</td><td>4.4.1 (2) d</td><td colspan="2">4.4.3 (2) c</td><td>4.7.1
4.4.1 (2) c</td><td>4.4.1 (2) e</td></tr>
</table>

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* 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 2

TABLE 3. — INCOMING EXCHANGE — NORMAL CONDITIONS

Conditions / Operations effected	Called subscriber free	Subscriber busy or national congestion		Congestion immediately outgoing from the incoming exchange	Congestion of common equipment at the incoming exchange
		The incoming exchange cannot recognize the busy condition	The incoming exchange can recognize the busy condition		
Release of register	After sending the number-received back and sending the numerical information to the national network equipment			After sending the busy-flash signal	
Speech position				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	1.5 4.4.3 (1)	1.5 1.6.b	1.5 1.6.b	1.6.b 4.2.4, 4.4.3 (1)	4.2.4

ANNEX 2

TABLE 4. — INCOMING EXCHANGE — ABNORMAL CONDITIONS

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	5-10 seconds after sending the proceed-to-send signal	30-60 seconds after receipt of the last digit	After sending the number-received signal	
Speech position	After release of the register			
Sending of number-received signal			After recognition of the anomaly	
Sending of national number-unobtainable tone or a verbal announcement			If possible (after sending number-received signal)	
References	4.4.3 (2) b	4.4.3 (2) a	4.4.3 (2) c	

ANNEX 2

TABLE 5. — TRANSIT EXCHANGE — NORMAL CONDITIONS

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 position	After sending the seizing signal	After sending busy-flash signal	
Sending of busy-flash signal		0-10 seconds after receipt of the digits necessary to determine the routing	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	4.4.2 (1)	1.6.a 4.2.4, 4.4.2(1), 4.6	1.6.a 4.2.4, 4.6

ANNEX 2

TABLE 6. — TRANSIT EXCHANGE — ABNORMAL CONDITIONS

Conditions Operations effected	Non-receipt of the digits necessary to determine the routing	Receipt of an unused numerical information	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 position			After sending the seizing signal
Action on the outgoing international circuit			Possible blocking of the outgoing circuit
References	4.4.2 (2) a	4.4.2 (2) b	4.4.2 (2) 4.7.1 (1)

PART X

SIGNALLING SYSTEM No. 5

INTRODUCTION

PRINCIPLES OF No. 5 SIGNALLING SYSTEM

General

System No. 5 is compatible with both TASI- and non-TASI-equipped circuits and may be applied for automatic and semi-automatic operation and both-way working. It requires four-wire signalling and automatic access to the outgoing circuits.

The signalling equipment is in two parts:

a) line signalling—for the so-called supervisory signals, and

b) register signalling—for the numerical signals.

a) Line signalling

This is a link-by-link system using two in-band signalling frequencies 2400 c/s and 2600 c/s, two frequencies, instead of one frequency, being adopted for the following reasons:

i) Automatic detection of double seizing on both-way working;

ii) Frequency discrimination between signals, no time discrimination being incorporated.

Automatic detection of double seizing requires that the frequency of the proceed-to-send signal (2600 c/s) be different from that of the seizing signal (2400 c/s). The detection is achieved when one end transmits the outgoing seizing signal (2400 c/s) and at the same time receives the seizing signal (2400 c/s) from the other end and not the 2600-c/s proceed-to-send signal expected.

All signal recognition times are the same (125 ms) except for the seizing and proceed-to-send signals (40 ms). These two signals are not subject to signal imitation by speech and fast signalling is desired in particular to minimize double seizings.

To avoid, with this signalling system, relatively slow signalling in non-TASI applications and in lightly loaded conditions (the more usual) of TASI applications, all signals are continuous compelled * type except the forward transfer signal. Continuous signals ensure TASI trunk/channel association during the actual time this function requires. (The alternative of TASI-prefixed pulse type signals would, due to the 500-ms TASI prefix, introduce a slight risk of failure to associate a trunk with a channel, and would slow the signalling in terms of restoration of the transmission path after the signalling line splits under the more usual conditions of TASI loading and in non-TASI applications). Only the forward-transfer signal is a TASI-prefixed pulse since for this signal a slight risk of failure can be accepted because it is operator-controlled and may be repeated at will.

Except for the answer signal, all the compelled signals are normal compelled ** type. For reasons of fast speed, the answer signal is overlap-compelled ** at transit points. Fast answer signalling is desirable to minimize the risk of an abandoned call by either the called or calling party, should the verbal answer be lost due to the line splitting on answer signalling.

b) Register signalling

This is a link-by-link 2/6 multifrequency (MF) in-band en bloc *** pulse signalling system, forward signalling only. The alternative, continuous compelled signalling, would be slow due to the long circuit propagation times in certain applications. The frequencies (700 c/s... 1700 c/s) are outside of the line signalling frequencies. The numerical information signalling is preceded by a KP signal (start-of-pulsing) and terminated by an ST signal (end-of-pulsing). En bloc non-overlap sending *** applies at the outgoing international register, the seizing signal being sent, and thus the international circuit being taken as late as possible, namely when the ST condition is available in the outgoing international register. When sending, the outgoing register pulses out in a continuous sequence. The prior GO trunk/channel association due to the seizing signal is maintained by the TASI speech detector hangover during the interval between cessation of the seizing signal (on receipt of the proceed-to-send signal) and the start of the register pulse out, and during the intervals between successive MF signals.

En bloc overlap register signalling *** applies at the international transit registers and at the incoming international register to minimize the post-dialling delay.

Compandors affect signalling ****, particularly short-pulse compound signalling (e.g. register signalling), due to distortion and the production of intermodulation frequencies. By virtue of the link-by-link signalling and the adopted duration of the MF pulses, system No. 5 functions correctly in the presence of compandors.

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* See for this term Recommendation Q.141, section 2.1.6.

** See for these terms Recommendation Q.141, section 2.1.7.

*** See for these terms the footnote to Recommendation Q.151, section 3.1.1.

**** See Question 6/XI.

CHAPTER I

Definition and function of signals

RECOMMENDATION Q.140

1. DEFINITION AND FUNCTION OF SIGNALS

1.1 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 and to seize equipment for switching the call either to the national network of the incoming country or to another international exchange.

1.2 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 signals.

1.3 Start-of-pulsing signal, also called for system No. 5 "KP signal" (sent in the forward direction)

This numerical type signal is sent on receipt of a proceed-to-send signal and may be used to prepare the incoming international register for the receipt of the subsequent numerical signals.

Two different KP signals are provided to discriminate between terminal and transit calls:

a) KP1, terminal and

b) KP2, transit.

1.4 Numerical 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 numerical signals sent.

1.5 End-of-pulsing signal, also called for system No. 5 "ST signal" (sent in the forward direction)

This numerical type signal is sent to show that there are no more numerical signals to follow. The signal is always sent in semi-automatic as well as in automatic working.

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

This signal, which is sent only after the proceed-to-send 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, after register association, to indicate that there is congestion at that exchange or on the appropriate outgoing routes.

b) An incoming international exchange *must* send this signal, after register association, 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 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 optional because there are several countries that do not send it from their national networks.

Note. — The receipt of the busy-flash signal at the outgoing exchange will cause:

— an appropriate indication to be given to the outgoing operator or to the calling subscriber, and

— 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).

1.7 **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.

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

This signal 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 open the speech path at the outgoing international exchange.

In automatic working, arrangements must be made to clear the international connection, stop the charging and stop the measurement of call duration if, between 1 and 2 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. — See the corresponding Notes in Recommendation Q.120.

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* 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.

1.9 Clear-forward signal (sent in the forward direction)

This signal is sent in the forward direction at the end of a 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).

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 Recommendation Q.118, paragraphs 3.3.1 and 3.3.2 (automatic working) and 3.3.1 (semi-automatic working)). This signal may also be sent after an abnormal release of an outgoing register in the case indicated in Recommendation Q.156 under 3.6.2 a) 1.

1.10 Release-guard signal (sent in the backward direction)

This signal is sent in the backward direction in response to the clear-forward signal. 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.

1.11 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 the circuit if the call is automatically set up at that exchange. When a call is completed via an operator (incoming or delay operator) at the incoming international exchange, the signal should preferably cause this operator to be recalled.

1.12 Diagrams showing signal sequence

The sequence of signals in semi-automatic and automatic working is shown in Tables 1 and 2 of Annex 1 (see page 244 et seq.).

A description of the various operations coresponding to the various normal and abnormal conditions which may arise in setting up a call are given in the tables of Annex 2 (see page 254 et seq.).

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* See the definition of assistance operator in paragraph 1.1.6 of Recommendation Q.101.

CHAPTER II

Line signalling

RECOMMENDATION Q.141

2.1 SIGNAL CODE FOR LINE SIGNALLING

2.1.1 General

The line-signal coding arrangement is based on the use of two frequencies $f1$ (2400 c/s) and $f2$ (2600 c/s) transmitted individually or in combination as shown in Table 1. The use of compound signalling for the clear-forward/release-guard sequence increases the immunity to false release by signal imitation.

By taking advantage of the fixed order of occurrence of specific signals, signals of the same frequency content are used to characterize different functions. For example, in the backward direction $f2$ is used to indicate proceed-to-send, busy-flash and clear-back without conflict. The signalling equipment must operate in a sequential manner retaining memory of the preceding signalling states and the direction of signalling in order to differentiate between signals of the same frequency content. All signals except the forward-transfer signal are acknowledged in the compelled-type manner as indicated in Table 1. The order of transmission of backward signals is subject to the following restrictions:

a) busy-flash signal: never after an answer signal and only after a proceed-to-send signal;

b) answer signal: never after a busy-flash signal;

c) clear-back signal: only after an answer signal.

Note. — The receipt of the answer signal ($f1$) permits discrimination between the busy-flash and the clear-back signals (both $f2$).

A clear-forward signal, which must be acknowledged by a release-guard signal under all conditions of the equipment including the idle condition, may be sent from an outgoing end at any time to initiate the release of the circuit. The clear-forward signal is completely overriding and may break into any other signal sequence.

2.1.2 Transit working

In transit operation, the line equipment at the transit exchange shall be informed (e.g. by the register) that the condition is transit. This will facilitate the link-by-link transmission of line signals through the transit exchange without bringing about consequences appropriate to the terminal exchanges.

2.1.3 Sending duration of line signals

The sending durations of the line signals are shown in Table 1. Additional requirements are:

a) in the event of double seizing (due to both-way operation), the seizing signal transmitted from the end having detected double seizing should persist for at least 850 ± 200 ms to permit also the other end to detect the double seizing;

b) should the called party flash his switch-hook at a faster rate than the equipment can transmit a succession of clear-back and answer signals, the correct indication of the final position of the switch-hook must always be given by the appropriate signal;

c) once the sending of a signal (pulse or compelled) has begun it should be completed (but see paragraph 2.1.1 in regard to the clear-forward signal releasing the circuit at any stage and paragraph 2.1.7 in regard to the overlap answer signal at transit points). If two signals have to be sent one immediately after the other in the same direction, a silent interval of not less than 100 ms should separate the two successive signals. The silent interval should not be so long as to cause unreasonable delay in signalling;

Exceptionally: 1) the intervals between successive signals may be less than 100 ms. However, the technique of complete signals with intervals of at least 100 ms is the preferred arrangement;

2) the forward-transfer signal may be ceased immediately if a backward signal is received. The acknowledgement of the backward signal is then sent.

d) when sending a compound signal, the interval of time between the moments when each of the two frequencies is sent must not exceed 5 ms. The interval of time between the moments when each of the two frequencies ceases must not exceed 5 ms;

e) should any transmitted signal persist beyond a maximum of 10 to 20 seconds because of a fault, the signal shall be terminated and Administrations should make appropriate provisions in regard to the action to be taken in the event of such signal time-out.

The duration of the forward-transfer signal is based on the possibility that TASI may clip a signal by up to 500 ms on rare occasions during heavy traffic periods, and on the need for establishing a recognition time that minimizes signal imitation.

2.1.4 Recognition times of line signals

Recognition time is defined as the minimum duration a direct-current signal, at the output of the signal receiver, must have in order to be recognized as a valid condition by the switching equipment. The recognition times are given in Table 1.

For equal immunity against signal imitation, the recognition time of compound signals such as the clear-forward/release-guard sequence could be less than that of the single-frequency signals liable to signal imitation. However, for convenient design arrangements, and to improve the immunity of the clear-forward/release-guard sequence, the recognition time of the compound signals is the same (125 ± 25 ms) as that of the single-frequency signals liable to signal imitation.

After signal recognition, interruptions of up to 15 ms in the primary or acknowledgement signals shall be ignored in the compelled signalling sequences. Interruptions of more than 40 ms must be recognized as the end of the appropriate signal in the compelled signalling sequences.

2.1.5 Line signal code of system No. 5

The line signal code is given in Table 1.

TABLE 1

Line signal code

Signal	Direction (1)	Frequency (2)	Sending duration	Recognition time
Seizing — *Prise*	——▶	*f*1	continuous	40 ± 10 ms
Proceed-to-send — *Invitation à transmettre*	◀——	*f*2	continuous	40 ± 10 ms
Busy-flash — *Occupation*	◀——	*f*2	continuous	125 ± 25 ms
Acknowledgement — *Accusé de réception*	——▶	*f*1	continuous	125 ± 25 ms
Answer — *Réponse*	◀——	*f*1	continuous	125 ± 25 ms
Acknowledgement — *Accusé de réception*	——▶	*f*1	continuous	125 ± 25 ms
Clear-back — *Raccrochage du demandé*	◀——	*f*2	continuous	125 ± 25 ms
Acknowledgement — *Accusé de réception*	——▶	*f*1	continuous	125 ± 25 ms
Forward-transfer — *Signal d'intervention*	——▶	*f*2	850 ± 200 ms	125 ± 25 ms
Clear-forward — *Signal de fin*	- - -▶	*f*1 + *f*2 (compound)	continuous	125 ± 25 ms
Release-guard — *Libération de garde*	◀- - -	*f*1 + *f*2 (compound)	continuous	125 ± 25 ms

Notes to Table 1

(1) ——▶ forward signals
◀—— backward signals

(2) *f*1 = 2400 c/s *f*2 = 2600 c/s

2.1.6 Further specification clauses relative to the line signalling code

a) The seizing signal continues until acknowledged by the proceed-to-send signal. The proceed-to-send signal is transmitted when an incoming register is associated and continues until acknowledged by the stopping of the seizing signal *.

b) The clear-forward signal continues until acknowledged by the release-guard signal, which may be sent as described under 1) or 2) below:

1) The release-guard signal is sent on recognition of the clear-forward signal and continues until acknowledged by the cessation of the clear-forward signal or until the relevant incoming equipment at the international exchange is released, whichever occurs later *.
2) The release-guard signal is sent in response to the clear-forward signal to indicate that the latter has brought about the release of the relevant incoming equipment at the international exchange. The release-guard signal continues until cessation of the clear-forward signal is recognized *.

The outgoing access of the incoming end of the both-way circuit shall be maintained busy for 200 to 300 ms after the end of the transmission of the release-guard signal.

c) With respect to the busy-flash, answer and clear-back signals, the acknowledgement signal shall not be transmitted before the signal recognition time (125 ± 25 ms) of the primary signal has elapsed. The primary signal shall not be ceased until the signal recognition time (125 ± 25 ms) of the acknowledgement signal has elapsed * (see section 2.1.7 with respect to the transmission of the answer signal at a transit point).

d) The busy-flash signal will be transmitted if the call cannot be completed for any of the following reasons:

1) congestion at an incoming international exchange,
2) congestion at a transit international exchange,
3) error detected in the receipt of the register signals,
4) busy-flash (if received) from a subsequent international system (e.g. system No. 4) or from the national network,
5) time-out of an incoming international register.

e) Receipt of busy-flash at the outgoing international exchange will cause:

— after signal recognition time:

1) the acknowledgement signal to be sent, and
2) an appropriate audible indication to be transmitted to the operator or to the subscriber. When the preceding circuit provides for the transmission of busy-flash, this signal should be transmitted to that preceding circuit;

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* This type of signalling is called " *continuous compelled* ".

— after the end of the compelled sequence, i.e. 100 ms after termination of the acknowledgement signal (see paragraph 2.1.3 *c)*:

3) a clear-forward signal to be transmitted from that exchange and the international circuit or chain of circuits to be released by the clear-forward/release-guard sequence.

f) Receipt of busy-flash at a transit exchange will cause after signal recognition time:

1) the acknowledgement signal to be sent, and

2) the busy-flash signal to be sent on the preceding incoming circuit.

Note. — The release of the chain of circuits is initiated from the outgoing (originating) international exchange only. This permits the possibility for maintenance and observation purposes to hold the connection from the outgoing (originating) exchange.

2.1.7 Backward signals on multilink connections

(see as an example a connection *A-T-B*)

a) Normal compelled signalling for busy-flash and clear-back signals

With *normal compelled signalling* (see 2.1.6 *c)* above) at a transit point *T*, the transmission of the primary signal from *T* to *A* does not commence until the signal recognition time of the primary signal sent from *B* to *T* has elapsed. This technique is applied for the transmission of busy-flash and clear-back signals.

b) Overlap compelled signalling for the answer signal

With *overlap compelled signalling* at a transit point *T*, the process of transmitting the primary signal from *T* to *A* is initiated as soon as the signal receiver response has caused at *T* the receiving end line split of *BT*. The normal signal recognition of the primary signal is still required at each transit point. The acknowledgement signal on a particular link should not be transmitted until the signal recognition time of the primary signal has elapsed. To speed up the transmission of the answer signal, the overlap compelled technique is applied for this signal at a transit exchange when two No. 5 circuits are switched in tandem.

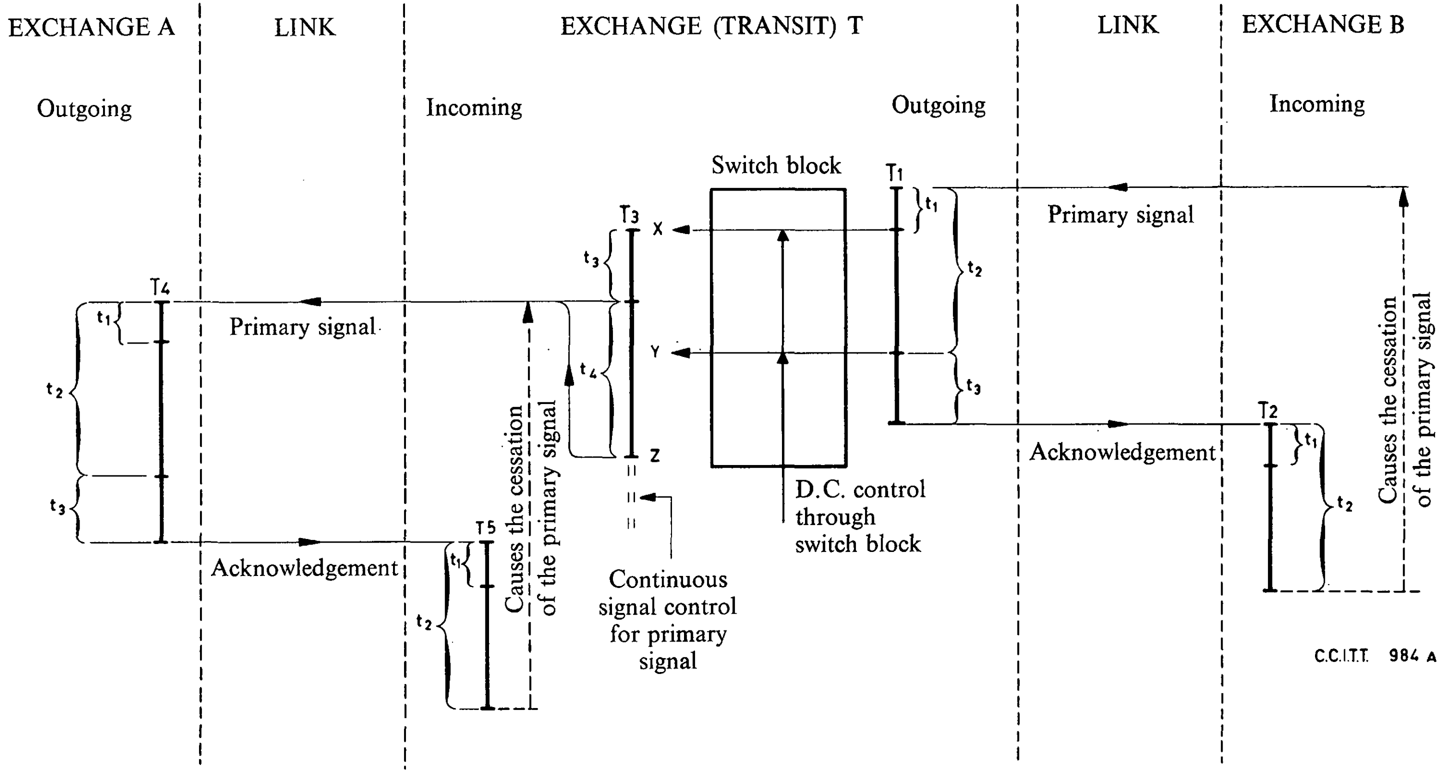
More details of the overlap compelled technique are given below:

If the primary signal from *B* to *T* lasts less than the signal recognition time, transmission of a primary signal already initiated at a transit point *T* from *T* to *A* will be stopped.

After the recognition time at *T* of a primary signal from *B* to *T* has elapsed, there shall be no control at *T* of the primary signal sent from *T* to *A* by the primary signal sent from *B* to *T*. In this case the primary signal on each link is ceased by its acknowledgement signal on that link (as in 2.1.6 *c)* above).

Figure 1 illustrates a typical arrangement and is included to illustrate the principle of overlap compelled signalling at transit points. Other design arrangements may be adopted as preferred by Administrations.

Transmission of the primary signal from *T* to *A* is initiated (by a " start to send " control condition *X* through the switch block at the transit point) as soon as the signal receiver response



T_1, etc. = Time base

t_1 = Receiving end line split (35 ms max.)

t_2 = Signal recognition time (125±25 ms)

t_3 = Sending end line split (40±10 ms)

t_4 = 125±25 ms typically

FIGURE 1. — **Typical arrangement to illustrate the principle of overlap compelled signalling at transit points**

on the primary signal from *B* to *T* has caused the receiving-end line split (t_1 of T_1). The primary signal is transmitted from *T* to *A* after the sending-end line split (t_3 of T_3). Signal recognition of the primary signal is required at the transit point and the acknowledgement signal on a particular link should not be transmitted until the signal recognition time (t_2 of T_1, t_2 of T_4) has elapsed. The primary signal is ceased after the signal recognition time (t_2 of T_2, t_2 of T_5) of the relevant acknowledgement signal.

To prevent imitations of the primary signal on link *BT* lasting less than the signal recognition time from giving rise to an effective compelled signalling sequence on link *TA*, transmission of the primary signal on link *TA* is first under the " start to send " control *X* of a time base T_3 followed, without break at the termination of the time base (at time *Z*), by the continuous signal control required for compelled signalling. Should the duration of the primary signal on link *BT* be less than the signal recognition time (t_2 of T_1), the " start to send " control (*X* control) is interrupted. This stops transmission of a primary signal on link *TA* (should this have commenced) within the period *X-Z* of T_3 and hence before the continuous signal control can be applied.

After the signal recognition time of the primary signal on link *BT* has elapsed, there shall be no control of the transmission of the primary signal on link *TA* by the primary signal on link *BT* at the transit point. To achieve this, a condition is applied to the *Y* control to inhibit the *X* control, which should ensure that transmission of the primary signal on link *TA* cannot be stopped during the period *X-Y* of T_3 and that the continuous signal control of the primary signal is applied without break at time *Y* (or at time *Z* depending upon the particular design). In these circumstances the primary signal on each link is ceased by its relevant acknowledgement signal.

RECOMMENDATION Q.142

2.2 DOUBLE SEIZING WITH BOTH-WAY OPERATION

2.2.1 Unguarded interval

Considering that on long international (intercontinental) circuits:

a) the sending end splitting time may be 50 ms prior to signal transmission;

b) TASI may occasionally clip the initial 500 ms of seizing signals;

c) circuit propagation time may be relatively long;

d) the signal receiver response time must be taken into account;

e) the recognition time of seizing signals is 40 ± 10 ms,

the unguarded interval relative to double seizing in the extreme case approaches 600 ms plus the circuit propagation time and the signal receiver response time. The signalling system should therefore detect double seizing and take action as defined in section 2.2.2.

2.2.2 Detection of double seizing

In the event of double seizing, the same frequency ($f1$) is received as is being transmitted at each terminal. This condition shall be detected by the signalling equipment and shall cause stoppage of the outgoing seizing signal at each end. An end having detected double seizing, and terminated the outgoing seizing signal 850 ± 200 ms after this signal has been transmitted, will maintain the circuit in the busy condition until the stoppage of the incoming seizing signal from the distant end. Each outgoing seizing signal maintained for at least 850 ± 200 ms will ensure that both ends of the circuit will detect the double seizing.

The signalling equipment will be released on termination of both the outgoing and incoming seizing signals and a clear-forward signal shall not be sent.

Either of the following arrangements may apply on detection of double seizing:

a) an automatic repeat attempt to set up the call, or

b) a re-order indication is given to the operator or to the subscriber and no automatic repeat attempt is made.

Method *a)* is the preferred arrangement (see Recommendation Q.108).

Method *a)* does not require the repeat attempt to be limited to the circuit used at the first attempt, but should the first circuit be seized again at the second attempt on the second search over the circuits, a minimum time of 100 ms shall elapse between the termination of the first attempt outgoing seizing signal (or the recognition of the cessation of the incoming seizing signal, whichever occurs later) and the commencement of the second attempt seizing signal.

To minimize the probability of double seizing, the circuit selection at the two ends should be such that, as far as possible, double seizing can occur only when a single circuit remains free (e.g. by selection of circuits in opposite order at the two ends).

RECOMMENDATION Q.143

2.3 LINE SIGNAL SENDER *

2.3.1 Signalling frequencies

2400 ± 6 c/s (*f*1) and 2600 ± 6 c/s (*f*2).

These frequencies are applied separately or in combination.

2.3.2 Transmitted signal level

-9 ± 1 dbm0 (-10 ± 1 dNm0) per frequency.

For compound signals the difference in transmitted level between *f*1 and *f*2 shall not exceed 1 db or 1 dN.

Note. — The level of the leak current transmitted to line should be at least 50 db (5.8 N) below signal level per frequency.

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* See also Recommendation Q.112.

RECOMMENDATION Q.144

2.4 LINE SIGNAL RECEIVER *

2.4.1 Operating limits

The line signal receiver shall operate in the conditions specified under section 2.4.5 for the distortion of received signals that meet the following conditions:

a) $f1$: 2400 ± 15 c/s; $f2$: 2600 ± 15 c/s.

b) The absolute power level N of each unmodulated signal received shall be within the limits:

$(-16 + n) \leqslant N \leqslant (-2 + n)$ dbm or
$(-18 + n) \leqslant N \leqslant (-2 + n)$ dNm

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

These limits give a margin of ± 7 db (± 8 dN) 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 in a compound signal may differ from each other by not more than 5 db (6 dN).

The tolerances given in *a)*, *b)* and *c)* are to allow for variations at the sending end and for variations in line transmission.

2.4.2 Non-operate conditions of line signal receiver

a) Selectivity

The signal receiver shall not operate on a signal having an absolute power level at the receiving end within the limits specified in section 2.4.1 when the frequency is outside:

$2400 \begin{smallmatrix} +\ 100 \\ -\ 150 \end{smallmatrix}$ c/s for the $f1$ signal circuit or

$2600 \begin{smallmatrix} +\ 150 \\ -\ 100 \end{smallmatrix}$ c/s for the $f2$ signal circuit.

b) Maximum sensitivity of line signal receiver

The signal receiver shall not operate on a signal of 2400 ± 15 c/s or 2600 ± 15 c/s whose absolute power level at the point of connection of the receiver is $(-17 -9 + n)$ dbm or $(-20 -10 + n)$ dNm, n being the relative power level at this point. This limit is 17 db (20 dN) below the nominal absolute level of the signal current at the input to the signal receiver.

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* See also Recommendation Q.112.

2.4.3 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 is long enough to be recognized as signals by the switching equipment);

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

To minimize signal imitation by speech currents it is advisable that the guard circuit be tuned.

To minimize signal interference by low-frequency noise it is advisable that the response of the guard circuit falls off towards the lower frequencies and that the sensitivity of the guard circuit at 200 c/s be at least 10 db (or 12 dN) less than that at 1000 c/s.

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 false operation of the *f*1 or the *f*2 signal circuit lasting more than 90 ms (the minimum recognition time of a signal liable to imitation is 100 ms);

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.

2.4.4 Guard circuit limits

A. *Steady noise*

Considering:

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

b) that unweighted noise of a level –40 dbm0 (–4.6 Nm0) (100000 pW) and uniform spectrum energy may arise on the longest international, i.e. intercontinental, circuit,

it is recommended that, for either one or two signalling currents (each being within the limits specified in section 2.4.1), the signal receiver should satisfy the conditions indicated in section 2.4.5 for the distortion of signals in the presence of noise of a level of –40 dbm0 (–4.6 Nm0) and uniform spectrum energy over the frequency range 300 to 3400 c/s.

B. *Surges*

A guard circuit with an excessive 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 $(-10 + n)$ dbm or $(-12 + n)$ dNm 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 section 2.4.1, the lengths of the received signals must remain within the limits specified in section 2.4.5.

2.4.5 Distortion of received signals

When the signal frequencies and levels are within the limits specified in section 2.4.1, the change in signal length in the presence of noise as defined in section 2.4.4, A should not exceed:

a) 15 ms when the signal receiver receives a pulse of one frequency $f1$ or $f2$ with a minimum duration of 150 ms;

b) 25 ms when the signal receiver receives a compound pulse of the two frequencies $f1$ and $f2$ with a minimum duration of 150 ms, the change being defined as the difference between the simultaneous reception of the two frequencies at the input to the receiver and the simultaneous production of the two components as a direct-current signal at the output of the signal receiver.

In general, the response time of the signal receiver should be as short as practicable to minimize the time required for signalling purposes.

Except for the forward transfer pulse signal, the above pulse distortion requirements are of minor importance for the remaining line signals, which are all of the continuous compelled * type. Nevertheless the limits are specified for receiver design and test purposes.

RECOMMENDATION Q.145

2.5 SPLITTING ARRANGEMENTS

Sending line split

2.5.1 According to Recommendation Q.25, section B, sending split arrangements have to be provided.

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

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

2.5.4 Exceptionally, the values quoted in 2.5.2 and 2.5.3 above may be 0 to 50 ms as the values are of minor importance with respect to compelled-type signals.

Receiving line split

2.5.5 The international circuit should be split at the international exchange when either a single-frequency or a compound-frequency signal is received, to ensure that no fraction of the signal exceeding 35 ms duration may pass out of the international circuit.

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* See Recommendation Q.141, section 2.1.6, explaining the term " continuous compelled ".

The splitting time of 35 ms may be reduced by each Administration concerned in order to help to protect 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 impair speech transmission.

2.5.6 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.

2.5.7 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 for setting up an international call.

2.5.8 The splitting device may be any suitable arrangement—for example, physical line disconnection, high impedance electronic device, insertion of signalling frequency band stop filter, etc. The level of leak current transmitted to the subsequent circuit from the splitting device in the split condition should be at least 40 db (4.6 N) below the received signal level. Exceptionally, the level of the leak current may be 25 db (2.9 N) below the received signal level if this causes no interference with the relevant networks.

RECOMMENDATION Q.146

2.6 SPEED OF SWITCHING IN INTERNATIONAL EXCHANGES

2.6.1 It is recommended that the equipment in the international exchanges shall have a high switching speed so that the switching time may be as short as possible.

2.6.2 At the outgoing international exchange the seizing of the circuit and the setting-up of the connection should take place as soon as the ST end-of-pulsing condition is available (see Recommendation Q.152). In automatic operation advantage should be taken of all cases in which the ST condition can be reasonably determined at once, i.e. with avoidance of the 4-6 seconds time-out.

At an international transit exchange the setting-up of the connection on the outgoing circuit should take place as soon as the digits necessary to determine the routing are received and analysed.

At the incoming international exchange the setting-up of the national part of the connection should start as soon as the register has received a sufficient number of digits.

2.6.3 At international exchanges the return of a proceed-to-send signal should be as fast as possible but in any case the return should normally be guaranteed before the time-out (minimum 10 seconds) of the seizing signal.

Furthermore, in the case of congestion on the circuits outgoing from a transit or an incoming exchange, a busy-flash signal should be returned as soon as practicable, but in any case within a maximum delay of 10 seconds following the receipt of the information necessary to determine the routing.

(Q.146)

CHAPTER III

REGISTER SIGNALLING

RECOMMENDATION Q.151

3.1 SIGNAL CODE FOR REGISTER SIGNALLING

3.1.1 General

1) Automatic access to the international circuits must be used for outgoing traffic and the numerical signals from the operator or subscriber are stored in an outgoing international register before an international circuit is seized. As soon as the ST (end-of-pulsing) condition is available to the outgoing register, a free international circuit is selected and a seizing line signal transmitted. On receipt of a proceed-to-send line signal the seizing signal is terminated and a KP ("start of pulsing") pulse, followed by the numerical signals, is transmitted by the register. The final register signal transmitted is an end-of-pulsing (ST) pulse. The register signalling is not required to be TASI-prefixed.

2) Link-by-link register signalling applies. The register signals are always sent en bloc *. En bloc non-overlap * applies at the outgoing international register. En bloc overlap * applies at the transit and incoming international registers.

3) On a particular link, the KP signal sent by the international register (outgoing or transit register) on receipt of a proceed-to-send signal may be used to prepare the distant international register on this link for the receipt of the subsequent numerical signals. This signal may also serve to discriminate between terminal and transit traffic:

a) Terminal KP (KP1). Used to create conditions at the next exchange so that equipment (or techniques) used exclusively for switching the call to the national network of the incoming country is brought into circuit.

b) Transit KP (KP2). Used to bring into circuit, at the next exchange, equipment (or techniques) required to switch the call to another international exchange.

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* *En bloc register signalling* is the transmission, by a register, of all the call information as a whole in a regular timed sequence of signals.

The technique requires that, in one register on the connection, all the relevant call information from a subscriber or operator shall be completely stored before output en bloc signal transmission takes place from that register.

At registers subsequent to the one where all the call information from a subscriber or operator is completely stored, the output signal transmission may commence before the complete reception of the input information; thus overlap (to any desired degree) of the output signal transmission with the input signal reception may occur and this may be understood as being *en bloc overlap*. Alternatively, the output signal transmission may be delayed until all the call information is received and stored. This may be understood as being *en bloc non-overlap*.

4) The register signalling is a 2-out-of-6 multifrequency code, forward signalling only, as shown in Table 2.

TABLE 2

Register signal code of system No. 5

Signal	*Frequencies (compound)* c/s	Remarks
KP1	1100/1700	Terminal traffic
KP2	1300/1700	Transit traffic
1	700/900	
2	700/1100	
3	900/1100	
4	700/1300	
5	900/1300	
6	1100/1300	
7	700/1500	
8	900/1500	
9	1100/1500	
0	1300/1500	
Code 11	700/1700	Code 11 operator
Code 12	900/1700	Code 12 operator
ST	1500/1700	End-of-pulsing

3.1.2 Sending sequence of register signals

The sequence of the register signals shall conform to the sequence indicated in Recommendation Q.107, noting the following:

a) a KP start-of-pulsing signal shall precede the sequence of numerical signals in all the cases indicated;

b) the ST end-of-pulsing signal will be transmitted from the register in automatic as well as in semi-automatic operation;

c) exceptionally, special numbers for giving access to incoming operators or delay operators may be dialled by outgoing operators and transmitted by outgoing international registers instead of code 11 and code 12 signals.

RECOMMENDATION Q.152

3.2 END-OF-PULSING CONDITIONS—REGISTER ARRANGEMENTS CONCERNING ST (END-OF-PULSING) SIGNAL

3.2.1 The register signalling arrangements provide for the sending of a ST signal for both semi-automatic and automatic operation; the arrangements in the outgoing international register for recognizing the ST end-of-pulsing condition will vary as follows:

a) Semi-automatic operation

The ST condition is determined by the receipt of the "sending-finished" signal from the operator (see Recommendation Q.106).

b) Automatic operation

(1) Where the ST condition is determined by the originating national network and an ST signal is produced and transmitted to the outgoing international register, no further arrangements are necessary in that register for this purpose.

(2) Where the ST condition is not received from the originating national network, the outgoing international register will be required to determine the ST condition. This ST condition is determined when the cessation of the numerical information input to the register exceeds a period of 4 seconds (5 ± 1 seconds) in either of the following two circumstances, as preferred by the Administration:

i) after the minimum number of digits in the world numbering plan, or

ii) after the minimum number of digits of the destination country numbering plan.

In (i) and (ii), prolonged cessation of the numerical information input before the minimum number of digits should result in time-out release of the register without the production of the ST condition.

An immediate ST condition may be produced by a digit count to avoid the 4-second delay ST condition in the following circumstances:

i) when the destination country numbering plan has a fixed number of digits,

ii) when the maximum number of digits in the numbering plan of the destination country has been received.

3.2.2 Under all conditions, the outgoing international circuit should not be seized until the ST end-of-pulsing condition is available in the outgoing international register.

RECOMMENDATION Q.153

3.3 MULTIFREQUENCY SIGNAL SENDER

3.3.1 Signalling frequencies

700, 900, 1100, 1300, 1500 and 1700 c/s.

A signal shall consist of a combination of any two of these six frequencies. The frequency variation shall not exceed ± 6 c/s of each nominal frequency.

3.3.2 Transmitted signal level

-7 ± 1 dbm0 (-8 ± 1 dNm0) per frequency.

The difference in transmitted level between the two frequencies comprising a signal shall not exceed 1 db (1 dN).

Note. — The level of the leak current transmitted to line should be at least:

a) 50 db (5.8 N) below the single-frequency level when a multifrequency signal is not being transmitted;

b) 30 db (3.5 N) below the transmitted signal level of either of the two frequencies when a multifrequency signal is being transmitted.

3.3.3 Signal durations

KP1 and KP2 signals: 100 ± 10 ms

All other signals: 55 ± 5 ms

Interval between all signals: 55 ± 5 ms

Interval between cessation of the seizing line signal and transmission of the register KP signal: 80 ± 20 ms.

3.3.4 Compound signal tolerance

The interval of time between the moments when each of the two frequencies comprising a signal is sent must not exceed 1 ms. The interval of time between the moments when each of the two frequencies ceases must not exceed 1 ms.

RECOMMENDATION Q.154

3.4 MULTIFREQUENCY SIGNAL RECEIVER

3.4.1 Operating limits

The signal receiver must ensure a separate output signal for each of the six voice-frequency signals received, and must operate satisfactorily for any combination of two of the frequencies, received as a single pulse or in a train of pulses, satisfying the following conditions:

a) the frequency of the received signal is within ± 15 c/s of the nominal signalling frequency;

b) the absolute power level N of each unmodulated signal shall be within the limits

$(-14 + n \leqslant N \leqslant n)$ dbm or

$(-16 + n \leqslant N \leqslant n)$ dNm

where n is the relative power level at the signal receiver input. These limits give a margin of ± 7 db (±8 dN) on the nominal absolute level of each received signal at the input to the signal receiver;

c) the absolute levels of the two unmodulated frequencies comprising a signal must not differ from each other by more than 4 db or 5 dN;

d) when the signal frequencies and levels are within the limits specified in *a)*, *b)* and *c)* above, and in the presence of noise as defined in section 3.4.3:

(1) at the input of a signal receiver, the minimum duration of an MF signal necessary to ensure correct registration of the digit shall not exceed 30 ms; this includes the operate time of the signal receiver and the two-and-two only check feature;

(2) furthermore, at the input of the signal receiver, the minimum duration of an interval necessary to ensure the correct functioning of the registration device shall not exceed 30 ms; this includes the release time of the signal receiver and the restoration time of the two-and-two only check feature.

Notes

1. The tolerances given in *a)*, *b)*, and *c)* are to allow for variations at the sending end and in line transmission.

2. The test values indicated in *d)* are less than the working values. The difference between the test and working values will allow for pulse distortion, difference in time of the receipt of the two frequencies comprising a signal, etc.

3.4.2 Non-operating conditions

a) Maximum sensitivity

The signal receiver shall not operate under the effect of a signal as indicated in paragraph 3.4.1 *a)* whose absolute power level at the point of connection of the receiver is $(-17 -7 + n)$ dbm or $(-20 -8 + n)$ dNm, n being the relative power level at this point.

This limit is 17 db (20 dN) below the nominal absolute power level of the signal current at the input to the signal receiver.

b) Transient response

Operation of the signal receiver shall be delayed for a minimum period necessary to guard against false operation due to spurious signals generated within the receiver on reception of any signal.

c) Short signal response

The signal receiver should not operate to a pulse signal of 10 ms or less. This signal may be of single frequency or two frequencies received simultaneously.

Likewise the signal receiver should ignore short intervals.

3.4.3 Steady noise

Considering that unweighted noise of a level -40 dbm0 (-46 dNm0) (100000 pW) and uniform spectrum energy may arise on the longest international circuit, the multifrequency receiver should satisfy the condition indicated in paragraph 3.4.1 *d)* for minimum signal and interval durations in the presence of noise of level -40 dbm0 (-46 dNm0) and uniform spectrum energy over the frequency range 300 to 3400 c/s.

(Q.154)

3.4.4 Input impedance

The input impedance should be such that the return loss over a frequency range 300 to 3400 c/s against a 600-ohm non-inductive resistor is greater than 20 db or 23 dN.

RECOMMENDATION Q.155

3.5 ANALYSIS OF DIGITAL INFORMATION FOR ROUTING

3.5.1 General requirements for the transit exchange

In an international transit exchange an analysis of some of the digits is required to determine the routing * to the desired international incoming exchange or to another international transit exchange. As a general rule the country code of the destination country is subject to this analysis. In some cases an analysis of more or fewer digits may be required (see Annex hereafter).

The transit exchange decides how many of the received digits it needs for this analysis.

3.5.2 Maximum number of digits to be analysed in an international transit exchange

(1) The *maximum* number of digits * which has to be analysed in a transit exchange to determine the routing at this exchange is as follows:

$I_1 \; Z \; N_1 \; N_2 \; N_3$

$I_1 \; I_2 \; Z \; N_1 \; N_2$

$I_1 \; I_2 \; I_3 \; Z \; N_1 \; N_2$

where I_1, I_2, I_3 = digits of the country code

Z = characteristic digit, i.e. discriminating digit (D) or language digit (L)

$N_1, ---, N_n$ = digits of the national (significant) number

Note. — In the case of countries with more than one incoming international exchange where code 11 or code 12 traffic requires for routing in the transit exchange a digit analysis beyond the country code, N_1 is the extra digit designating the incoming international exchange (see the Annex below, examples 1*b* and 3).

(2) Accordingly the maximum number of digits that have to be analysed at an international transit exchange is six, which number includes the language or the discriminating digit.

3.5.3 Digital analysis for routing at the outgoing international exchange

The *maximum* number of digits which have to be analysed in the outgoing international exchange to determine the routing is also six, as in section 3.5.2 for the transit exchange. This number of six digits includes the language or the discriminating digit.

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* See Recommendation Q.11, paragraph 1.2.

3.5.4 Digital analysis for inserting (or detecting) the language or discriminating digit

(1) In semi-automatic working in the case when the language digit is not sent by the operator and in automatic working it is necessary to determine in the outgoing international exchange the position where the language or the discriminating digit should be automatically inserted (immediately after the country code). This position is determined by an analysis of the first or the first two digits of the country code.

(2) In an international transit exchange an analysis, effective on the first or the first two digits of the country code, determines the number of digits in the country code. The position of the language or the discriminating digit which, in the sequence of numerical information, follows immediately the country code is therefore determined.

ANNEX

(To Recommendation Q.155)

Example of the digit analysis in a transit exchange

A list of possible cases for the digit analysis in a transit exchange is the following (the letters given to the international exchanges correspond to the figure and the letters given to the digits correspond to section 3.5.2 of this Recommendation):

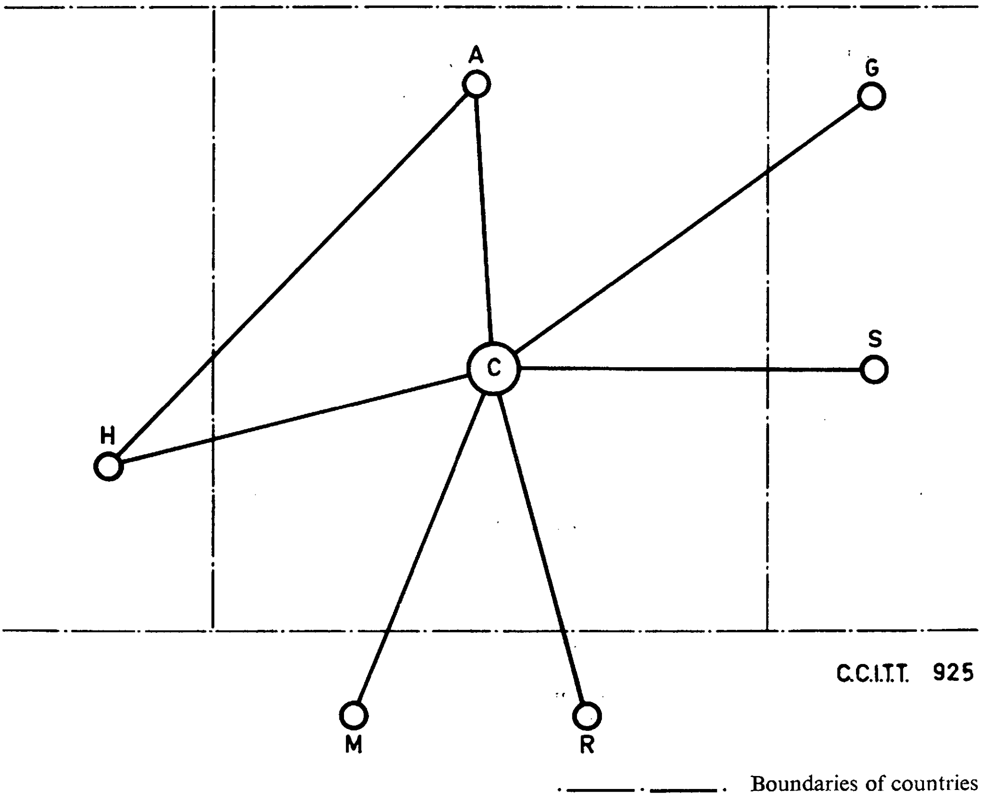

FIGURE 2. — **Example of the digit analysis in a transit exchange**

1. Transit traffic via *C* in one country routed to exchanges *M* or *R* in another country according to the first digit(s) of the national (significant) number.

a) Automatic and semi-automatic calls with normal national numbers.

Example: $\underbrace{I_1\ I_2\ Z\ N_1\ N_2}_{\text{Analysed}}\ ----$

*b)** Semi-automatic calls to code 11 or code 12 operators.

Examples: $\underbrace{I_1\ I_2\ L\ N_1}_{\text{Analysed}}\ C_{11}$ or $\underbrace{I_1\ I_2\ L\ N_1}_{\text{Analysed}}\ C_{12}$

2. Transit traffic via *C* in one country routed to *G* or *S* in another country with semi-automatic traffic to *S* and automatic traffic to *G* according to the presence of the language digit *(L)* or the presence of the discriminating digit *(D)*.

Examples: $\underbrace{I_1\ I_2\ D}_{\text{Analysed}}\ ---$ or $\underbrace{I_1\ I_2\ L}_{\text{Analysed}}\ ---$

3.* Terminal traffic incoming to an international exchange *C* in a country and which is to be routed to code 11 or code 12 operators in another international exchange *A* in the same country according to the extra digit N_1.

Examples: $\underbrace{L\ N_1}_{\text{Analysed}}\ C_{11}\ C_{15}$ or $\underbrace{L\ N_1}_{\text{Analysed}}\ C_{12}\ X\ X\ C_{15}$

RECOMMENDATION Q.156

3.6 RELEASE OF INTERNATIONAL REGISTERS

3.6.1 Normal release conditions

a) An outgoing international register shall be released when it has transmitted the ST signal.

b) An incoming international register shall be released in either one of the following two cases:

1. Depending on the arrangements adopted by the Administration concerned at the incoming international exchange. For example, release on transmission of the ST signal, release on receipt of a number-received condition from the national network, etc.

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* It is recognized that existing design of some present-day equipments does not permit the insertion of the extra digit N_1.

In this situation, agreement will be required between the relevant countries concerned that this insertion of N_1 would not be provided for at a particular outgoing international exchange as long as the equipment limitation applied. (This note applies to Recommendation Q.107 also.)

2. When the busy-flash signal is returned. The return of the busy-flash signal in the case of congestion at the incoming exchange should take place as soon as practicable, but in any case within a maximum delay of 10 seconds following the receipt, at the incoming exchange, of the digits necessary to determine the routing.

c) A transit international register shall be released in either one of the following two cases:

1. When it has transmitted the ST signal.

2. When the busy-flash signal is returned. The return of the busy-flash signal in the case of congestion at the transit exchange should take place as soon as practicable, but in any case within a maximum delay of 10 seconds following the receipt, at the transit exchange, of the digits necessary to determine the routing.

3.6.2 Abnormal release conditions

a) An outgoing international register shall be released in either one of the following two cases:

1. Proceed-to-send signal not received.

To release after the maximum delay of 10 to 20 seconds indicated by the time-out of the seizing signal. Register release after this delay will depend upon the arrangements preferred by the Administrations concerned, but release should preferably take place as quickly as possible after the time-out of the seizing line signal.

2. Proceed-to-send signal received.

This case assumes that the proceed-to-send signal has ceased at the incoming end in the normal way but owing to a fault condition the outgoing register has not pulsed out. The outgoing register will be released by the clear-forward/release-guard sequence prompted by the busy-flash signal sent from the incoming end on non-receipt of register signals within a certain time. This assumes that the busy-flash signal is received at the outgoing end before the termination of any forced release delay that Administrations may wish to incorporate in the outgoing register.

b) An incoming international register shall be released in either one of the following two cases:

1. The ST signal not received within a certain time after commencement of the transmission of the proceed-to-send signal from the incoming end.

2. On return of the busy-flash signal, transmitted from the incoming end when an error is detected in the receipt of the register multifrequency signals.

c) A transit international register shall be released in any one of the cases stated for the release of the outgoing and incoming registers in paragraphs *a)* and *b)* above.

RECOMMENDATION Q.157

3.7 SWITCHING TO THE SPEECH POSITION

At the outgoing and transit international exchanges, the circuit shall be switched to the speech position when the register (outgoing or transit) is released after sending the ST signal.

At the incoming international exchange, the circuit will be switched to the speech position when the register is released (see 3.6.1).

CHAPTER IV

Manual testing arrangements for signalling system No. 5

RECOMMENDATION Q.161

4.1 GENERAL ARRANGEMENTS FOR MANUAL TESTING *

4.1.1 The guiding principles for the maintenance of automatic circuits, as covered by Recommendations Q.70 to Q.73 and Q.75, are applicable to manual testing arrangements * for system No. 5 with the following exceptions:

a) Since Recommendations Q.71 and Q.72 do not expressly prohibit non-control International Maintenance Centres from initiating functional tests, and in view of the time required to perform manual tests such as those outlined in section 4.3.3 of Recommendation Q.163, it is recommended that such tests be initiated only with the consent of the control I.M.C.

b) Functional tests from the I.M.C. may require co-operation of personnel at the distant end. This does not conform to the requirements stated in section 1.4 of Recommendation Q.72.

c) These manual testing arrangements do not fully provide for the circuit limit tests specified in Recommendation Q.72.

d) Blocking signals as described in section 3 of Recommendation Q.73 will not be used. In view of this, the control I.M.C. should be informed of any out-of-service situations and action to remove a circuit from service should be taken at both terminals.

Note. — The out-of-service situation includes intervention of maintenance personnel which causes or has caused interference with service on a circuit.

e) The procedure described in Recommendation Q.75 under item 4 may be modified if a like item of equipment, known to be properly adjusted, is switched in to take the place of equipment under test (4.2.2 *c)*).

4.1.2 The transmission tests on system No. 5 will be made by manual methods or by using test call transmission devices existing at the terminal international exchange.

RECOMMENDATION Q.162

4.2 ROUTINE TESTING OF EQUIPMENT (LOCAL MAINTENANCE)

4.2.1 Routine tests for testing individual items of equipment such as circuit equipment, connecting circuits, operator's line calling equipment, selectors, registers, etc., must be

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* Automatic test devices for system No. 5 are being studied by the C.C.I.T.T. in 1964-1968 (Question 7/XI).

provided for in every international exchange equipped for automatic switching. These routine tests will be made in accordance with the practice followed in each country for the local maintenance of the switching equipment.

4.2.2 The testing equipment must conform to the following principles:

a) an item of equipment must not be taken for test until it is free;

b) an item of equipment taken for test will be marked engaged for the duration of the test. Before a circuit equipment is taken for test, the circuit will be withdrawn from service at both international exchanges;

c) as an alternative to *b)*, a like item of equipment, known to be properly adjusted, may be switched in, and the item of equipment to be tested is switched out during the test.

4.2.3 Testing of the circuit and signalling equipment should include a check that the specifications of system No. 5 are met in regard to the following:

a) Line signalling system

Signalling frequencies
Transmitted signal levels
Signal frequency leak
Receiver operate and non-operate limits
Receiving-end line split
Sending-end line split
Line signal codes
Sending duration of signals
Recognition time of signals
Overlap transmission of answer signal on transit calls
Double seizing
Time-out and alarm features

b) Register signalling system

Signalling frequencies
Transmitted signal levels
Signal frequency leak
Sending duration of signals
Receiver operate and non-operate limits
Operation of the receiver to a series of pulses
Error-checking features

4.2.4 *Simulated end-to-end tests*

It is desirable that a means be provided whereby end-to-end testing can be simulated on a local basis. A local loop-around arrangement permitting an outgoing test call to be routed directly on a four-wire basis into incoming equipment should be provided. The loop-around arrangement replaces the international line and is connected to the circuit equipment under test on the one side and on the other side to similar working spare both-way circuit equipment and signalling equipment having access to the switching system.

(Q.162)

RECOMMENDATION Q.163

4.3 MANUAL TESTING

4.3.1 Functional testing of signalling arrangements

Functional tests from one end of the circuit to the other ("end-to-end" testing) can be made in the following three ways:

a) The first method consists of a rapid verification of satisfactory signal transmission by ensuring 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.

b) The second method consists of verification of satisfactory signal transmission by initiating a test call to:

1. technical personnel at the distant-end international exchange, or
2. to a test call signal testing and answering device, if such equipment is available at the distant-end international exchange.

c) The third method consists of complete verification of satisfactory line and register signal transmission. The verification consists of a check of ability to:

1. generate and receive line and register signals,
2. transmit the appropriate acknowledgement signals,
3. provide required duration and spacing of MF signals,
4. complete terminal and transit * calls.

4.3.2 First method: rapid test

1. Verification of satisfactory signal transmission:

   a) Initiate a seizing signal and verify the receipt and recognition of the proceed-to-send signal from the distant end.

Note. — Absence of numerical information following termination of the seizing signal may result in receipt of a busy-flash signal provided by some Administrations from the distant-end equipment.

   b) Initiate a clear-forward signal and verify the receipt and recognition of the release-guard signal from the distant end.

2. Failure to complete the seizing/proceed-to-send signalling sequence or the clear-forward/release-guard signalling sequence should result in the automatic termination of the frequencies being transmitted within 10-20 seconds.
3. In the event of a failure appropriate steps should be taken to locate and correct the trouble.
4. The above tests are short, simple and should be made daily, from each end of the circuit.

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* See the note to paragraph 4.3.4.3 at the bottom of page 239.

4.3.3 Second method: test calls

1. Verification of satisfactory transmission of signals involved in completion of test calls (manual method):

   a) Place a call to the technical personnel at the distant international exchange.

   b) On completion of connection:

      1. the audible ringing tone should be heard.
      2. the answer signal should be received when the call is answered at the distant end.

   c) Request distant end to initiate a clear-back signal, followed by an answer signal.

   d) A clear-back signal should be received and recognized when the distant end hangs up and a second answer signal should be received and recognized when the distant end re-answers the call.

   e) Initiate a forward-transfer signal which should result in bringing in the assistance operator at the distant end.

   f) Terminate the call and observe that the circuit restores to the idle condition.

2. Verification of satisfactory transmission of signals involved in completion of test calls (semi-automatic method);

   If test call signal testing and answering devices are available at the distant international exchange, the signal verification tests should be made using this equipment to the extent that the applicable features indicated in 1 above are available.

3. The above tests should be made from each end of the circuit. They should be made weekly when the manual testing methods prescribed in 1 are used.

   They may be made daily when semi-automatic test arrangements are available.

4.3.4 Third method: comprehensive tests; terminal and transit test calls

1. Verification of satisfactory signal transmission (frequency, level, duration, etc.) involved in terminal and transit calls.

   a) These tests are made in conjunction with:

      - verification and location of faults,
      - ensuring that new circuits are satisfactory in operation before being brought into service.

   b) When establishing new circuits all of the tests outlined in 4.2.3 should have been completed at both terminals. New circuits assigned to Time Assignment Speech Interpolation (TASI) equipment should be patched as non-TASI for the duration of these tests.

2. Terminal calls

Initiate a call to the distant end test centre. Co-ordinate this test with the distant end so that appropriate test equipment is connected prior to establishing the call. Check the following:

a) At the originating end check that a seizing signal is followed by the receipt and recognition of the proceed-to-send signal from the distant end. Check that the proceed-to-send signal persists until the seizing signal ceases.

b) At the distant end check the following:

	Duration of transmitted signal
1. Interval between termination of seizing signal and start of KP signal	80 ± 20 ms
2. KP signal duration	100 ± 10 ms
3. Digital and ST signal duration	55 ± 5 ms
4. Interval between all signals	55 ± 5 ms

c) Check that the audible ringing tone is heard at the originating end.

d) At the originating end check that the answer signal is received, recognized and acknowledged. Check that the acknowledgement signal persists until the answer signal ceases.

e) At the distant end initiate a clear-back signal.

f) At the originating end check that a clear-back signal is received, recognized and acknowledged. Check that the acknowledgement signal persists until the clear-back signal ceases.

g) At the originating end initiate a forward-transfer signal.

h) At the distant end check the receipt of the forward-transfer signal. The transmitted duration of this signal should be 850 ± 200 ms. This signal may be subject to TASI clipping.

i) At the distant end arrange to transmit a succession of clear-back and answer signals; first at a slow rate, then at a rate which is faster than the system is capable of following.

j) At the originating end check during the slow transmission of the switch-hook flashes that each clear-back and answer signal is received and properly recognized. Verify that after the fast transmission of switch-hook flashes the equipment indicates the final position of the switch-hook.

k) At the originating end release the circuit and check that the clear-forward signal is followed by the receipt and recognition of the release-guard signal from the distant end. Check that the release-guard signal ceases after the clear-forward signal ceases. Check that the circuit restores to the idle condition.

l) At the originating end check that the clear-forward signal sent to the incoming equipment in the idle condition results in the return of the release-guard signal and that the equipment restores to the idle condition.

m) At the originating end check that the busy-flash signal is received, recognized and acknowledged. Check that the acknowledgement ceases after the busy-flash signal ceases. (Some Administrations at the incoming end may find it convenient to provide a test call device which prompts the return of a busy-flash signal.)
In normal service the receipt of a busy-flash signal causes (after the acknowledgement) a clear-forward signal to be sent automatically from the international exchange originating the call. On a test call procedure some Administrations may prefer to avoid this process. In this case, the release of the connection is controlled by the personnel at the terminal originating the test call.

Note on items a) to m). — As part of the comprehensive tests it may, in certain circumstances such as fault localization, be desirable to test the frequency, level, and duration of received signals. Normally, however, it may be assumed that each Administration has verified the accuracy of its signal transmission locally as covered in paragraph 4.2.3.

3. Transit calls *

a) After securing the co-operation of a third international exchange initiate a transit call to this exchange through the international exchange covered in 2 above.

b) With the assistance of technical personnel at the third international exchange repeat steps 2 *c)* to 2 *k)* except that in step 2 *h)* measurement of the duration of the forward-transfer signal need not be made.

Note. — Detailed tests of certain transit features such as that of the transmission of the answer signal on an overlap basis at the transit point should be performed locally.

RECOMMENDATION Q.164

4.4 TEST EQUIPMENT FOR CHECKING EQUIPMENT AND SIGNALS

4.4.1 General

For local checks of correct equipment operation and for readjusting the equipment, international exchanges should have test equipment available which includes:

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* When making transit test calls it is not the intention to check the performance or the quality of the circuit beyond the transit exchange, this being completely the responsibility of the Administration concerned. However, it is important that in principle the transit operations can be checked.

a) Line and register signal generators.

b) Signal-measuring apparatus.

c) Loop-around equipment (see 4.4.4).

4.4.2 Signal generators

The signal generators should be able to simulate all line and register signals. The generators may be part of test equipment which cycles the equipment to be tested through actual signalling sequences, in a manner which enables rapid complete testing to determine whether the equipment meets the system specifications. The generators should have the following characteristics:

a) Line signal generator

1. Signal frequencies should be within ± 5 c/s of the nominal signalling frequency or frequencies and shall not vary during the time required for testing.
2. Signal levels should be variable between the limits given in the specification and be able to be set within ± 0.2 db (± 0.2 dN).
3. Signal durations should be long enough so that the signals can be recognized and long enough in the case of compelled signals to complete the acknowledgement process.

b) Register signal generator

1. Signal frequencies should be within ± 5 c/s of the nominal signalling frequency or frequencies and shall not vary during the time required for testing.
2. Signal levels should be variable between the limits given in the specification and be able to be set within ± 0.2 db (± 0.2 dN).
3. Signal durations and intervals between signals shall be within the limits given in the specification in Recommendation Q.153, section 3.3.3, for normal operate values and in Recommendation Q.154, section 3.4.1 *d)*, for test operate values.

4.4.3 Signal-measuring equipment

Equipment capable of measuring signal frequencies, signal levels, signal durations and other significant signal time intervals may be part of the test equipment referred to in section 4.4.2, or separate instruments. In either case the characteristics of the measuring equipment should be as follows:

a) Line signal-measuring equipment

1. Signal frequency or frequencies to be measured to be between the extreme limits given in the specification, the reading being made with an accuracy of ± 1 c/s.
2. Level of the signal frequency or frequencies measured over the range given in the specification to be measured with an accuracy of ± 0.2 db (± 0.2 dN).

3. Signal durations, signal recognition times and other significant time intervals as given in the specification should be measured within an accuracy of 1 ms or ± 1% of the nominal duration, whichever yields the higher value. The range of time intervals to be measured is approximately 5 to 1050 ms. Time-out intervals of 10 to 20 seconds should be determinable within an accuracy of ± 1 second.

b) *Register signal-measuring equipment*

1. Signal frequency or frequencies to be measured to be between the extreme limits given in the specification, the reading being made with an accuracy of ± 1 c/s.
2. Level of the signal frequency or frequencies measured over the range given in the specification to be measured with an accuracy of ± 0.2 db (± 0.2 dN).
3. Signal duration and intervals between signals as given in the specification should be measured with an accuracy within 1 ms.

c) In regard to measuring time intervals a recorder having a minimum of two input channels may be useful. The recorder characteristic should conform with the accuracy quoted in *a)* and *b)* above and be easily connected to the circuit under test. The recorder input characteristic should be such as to have a negligible effect on circuit performance.

4.4.4 Loop-around equipment

Four-wire loop-around equipment should simulate line facilities without introducing signalling degradation. The gain of the loop-around equipment should be set to provide proper transmission levels. Alternatively, if the testing of the individual items of equipment is on a limit test basis it would not be essential to set the gain of the loop to provide the exact transmission levels. In this event a straight patch would be adequate.

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ANNEXES TO SIGNALLING SYSTEM No. 5 SPECIFICATIONS

ANNEX 1

SIGNALLING SEQUENCES

Table 1: Semi-automatic (SA) and automatic (A) terminal traffic.

Table 2: Semi-automatic (SA) and automatic (A) transit traffic.

In these tables, an arrow with a full line denotes the sending of a signal, an arrow with a dotted line the ceasing of a signal.

ANNEX 2

DESCRIPTION OF THE OPERATIONS CORRESPONDING TO THE VARIOUS NORMAL AND ABNORMAL CONDITIONS WHICH MAY ARISE IN SETTING UP A CALL

Table 1: Outgoing exchange — Normal conditions

Table 2: Outgoing exchange — Abnormal conditions

Table 3: Incoming exchange — Normal conditions

Table 4: Incoming exchange — Abnormal conditions

Table 5: Transit exchange — Normal conditions

Table 6: Transit exchange — Abnormal conditions

ANNEX 1

TABLE 1. — SEMI-AUTOMATIC (SA) AND AUTOMATIC (A) TERMINAL TRAFFIC

Outgoing international exchange		Incoming international exchange
	CALL TO A FREE SUBSCRIBER	
The seizing signal is sent forward when the ST end-of-pulsing condition is recognized in the outgoing register (the speech path is open as long as the register is connected).	2400 ——▶	Receipt of the seizing signal causes a register at the incoming exchange to be connected; when the latter is ready to receive the digital information a proceed-to-send signal is sent back (the speech path is open as long as the incoming register is connected).
Receipt of the proceed-to-send signal causes the seizing signal to cease.	◀—— 2600	
	2400 ·····▶	The end of reception of the seizing signal causes the proceed-to-send signal to cease.
	◀····· 2600	
It is followed by the sending en bloc in multifrequency code of: the KP1 signal, the language or the discriminating digit, the national (significant) number, the ST signal. The outgoing register releases after the ST signal has been sent. The speech path through the outgoing exchange is established.	MF 2/6 code ——▶	The numerical signals are received in the incoming register. This register starts the setting-up of the call in the incoming country when enough digits have been received to determine the routing. The incoming register carries out the appropriate operations according to the language (or discriminating) digit. In SA operation for code 11 or 12 calls, the register directs the call to the operators' positions. The incoming register releases, and sets up the speech path in the incoming exchange as soon as it has sent forward all the information received.
SA: The operator or A: the calling subscriber hears the ringing tone.	◀· · · · · · · · · · · · · · ·	The ringing tone of the country of destination is sent back.
SA: An " answer " indication is given to the controlling operator. A: Charging and measurement of the call duration begin.	◀—— 2400	*The called subscriber answers.* An answer signal is sent back.

ANNEX 1 — *Table 1* (continued)

Outgoing international exchange		Incoming international exchange
Receipt of the answer signal causes an acknowledgement signal to be sent.	2400 →	Receipt of the acknowledgement ceases the answer signal.
The end of reception of the answer signal ceases the acknowledgement signal.	⇠ 2400	
	2400 ⇢	
SA: A clearing supervisory signal is given to the controlling operator. A: After 1-2 min., if there is no clear-forward signal, the international connection is released and charging and measurement of the call duration are ceased.	← 2600	*The called subscriber clears.* The clear-back signal is sent back.
The clear-back signal causes acknowledgement to be sent.	2400 →	Receipt of the acknowledgement ceases the clear-back signal.
The end of reception of the clear-back signal ceases the acknowledgement signal.	⇠ 2600	
	2400 ⇢	
The outgoing operator (SA) *or the calling subscriber* (A) *clears* A clear-forward signal is sent.	2400+2600 →	The clear-forward signal causes a release-guard signal to be sent back: a) on receipt of the clear-forward signal, or b) when the incoming equipment has been released.
The receipt of the release-guard signal ceases the clear-forward signal.	← 2400+2600	The clear-forward signal is sent in the country of destination.
	2400+2600 ⇢	The release-guard signal is ceased: a) subject to the two conditions that the incoming equipment has been released and that the clear-forward signal is no longer received; or
The end of the release-guard signal terminates the guard condition at the outgoing end.	⇠ 2400+2600	b) subject to the single condition that the clear-forward signal is no longer received. The outgoing access of the incoming end is maintained busy for 200 to 300 ms after the cessation of the release-guard signal.

ANNEX 1 — *Table 1* (continued)

Outgoing international exchange			Incoming international exchange
			CALL TO A BUSY SUBSCRIBER (OR CONGESTION)
The signal sequence is the same as for a call to a free subscriber, up to the point where the incoming register releases			
			1st Case
SA: A " busy " indication is given to the operator. A: The calling subscriber hears the busy tone of the outgoing (national or international) exchange.	The busy-flash signal	←——— 2600	The national network of the incoming country can give a busy-flash signal. This signal is detected by the incoming international equipment, which sends a busy-flash signal back.
	causes the acknowledgement signal to be sent.	2400 ———→	The acknowledgement signal ceases the busy-flash signal.
	The end of reception of the busy-flash signal ceases the acknowledgement signal.	←⋯⋯⋯ 2600	
		2400 ⋯⋯⋯→	
The cessation of the acknowledgement signal is followed automatically by the sending of the clear-forward signal which releases the international connection.			
			2nd Case
SA: The operator, or A: the calling subscriber hears the busy tone and clears and the clear-forward signal is sent.		←⋯⋯⋯	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
1. FORWARD TRANSFER			
1st Case			
SA: Following a call switched automatically to a subscriber, or following a call established via a special number incoming or delay operator, the controlling operator wishes to call in an assistance operator at the incoming international exchange. A forward-transfer signal is sent.		2600 ———→	The forward-transfer signal causes an assistance operator to intervene at the incoming international exchange.

ANNEX 1 — *Table 1* (concluded)

Outgoing international exchange	Incoming international exchange
2nd Case SA: Following a call via code 11 or 12, the controlling operator wishes to recall the incoming operator at the incoming international exchange. A forward-transfer signal is sent. 2600 →	→ Recalls the incoming operator on calls completed via the operator positions of this exchange.
2. DOUBLE SEIZING The outgoing end sends the seizing signal. 2400 →	→
←	2400 The incoming end also sends the seizing signal.
The two ends of the circuit send and receive the seizing signal for a sufficiently long time to ensure that the signal can be recognized at both ends. The two ends recognize the double seizing by this condition.	
The equipment is cleared at each end without the sending of a clear-forward signal; then: a) either a second automatic attempt to set up the connection takes place, or b) SA: a re-order indication is given to the operator; A: a busy tone is sent to the subscriber.	

ANNEX 1

TABLE 2. — SEMI-AUTOMATIC AND AUTOMATIC TRANSIT TRAFFIC

Outgoing international exchange		International transit exchange		Incoming international exchange
		CALL TO A FREE SUBSCRIBER		
A seizing signal is sent forward when the ST end-of-pulsing condition is recognized in the outgoing register (the speech path is open as long as outgoing register is connected).	2400 ───▶	Receipt of the seizing signal causes a register at the transit exchange to be connected. The proceed-to-send signal is sent back when the register is connected. (The speech path is open as long as the register is connected.)		
Receipt of the proceed-to-send signal ceases the seizing signal.	◀─── 2600			
It is followed by the sending en bloc in multifrequency code of:	2400 ┈┈┈▶	The end of reception of the seizing signal ceases the proceed-to-send signal.		
— the KP2 signal — the country code — the language or the discriminating digit — the national (significant) number — the ST signal.	◀┈┈┈ 2600 MF 2/6 code ───▶	The numerical signals are received in the register at the transit exchange.		
The outgoing register releases after the ST signal has been sent. The speech path through the outgoing exchange is established.				
		When enough digits have been received to determine the routing, a circuit is taken. A seizing signal is sent forward.	2400 ───▶	Receipt of the seizing signal causes a register to be connected at the incoming exchange and, when this register is connected, the proceed-to-send signal is sent back (the speech path is open as long as the register is connected).
			◀─── 2600	
		Receipt of the proceed-to-send signal ceases the seizing signal.	2400 ┈┈┈▶	

ANNEX 1 — *Table 2* (continued)

Outgoing international exchange	International transit exchange	Incoming international exchange
	It is followed by the sending en bloc overlap in multifrequency code of: — the KP1 signal — the language or the discriminating digit — the national (significant) number — the ST signal. The transit register releases after the ST signal has been sent. The speech path through the transit exchange is established.	◀········ 2600 The end of reception of the seizing signal ceases the proceed-to-send signal. MF2/6 code ────▶ The numerical signals are received in the incoming register. This register starts the setting up of the call in the incoming country when enough digits have been received to determine the routing. The incoming register carries out the appropriate operations according to the language (or discriminating) digit. In SA operation for code 11 or 12 calls, the register routes the call to the operators' positions. The incoming register releases and establishes the speech path at the incoming exchange as soon as it has sent forward all the information received.
SA: The operator } A: the calling subscriber } hears the ringing tone.	◀· ·	· · · · The ringing tone of the incoming country is sent back.
	Receipt of the answer signal:	◀──── 2400 *The called subscriber answers.* An answer signal is sent back.
◀──── 2400	— causes an answer signal to be sent back in " overlap compelled " manner. — causes an acknowledgement signal to be sent forward.	2400 ────▶

ANNEX 1 — *Table 2* (continued)

Outgoing international exchange			International transit exchange			Incoming international exchange
					◀······ 2400	Receipt of the acknowledgement signal ceases the answer signal.
SA: An answer indication is given to the controlling operator.	Receipt of the answer signal causes an acknowledgement signal to be sent forward.	2400 ——▶	Receipt of the acknowledgement signal ceases the answer signal.	The end of reception of the answer signal ceases the acknowledgement signal.	2400 ······▶	
A: Charging and measurement of the call duration begin.	The end of reception of the answer signal ceases the acknowledgement signal.	◀······ 2400				
		2400 ······▶				
			Receipt of the clear-back signal:		◀—— 2600	*The called subscriber clears.* The clear-back signal is sent back.
SA: A clearing supervisory signal is given to the controlling operator.	Receipt of the clear-back signal causes an acknowledgement signal to be sent forward.	◀—— 2600	— causes a clear-back signal to be sent back.	— causes an acknowledgement signal to be sent forward.	2400 ——▶	Receipt of the acknowledgement signal ceases the clear-back signal.
				The end of reception of the clear-back signal ceases the acknowledgement signal.	◀······ 2600	
		2400 ——▶	Receipt of the acknowledgement signal ceases the clear-back signal.		2400 ······▶	
A: After 1-2 min. if there is no clear-forward signal, the international connection is released and charging and measurement of the call duration are ceased.	The end of reception of the clear-back signal ceases the acknowledgement signal.	◀······ 2600				
		2400 ······▶				

ANNEX 1 — *Table 2* (continued)

Outgoing international exchange		International transit exchange		Incoming international exchange
SA: *The controlling operator, or* A: *The calling subscriber clears.* The clear-forward signal is sent.	2400 + 2600 →	Receipt of the clear-forward signal causes:		
		— a release-guard signal to be sent back: a) on receipt of the clear-forward signal, or b) when the incoming equipment has been released.		
		— a clear-forward signal to be sent forward.	2400 + 2600 →	The clear-forward signal causes the release-guard signal (which serves as an acknowledgement) to be sent back, a) on receipt of the clear-forward signal, or b) when the incoming equipment has been released.
		Receipt of the release-guard signal ceases the clear-forward signal.	← 2400 + 2600	
Receipt of the release-guard signal ceases the clear-forward signal.	← 2400 + 2600			
	2400 + 2600 ···→		2400 + 2600 ···→	The clear-forward signal is sent in the country of destination.
		The release-guard signal is ceased: a) subject to the two conditions that the incoming equipment has been released and the clear-forward signal is no longer received, or b) subject to the single condition that the clear-forward signal is no longer received.		The release-guard signal is ceased: a) subject to the two conditions that the incoming equipment has been released and the clear-forward signal is no longer received, or b) subject to the single condition that the clear-forward signal is no longer received.
The end of the release-guard signal terminates the guard condition at the outgoing end.	←··· 2400 + 2600			
		The end of the release-guard signal terminates the guard condition at the outgoing end in the transit exchange.	←··· 2400 + 2600	The outgoing access of the incoming end is maintained busy for 200 to 300 ms after the cessation of the release-guard signal.

ANNEX 1 — *Table 2* (continued)

Outgoing international exchange	International transit exchange	Incoming international exchange
	The outgoing access of the incoming end is maintained busy for 200 to 300 ms after the cessation of the release-guard signal.	

CALL TO BUSY SUBSCRIBER (OR CONGESTION)

The signal sequence is the same as for a call to a free subscriber up to the point where the incoming register releases.

Outgoing international exchange	International transit exchange	Incoming international exchange
	Receipt of the busy-flash signal:	◄—— 2600 *1st Case:* The national incoming network gives the busy-flash signal. The busy-flash signal is sent back.
	— causes the busy-flash signal to be sent back. — causes the acknowledgement signal to be sent forward. 2400 ——►	Receipt of the acknowledgement signal 2600 ceases the busy-flash signal.
SA: A busy indication is given to the operator. A: The calling subscriber hears the busy tone sent by the outgoing (national or international) exchange.	Receipt of the busy-flash signal causes an acknowledgement signal to be sent. ◄—— 2600	The end of reception of the busy-flash signal ceases the acknowledgement signal. ◄······
Receipt of the busy-flash signal causes an acknowledgement signal to be sent. 2400 ——►	Receipt of the acknowledgement signal ceases the busy-flash signal.	2400 ······►
The end of reception of the busy-flash signal ceases the acknowledgement signal. ◄······ 2600		
2400 ······►		

ANNEX 1 — *Table 2* (concluded)

Outgoing international exchange	International transit exchange	Incoming international exchange
The cessation of the acknowledgement signal is followed automatically by the sending of the clear-forward signal to release the international circuit, clearance being effected from the outgoing exchange.		
SA: The operator, or A: the calling subscriber hears the busy tone and clears. The clear-forward signal is sent. ◄	· ·	*2nd Case:* The national incoming network does not give the busy-flash signal. The busy tone of the incoming country is sent back.
	SPECIAL CONDITIONS	
FORWARD-TRANSFER *1st Case* SA: Following a call switched automatically to a subscriber, or following a call established via a special number incoming or delay operator, the controlling operator wishes to call in an assistance operator at the incoming international exchange. A forward-transfer signal is sent. 2600 →	The forward-transfer signal causes a forward-transfer signal to be sent over the following circuit. 2600 →	The forward-transfer signal causes an assistance operator to intervene at the incoming international exchange on an established connection completed automatically.
2nd Case SA: Following a call via code 11 or 12, the controlling operator wishes to recall the incoming operator at the incoming international exchange. The forward-transfer signal is sent. 2600 →	The forward-transfer signal causes a forward-transfer signal to be sent over the following circuit. 2600 →	Recalls the incoming operator on calls completed via the operators' positions of this exchange.

ANNEX 2

TABLE 1. — OUTGOING EXCHANGE — NORMAL CONDITIONS

<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 at a transit or an incoming exchange or on circuits immediately outgoing from that exchange (after register association)</th></tr>
<tr><th colspan="2">The busy-flash signal:</th></tr>
<tr><th>is not provided</th><th>is provided</th></tr>
<tr><td rowspan="5">Operations effected</td><td>Release of register</td><td colspan="4">After sending the ST signal</td></tr>
<tr><td>Speech position</td><td colspan="4">After release of register</td></tr>
<tr><td>Action on the international circuit</td><td colspan="2"></td><td colspan="2">Release of the circuit after reception of a busy-flash signal</td></tr>
<tr><td>SA - Local signals given to the operator</td><td colspan="2"></td><td colspan="2">Busy</td></tr>
<tr><td>A - Transmission of an appropriate indication to the calling subscriber</td><td colspan="2"></td><td colspan="2">Busy tone</td></tr>
<tr><td rowspan="2">Information received from the international circuit</td><td>Signals received</td><td colspan="2"></td><td colspan="2">Busy-flash signal</td></tr>
<tr><td>Audible indication received</td><td>Ringing tone</td><td>Busy tone</td><td colspan="2"></td></tr>
<tr><td colspan="2">References</td><td>3.6.1</td><td>3.7</td><td colspan="2">3.6.1, 3.7, 1.6</td></tr>
</table>

SA = Semi-automatic service } When there is no specific indication the clause is applicable to both services.
A = Automatic service }

ANNEX 2

TABLE 2. — OUTGOING EXCHANGE — ABNORMAL CONDITIONS

Conditions		The outgoing register receives no more digits	Registration of unused numerical information	Non-receipt of a proceed-to-send signal after sending the seizing signal	The outgoing register not having detected an abnormality, the incoming register receives an incomplete number or a non-existing number and it detects the abnormality
Operations effected	Release of register	SA - (local sending-finished signal not received): 10-20 seconds * after seizure or receipt of last digit. A - 15-30 seconds * after seizure if no, or less than the minimum number of, digits received. (When enough digits received, 4-6 seconds after the receipt of the last digit, normal ST condition is assumed)	Immediately the abnormality is recognized	10-20 seconds after the start of sending the seizing signal	After sending the ST signal
	Speech position	(A - After release of the register should ST condition be assumed)			After release of the register
	Action on the inter-national circuit	(A - Seized in normal manner should ST condition be assumed)		Released by clear-forward signal	
	SA - Local signals given to the operator	Determined by each Administration, as this is a national matter			
	A - Indications given to the subscriber	Appropriate audible indication			
Signals received from the intern. circuit					Busy-flash
References		3.2		3.6.2, 1.9	2.1.6 *d*, 3.6.1

---

* Typical value.

ANNEX 2

TABLE 3. — INCOMING EXCHANGE — NORMAL CONDITIONS

Conditions Operations effected	Called subscriber free	Subscriber busy or national congestion		Congestion at the incoming exchange or on circuits immediately outgoing from that exchange (after register association)
		The busy-flash signal:		
		is not provided	is provided	
Release of register	After *a)* sending the numerical information to, or *b)* sending an ST signal to, or *c)* receipt of an end-of-selection signal from, the national network equipment			After sending the busy-flash signal
Speech position	After release of the register			
Sending of busy-flash signal on the international circuit			After receipt of the national busy-flash signal	0-10 seconds after receipt of the information necessary for determining the route
Sending of an audible indication	National ringing tone	National busy tone	National busy tone (if present)	
References	3.6.1.*b*.1	3.6.1.*b*.1	2.1.6.*d*.4 3.6.1.*b*.2	1.6 2.1.6.*d*.1 3.6.1.*b*.2

ANNEX 2

TABLE 4. — INCOMING EXCHANGE — ABNORMAL CONDITIONS

Conditions Operations effected	Non-receipt of numerical signals	Error detected in receipt of the numerical signals	ST signal not received	Receipt of an incomplete number or a non-existing number (ST signal received)
Release of register	10-20 seconds after the start of sending the proceed-to-send signal	Immediately the error is recognized	20-40 seconds * after the start of sending the proceed-to-send signal	After *a)* sending the numerical information to, or *b)* sending an ST signal to, or *c)* receipt of an end-of-selection signal from, or *d)* receipt of a busy-flash signal from, the national network equipment or *e)* recognition of the abnormality by the incoming international register.
Speech position	After release of the register			
Signals sent back on the international circuit	Busy-flash			*d)* Busy-flash *e)* Busy-flash
References	2.1.3.*e* 2.1.6.*d*	2.1.6.*d*	2.1.6.*d* 3.6.2.*b*.1	2.1.6.*d* 3.6.2.*b*.2

* Typical value.

ANNEX 2

TABLE 5. — TRANSIT EXCHANGE — NORMAL CONDITIONS

Conditions Operations effected	Successful attempt (as far as transit exchange is concerned)	Congestion at the transit exchange or on international circuits immediately outgoing from that exchange (after register association)
Release of register	After sending the ST signal	After sending the busy-flash signal
Speech position	After release of the register	
Sending of busy-flash signal back		0-10 seconds after the receipt of the information necessary for determining the routing
References	3.6.1.*c*.1	3.6.1.*c*.2

ANNEX 2

TABLE 6. — TRANSIT EXCHANGE — ABNORMAL CONDITIONS

Conditions Operations effected	Non-receipt of numerical signals	Error detected in the receipt of the numerical signals	ST signal not received	Receipt of unused numerical information	Non-receipt of the proceed-to-send signal after sending the seizing signal
Release of register	10-20 seconds after the start of sending the proceed-to-send signal	Immediately the error is recognized	20-40 seconds * after the start of sending the proceed-to-send signal	After recognition of the abnormality	10-20 seconds after the start of sending the seizing signal
Speech position	After release of the register				
Signals sent back on the incoming international circuit	Busy-flash				
Action on the outgoing international circuit					Released by clear-forward signal
References	2.1.3.*e* 2.1.6.*d*	2.1.6.*d*	2.1.6.*d* 3.6.2.*c*	2.1.6.*d*	2.1.3.*e* 2.1.6.*d* 3.6.2.*c*

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* Typical value.

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PART XI

INTERWORKING OF SYSTEMS No. 4 AND No. 5

RECOMMENDATION Q.180

INTERWORKING OF SYSTEMS No. 4 AND No. 5

1. General

It is possible to ensure normal operation for both semi-automatic and automatic service when interworking takes place between signalling systems No. 4 and No. 5, in either the "4 to 5" or "5 to 4" direction.

The interworking is possible because:

— the line signals (i.e. the supervisory signals) generally have the same meaning and the same function in both systems;

— the numerical (address) information is sent in the same sequence in both systems;

— all conditions for the use of the language digit in the semi-automatic service and the discriminating digit in the automatic service are the same in both systems.

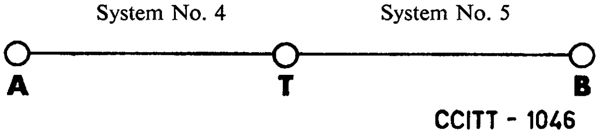
In general, the interworking of the two systems merely requires that a signal received in the code of one of the systems be converted into the corresponding signal of the code used by the other system. Nevertheless, in a transit exchange where there is interworking of systems No. 4 and No. 5, special precautions are necessary with regard to signals which are used differently in the two systems. These differences are as follows:

a) system No. 5 always uses a forward end-of-pulsing signal (the ST signal), whereas the end-of-pulsing signal (code 15) is not always given in system No. 4;

b) system No. 4 uses a backward number-received signal which is not provided in system No. 5.

2. Calls from system No. 4 to system No. 5

2.1 *Semi-automatic calls from system No. 4 to system No. 5*



1. In semi-automatic operation the outgoing exchange *A* of system No. 4 sends an end-of-pulsing signal over link *AT* and the outgoing register at *A* is released.

2. The end-of-pulsing signal of system No. 4, which is a numerical type signal (code 15), is acknowledged.

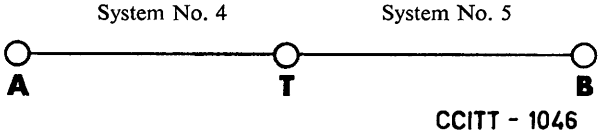
3. On receipt of an end-of-pulsing signal from *A*, the incoming part of system No. 4 at transit exchange *T* sends to *A* an acknowledgement of the end-of-pulsing signal and then sends to *A* a number-received signal.

4. At *T*, an end-of-pulsing signal ST is sent over link *TB* on system No. 5; this ST signal is obtained by converting the end-of-pulsing signal (code 15) of system No. 4.

5. At *T*, the outgoing register* of system No. 5 is released as soon as the signal ST has been sent over link *TB* on system No. 5. At *T*, the incoming register* of system No. 4 is released after the number-received signal of system No. 4 has been sent back to *A*.

Note. — The number-received signal is sent from *T* over link *TA* in order to conform to the specifications of system No. 4. Since the outgoing register at *A* will be released as soon as *A* has sent the end-of-pulsing signal (in accordance with the specifications of system No. 4), the only possible role of the number-received signal at *A* is to indicate to the operator that the selection procedure has been effected. However, since the number-received signal relates only to operations on the link *AT* on system No. 4, this signal provides no information about the entire selection process from *A* to *B*; the indication to the operator is hence of little value.

2.2. *Automatic calls from system No. 4 to system No. 5*



1. The system No. 4 link *AT* does not provide for an end-of-pulsing signal from exchange A in automatic operation; the transit exchange *T* will therefore have to recognize that all the digits have been received in order to:

a) send a forward ST signal to *B* in system No. 5, and

b) send a backward number-received signal to *A* in system No. 4.

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* These register functions may be combined in a single register.

In this situation the system No. 5 register signalling at *T* will be en bloc non-overlap*. (See Recommendation Q.152, paragraph 3.2.1*b*(2) for the action to be taken by the system No. 5 register at *T* to recognize that all digits have been received.)

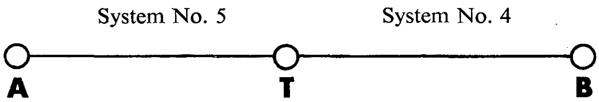
2. At *A*, release of the outgoing register of system No. 4 depends upon reception of the number-received signal.

At the incoming end of system No. 4 at *T*, the incoming register ** of system No. 4 is released as soon as the number-received signal is sent backward and all the numerical information necessary for setting up the call is sent to *B*.

At *T*, an ST end-of-pulsing signal is sent to *B* by system No. 5 after the numerical information has been sent, and the outgoing register ** of system No. 5 at *T* is then released.

3. Calls from system No. 5 to system No. 4

3.1 *Semi-automatic calls from system No. 5 to system No. 4*



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1. In semi-automatic operation at transit exchange *T* the incoming register ** part of system No. 5 receives an ST end-of-pulsing signal 55 ms after reception of the last numerical signal.

2. At *T*, the ST end-of-pulsing signal of system No. 5 is converted into an end-of-pulsing signal of system No. 4, which is sent to the incoming end *B* of this system.

3. The end-of-pulsing signal of system No. 4, which is a numerical type signal (code 15), is acknowledged.

4. At *A*, the outgoing register of system No. 5 is released after the ST signal has been sent.

5. At *T*, the outgoing register ** of system No. 4 is released when the end-of-pulsing signal is sent.

6. At *B*, the incoming register of system No. 4 is released as soon as the number-received signal is sent backward to *T* on system No. 4 and all the numerical information necessary for setting up the call in the incoming country has been sent forward.

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* See for this term the footnote to Recommendation Q.151.

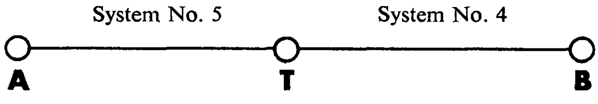
** These register functions may be combined in a single register.

7. The number-received signal is sent over link *BT* upon reception at *B* of the end-of-pulsing signal. It will be noted that the number-received signal is sent over link *BT* solely in order to conform to the specifications of system No. 4, even though this signal is superfluous in this case as:

a) the number-received signal is not needed to release the outgoing register * of system No. 4 at *T* since it is released when it sends the end-of-pulsing signal;

b) this signal cannot be used to give any information to the operator at *A* since it cannot be passed by system No. 5 on link *AT*.

3.2 *Automatic calls from system No. 5 to system No. 4*



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1. This situation raises no difficulties since system No. 5 possesses the ST signal which, by determining the end of pulsing at *T*, places the outgoing register * of system No. 4 at *T* in conditions that are comparable to those existing with semi-automatic operation in system No. 4.

2. At *T*, the ST signal of system No. 5 is converted into the end-of-pulsing signal (code 15) of system No. 4.

3. The specifications of system No. 4 require that the incoming exchange *B* of system No. 4 must send the number-received signal as soon as:

— an end-of-pulsing signal has been received, or

— it has recognized that all the digits have been received.

In this case of interworking the first-mentioned condition is generally fulfilled first. It may happen, however, that a complete national number is recognized before the end-of-pulsing signal is received (for example, when the number of digits in the national number of the incoming country is constant). The transit exchange *T* must hence be capable of receiving the number-received signal not only after emission of the end-of-pulsing signal but also when the last digit preceding that signal has been sent.

4. Exchange *B* must be capable of receiving the end-of-pulsing signal (code 15) on automatic calls.

4. Overflow from system No. 5 to system No. 4

4.1 In an exchange equipped with system No. 4 and system No. 5 it may be desirable to provide for overflow from a group of circuits operated by system No. 5 to a group operated by system No. 4. This may be the case for a call outgoing from an exchange *A* (Figure 1)

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* These register functions may be combined in a single register.

or for a call from an outgoing exchange *K* (Figure 2) and arriving via a group of circuits in system No. 4 at a transit exchange *T* where a choice must be made between a first-choice route operated by system No. 5 and an overflow route operated by system No. 4.

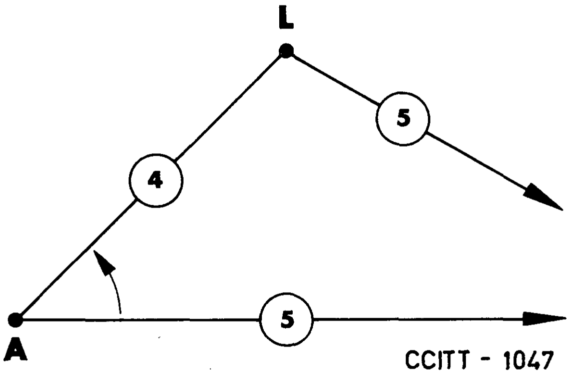

FIGURE 1

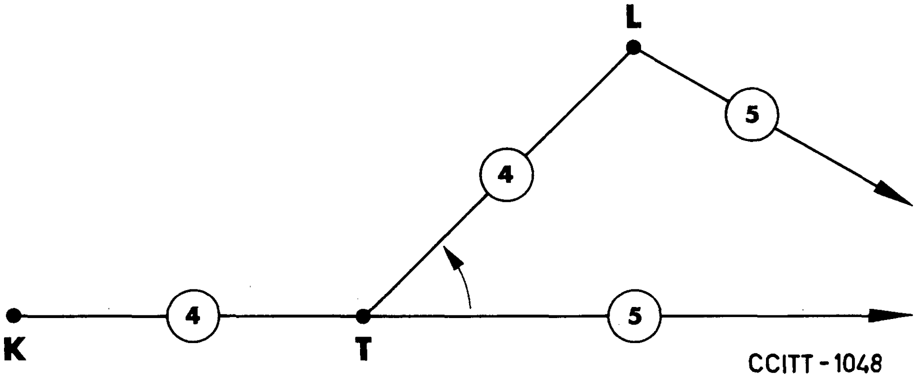

FIGURE 2

4.2 There are two possible ways of arranging for the overflow, in particular in respect to the moment at which the decision is taken to use the overflow route:

- Single exploration;
- Double exploration.

4.2.1 *Single exploration*

With single exploration, the state of occupation, or availability, of the system No. 5 group at exchange *A* or exchange *T* is considered only when the condition ST is determined at this exchange in the system No. 5 outgoing register.

a) If the exploration at *A* or at *T* shows that no free circuit in the system No. 5 group is available, overflow to the system No. 4 group takes place.

For this overflow the register has all the numerical information (even in the case of a transit register like that of the *T* exchange mentioned above), and the end-of-pulsing indication ST.

The register at the transit exchange *T* will be regarded, for successive selection operations, as an outgoing system No. 4 register. Thus, in this case, signalling between the three system No. 4 registers involved will be link-by-link and not end-to-end.

In the case of Figure 2, as soon as the ST condition is available (at the latest immediately after the 5 ± 1 seconds delay provided for in the specifications for system No. 5) the number-received signal will be sent back from *T* to *K* in system No. 4.

The ST condition will also be used to cause the end-of-pulsing signal (code 15) to be sent forward from *T* to *L*, even in automatic working. The code-15 signal will cause the number-received signal to be sent back from *L* to *T*, so that there will be no need to wait for five or ten seconds at *L* before it is known that a complete number has been received.

The number-received signal sent by *T* will be received at *K* and will, in the case of an automatic call, release the outgoing register at that exchange. The second number-received signal, which will be sent by *L*, will be received at *T* to release the register at that exchange, despite the fact that the register has transmitted an end-of-pulsing signal which could have been used for releasing the register. The establishment of the speech path at *T* takes place immediately after the release of the register.

If in the case of Figure 1 the ST condition is recognized in the outgoing exchange *A*, this same condition will also be used to cause the sending of the end-of-pulsing signal (code 15) from *A* to *L*, even in automatic operation. This end-of-pulsing signal will in the same way cause the number-received signal to be sent back from *L* to *A*.

b) If the exploration at *A* or at *T* shows that a free circuit in the system No. 5 group is available, the en bloc numerical information has to be transmitted over this circuit, followed by the end-of-pulsing signal ST, in accordance with the specifications for system No. 5.

In the case of Figure 2, the conditions for the number-received signal and the release of the outgoing register are the same as under 4.2.1. *a)*.

4.2.2 *Double exploration*

With double exploration the state of availability of the system No. 5 circuit group is examined twice, namely:

- as soon as the direction to be chosen is determined;
- after receipt of the complete numerical information.

With the double exploration, advantage is taken of the fact that, without awaiting condition ST, exchange *A* or exchange *T* can know that the direct route by system No. 5 is occupied as soon as the direction to be chosen is determined.

a) If the first exploration at *A* or at *T* shows that no free circuit in the system No. 5

group is available, overflow to the system No. 4 group should take place immediately; the use of the signals on the system No. 4 circuit(s) must be in accordance with the normal procedure of that system:

- in the case of Figure 2, end-to-end working (*K-T-L*) for the numerical signals and the number-received signal;
- the end-of-pulsing signal (code 15) only for semi-automatic calls.

The procedure of overflow at this first exploration reduces post-dialling delay in automatic working since there is no need to wait until all the digital information is assembled en bloc before proceeding with the setting-up of the connection. On the other hand, there is a slight reduction in the efficiency of the first choice system No. 5 group.

b) After the first exploration has shown no congestion of the system No. 5 group, it may happen, during or after reception in the outgoing register at *A* (or transit register, in the case of *T*) of the digits following the digits necessary to determine the routing, that the system No. 5 group gets busy, more particularly because such a circuit group is a first-choice high-usage route with consequently a high probability of loss. When this happens, after noting by this second exploration that all circuits in the system No. 5 group are busy, overflow to the system No. 4 group takes place.
For this case of overflow, the conditions can be considered to be the same as in 4.2.1. *a)*.

c) If also the second exploration shows no congestion of the system No. 5 group, the conditions mentioned in 4.2.1. *b)* fully apply.

4.3 Line signalling for calls set up in overflow through two successive No. 4 systems will be done normally, that is, end-to-end. The number-received signal, however, will be sent as stated in 4.2.1. *a)*, 4.2.2. *a)* or 4.2.2. *b)*.

5. Interworking line signalling conditions

5.1 *Forward-transfer signal*

The forward-transfer signal, in the event of a transit call going from system No. 4 to system No. 5, or from system No. 5 to system No. 4, should cause the assistance operator to intervene in the country of arrival, and not at the transit exchange.

The incoming line relay set of the first system at the transit exchange is informed, e.g. by the transit register, that the call is a transit call. Hence, when a forward-transfer signal arrives on the first system, it causes the forward-transfer signal to be transferred to the outgoing line relay set of the second system without intervention by the operator at the transit exchange.

5.2 *Answer signal*

5.2.1 *System No. 4 to system No. 5 (traffic direction)*

The answer signal on the system No. 4 link should be sent only after complete recognition of the answer signal received from the system No. 5 link, i.e. overlap transmission should not be used.

The considerations for this requirement are:

— the overlap technique could give rise to troubles in signalling system No. 4 in case of imitation of the P signal;

— in the transfer of the answer signal from system No. 5 to system No. 4, the sending end line split (silent period) before starting P is a necessity due to the pulse type signals of system No. 4. The requirement for this sending-end line split period (40 ± 10 ms) would have meant little speed advantage of overlap operation in transferring the answer signal from system No. 5 to system No. 4 (about 50 ms).

— overlap operation would be contrary to the design characteristic of system No. 4 in that once the sending of a signal has begun it must be sent completely.

5.2.2 *System No. 5 to system No. 4 (traffic direction)*

In the interworking arrangements in a transit centre for transferring the answer signal backward from system No. 4 to system No. 5, overlap transmission should not be used.

In system No. 4, overlap operation is incompatible with the use of time measurement for recognition of the suffix signal (short suffix or long suffix). The overlap operation would not permit waiting for the end of a signal PY (answer signal), to determine that it is not a PYY signal (release-guard signal).

5.3 *Busy-flash signal*

In the case of interworking at a transit point from system No. 4 to system No. 5 or vice versa, a busy-flash signal received at that transit point from the outgoing circuit is to be converted to a busy-flash signal on the incoming circuit.

In the case of interworking from system No. 5 to system No. 4, the busy-flash signal will cause the release of the international connection initiated from the outgoing exchange.

In the case of interworking from system No. 4 to system No. 5, the system No. 5 equipment at this transit exchange should function as an outgoing system No. 5 equipment on the receipt of a busy-flash signal and release the system No. 5 circuit from the transit point. Be it observed that the system No. 4 circuit is also released in the case of automatic calls.

5.4 *Time-out delays to clear a connection in the event of signal failures*

5.4.1 *Non-reception of a clear-forward signal after a clear-back signal has been sent*

In the event of transit working from system No. 4 to system No. 5 at an exchange *T*, this latter represents the terminal for system No. 4.

The action to be taken at an international incoming exchange for system No. 4 holds good for the exchange *T*. After a time-out of 2 to 3 minutes, the system No. 4 incoming equipment at *T* should produce an effect forward on the circuit of system No. 5, so as to release the international circuit (for example, should there be some interruption in the system No. 4 circuit). This release should proceed in the same way as the release of the national part of the connection, when the incoming exchange is indeed the incoming international exchange of the international connection.

For symmetry's sake, the action at *T* to release the connection should also be undertaken when there is transit working from system No. 5 to system No. 4, since a time-out of 2 to 3 minutes exists in system No. 5 to release the connection forward.

5.4.2 *Delay in clearing by the calling subscriber in automatic working*

In the case of automatic calls with interworking from system No. 4 to system No. 5, or from system No. 5 to system No. 4, release of the international connection as brought about by the time-out of 1 to 2 minutes must take place *at the outgoing exchange only*, and not at the exchange *T*, the point of connection of the two systems. In exchange *T*, the outgoing line relay sets of the second system in the connection must accordingly be marked that they are acting, not as relay sets for the terminal outgoing end of the system in question, but as transit exchange relay sets.

5.4.3 *Non-reception of an answer-signal at the outgoing exchange after reception of a number-received signal or generation of the ST condition*

When a connection passes through system No. 4 towards system No. 5, or vice versa, release must be undertaken *at the outgoing exchange only*. Hence nothing must be done at the transit exchange *T*, the point at which systems Nos. 4 and 5 are connected.

In the case of system No. 4 towards system No. 5, exchange *T* represents the connecting transit exchange for both systems. Non-reception at *T* of an answer-signal within 2 to 4 minutes after condition ST has been determined must produce *no* effect at exchange *T*. It will be for the outgoing exchange to cause release (by sending the clear-forward signal) on the 2 to 4 minutes' time-out after reception of the number-received signal from exchange *T*.

In the case of system No. 5 towards system No. 4, exchange *T* represents the connecting transit exchange for both systems. Non-reception at *T* of an answer-signal within 2 to 4 minutes after reception of the number-received signal from the incoming exchange must *not* affect exchange *T*. It will be for the outgoing exchange to cause release of the connection (by sending the clear-forward signal) after the delay of 2 to 4 minutes following the generation of the ST condition at that exchange.

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ANNEXES TO INTERWORKING SPECIFICATIONS OF SYSTEMS No. 4 AND No. 5

ANNEX 1

SIGNALLING SEQUENCES IN INTERWORKING FROM SYSTEM No. 4 TO SYSTEM No. 5

ANNEX 2

SIGNALLING SEQUENCES IN INTERWORKING FROM SYSTEM No. 5 TO SYSTEM No. 4

In these tables, an arrow with a full line denotes the sending of a signal,
an arrow with a dotted line the ceasing of a signal.

ANNEX 1

SIGNALLING SEQUENCES IN INTERWORKING FROM SYSTEM No. 4 TO SYSTEM No. 5

Outgoing international exchange System No. 4		International transit exchange System No. 4 to system No. 5	Incoming international exchange System No. 5
		CALL TO A FREE SUBSCRIBER	
Transit seizing signal sent forward (speech path open while register associated).	PY →	Causes transit register to be connected (speech path open while register associated).	
Causes the first digit of the country code to be sent forward.	← Y	Transit proceed-to-send signal returned.	
	Binary code →	Received in transit register.	
Causes the next digit and all the other digits of the numerical information to be sent forward.	← y	Digit acknowledgement and request for next digit required.	
	Binary code →	Received in transit register. Each digit acknowledged.	
Received in outgoing register.	← y	A: Acknowledgement of last digit of national (significant) number.	
Received in outgoing register.	← x or y	SA: the last numerical signal to be acknowledged is code 15 (end-of-pulsing) and is acknowledged by *x* or *y*.	
Release of the outgoing register and speech path established: SA: after an end-of-pulsing signal is sent. A: after the receipt of the number-received signal.	← P	The ST condition is now established. A number-received signal is sent back to the outgoing exchange.	

ANNEX 1 (continued)

Outgoing international exchange System No. 4		International transit exchange System No. 4 to system No. 5		Incoming international exchange System No. 5
		A seizing signal is sent to the incoming exchange.	2400 →	Causes a proceed-to-send signal to be returned when a register is connected (speech path open while register associated).
		Causes the cessation of the seizing signal followed by:	← 2600	
		— the sending of KP1	2400 ⇢	Causes the cessation of the proceed-to-send signal.
		— the language (or the discriminating) digit	⇠ 2600	
		— the national (significant) number — the ST signal.	MF 2/6 code →	Register takes appropriate action on the language (or the discriminating) digit, passes forward the national (significant) number and releases (speech path established).
		Release of the transit register (speech path established).		
The operator (SA) or the calling subscriber (A) { hears the ringing tone	⇠		⇠	The ringing tone of the incoming country is sent back.
		Receipt of the answer signal, causes:	← 2400	*Called subscriber answers.* Answer signal returned.
SA: answer supervisory signal to operator. A: both the charging of the subscriber and the measurement of call duration start.	← PY	— return of an answer signal. — acknowledgement signal to be sent forward.	2400 →	
			⇠ 2400	Causes cessation of the answer signal.
		Causes cessation of the acknowledgement signal.	2400 ⇢	

ANNEX 1 (continued)

Outgoing international exchange System No. 4		International transit exchange System No. 4 to system No. 5		Incoming international exchange System No. 5
				Called subscriber clears.
		Receipt of the clear-back signal, causes:	◀—— 2600	Clear-back signal returned.
SA: clearing supervisory signal to the operator. A: after 1-2 min, in the absence of a clear-forward signal, the international connection will be released, and both the charging of the subscriber and the measurement of call duration are ceased.	◀—— PX	— return of a clear-back signal. — acknowledgement signal to be sent forward.	2400 ——▶	Causes cessation of the clear-back signal.
		Causes cessation of the acknowledgement signal.	◀······ 2600	
			2400 ······▶	
SA: operator or A: calling subscriber clears. Clear-forward signal sent.	PXX ——▶	Receipt of the clear-forward signal:		
		— releases the incoming part of the No. 4 circuit and when fully released sends back a release-guard signal. — causes a clear-forward signal to be sent forward.	2400 + 2600 ——▶	Causes release-guard signal to be returned (see Recomm. Q.141, para. 2.1.6). Clear-forward signal sent to national network of incoming country.
	◀—— PYY	Causes cessation of clear-forward signal.	◀—— 2400 + 2600	
Causes removal of guard from the outgoing circuit.			2400 + 2600 ······▶	Causes cessation of the release-guard signal (see Recomm. Q.141).

ANNEX 1 (continued)

Outgoing international exchange System No. 4	International transit exchange System No. 4 to system No. 5	Incoming international exchange System No. 5
	Causes removal of guard from outgoing circuit. ◄ ······ 2400 + 2600	The outgoing access of the incoming end is maintained busy for 200 to 300 ms after the cessation of the release-guard signal.

CALL TO A BUSY SUBSCRIBER (OR CONGESTION)

The sequence of signals is the same as for a call to a free subscriber up to the point at which the incoming register releases.

Outgoing international exchange System No. 4	International transit exchange System No. 4 to system No. 5	Incoming international exchange System No. 5
	Receipt of the busy-flash signal, causes: ◄—— 2600	*1st Case* The national network of the incoming country can give a busy-flash signal. This is detected by the incoming international exchange which returns the busy-flash signal.
SA: the operator is given a busy indication, the operator then releases the connection. A: the clear-forward signal is sent forward to automatically release the system No. 4 circuit. The calling subscriber hears the busy tone from the outgoing (national or international) exchange.	◄—— PX — the sending back of a busy-flash signal. — the sending of the acknowledgement signal. 2400 ——►	Causes the cessation of the busy-flash signal.
	Causes the cessation of the acknowledgement signal. ◄ ······ 2600	
	2400 ······►	
	The cessation of the busy-flash acknowledgement signal is followed by the sending forward of the clear-forward signal to the incoming international exchange to automatically release the system No. 5 circuit.	

ANNEX 1 (concluded)

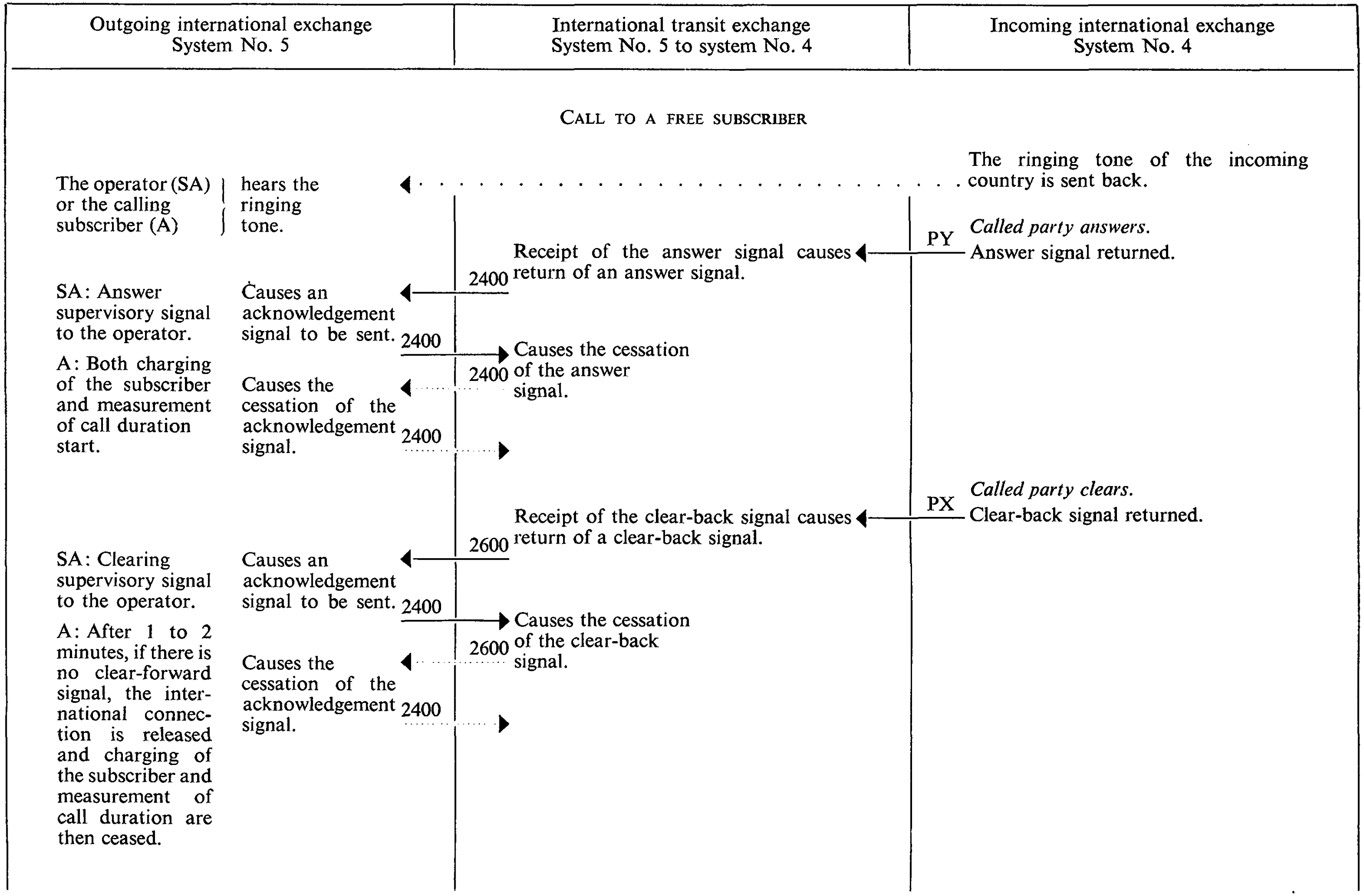
Outgoing international exchange System No. 4	International transit exchange System No. 4 to system No. 5	Incoming international exchange System No. 5
The operator and/or the calling subscriber hears the busy tone and releases the connection. ◀ · · ·	· ·	· · · *2nd Case* The national network of the incoming country cannot give a busy-flash signal. The busy tone of the incoming country is sent back.
	SPECIAL CONDITIONS	
1st Case SA: Following a call switched automatically to a subscriber, or following a call established via a special number incoming or delay operator, the controlling operator wishes to call in an assistance operator at the incoming international exchange. A forward-transfer signal is sent. PYY ——▶	Causes the sending of a forward-transfer signal on the next circuit. 2600 ——▶	Causes an assistance operator to intervene at the incoming international exchange.
2nd Case SA: Following a call via code 11 or 12 the controlling operator wishes to recall the incoming operator at the incoming international exchange. A forward-transfer signal is sent. PYY ——▶	Causes the sending of a forward-transfer signal on the next circuit. 2600 ——▶	Recalls the incoming operator on calls completed via the operator positions of this incoming international exchange.

ANNEX 2

SIGNALLING SEQUENCES IN INTERWORKING FROM SYSTEM No. 5 TO SYSTEM No. 4

Outgoing international exchange System No. 5		International transit exchange System No. 5 to system No. 4		Incoming international exchange System No. 4
		SETTING-UP OF THE CONNECTION		
A seizing signal is sent when the ST-condition is recognized.	2400 →	Causes the connection of a register.		
Causes cessation of the seizing signal, followed by the sending en bloc of	← 2600	When a register is connected a proceed-to-send signal is returned.		
— KP2 signal — country code — language or discriminating digit — national (significant) number — ST signal.	2400 ⋯→	Causes cessation of the proceed-to-send signal.		
	←⋯ 2600			
	MF 2/6 code →	Analysis of digits necessary to determine the routing. Seizure of an outgoing circuit; a terminal seizing signal is sent.	PX →	Causes the connection of a register.
Release of the register (speech path established).		Causes the sending of the language or discriminating digit, national (significant) number + code 15.	← X	When a register is connected, a terminal proceed-to-send signal is returned.
			Binary code →	
		Release of the register (speech path established).	← x	Digit-acknowledgement signals.
				Setting up of the call in the incoming country.
			← P	After the determination of a " complete number " a number-received signal is sent. Release of the register (speech path established).

ANNEX 2 (continued)



Outgoing international exchange System No. 5	International transit exchange System No. 5 to system No. 4	Incoming international exchange System No. 4

CALL TO A FREE SUBSCRIBER

The ringing tone of the incoming country is sent back.

The operator (SA) or the calling subscriber (A) hears the ringing tone.

PY Called party answers. Answer signal returned.

Receipt of the answer signal causes return of an answer signal.

SA: Answer supervisory signal to the operator.

A: Both charging of the subscriber and measurement of call duration start.

Causes an acknowledgement signal to be sent.

Causes the cessation of the answer signal.

Causes the cessation of the acknowledgement signal.

PX Called party clears. Clear-back signal returned.

Receipt of the clear-back signal causes return of a clear-back signal.

SA: Clearing supervisory signal to the operator.

A: After 1 to 2 minutes, if there is no clear-forward signal, the international connection is released and charging of the subscriber and measurement of call duration are then ceased.

Causes an acknowledgement signal to be sent.

Causes the cessation of the clear-back signal.

Causes the cessation of the acknowledgement signal.

ANNEX 2 (continued)

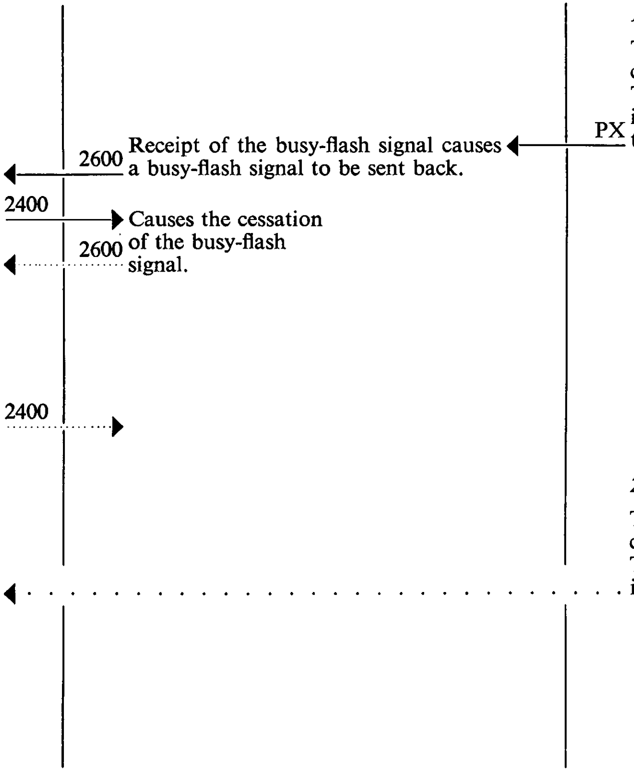
Outgoing international exchange System No. 5	International transit exchange System No. 5 to system No. 4	Incoming international exchange System No. 4
The operator (SA) or the calling subscriber (A) clears. Clear-forward signal sent. 2400 + 2600 →	Causes the sending of: — a release-guard signal backward (see Q.141, para. 2.1.6). — a clear-forward signal forward.	
Causes cessation of the clear-forward signal. ← 2400 + 2600	PXX →	Releases the connection and when the release is fully effective a release-guard signal is returned.
2400 + 2600 ⇢	Causes cessation of the release-guard signal (see Q.141).	
Causes removal of guard from the outgoing circuit. ⇠ 2400 + 2600	The outgoing access of the incoming end is maintained busy for 200 to 300 ms after the cessation of the release-guard signal. Causes removal of guard from the outgoing circuit. ← PYY	

ANNEX 2 (continued)

Outgoing international exchange System No. 5	International transit exchange System No. 5 to system No. 4	Incoming international exchange System No. 4

CALL TO A BUSY SUBSCRIBER (OR CONGESTION)

The sequence of signals is the same as for a call to a free subscriber up to the point at which the incoming register releases.



1st Case:

The national network of the incoming country can give a busy-flash signal. This signal is detected by the incoming international equipment, which sends the busy-flash signal back.

Receipt of the busy-flash signal causes a busy-flash signal to be sent back.

SA: A busy indication is given to the operator.

A: The calling subscriber hears the busy tone of the outgoing (national or international) exchange.

Causes an acknowledgement signal to be sent.

Causes the cessation of the busy-flash signal.

Causes the cessation of the acknowledgement signal, followed by the automatic release of the connection (see above).

2nd Case:

The national network of the incoming country cannot give a busy-flash signal. The busy tone of the incoming country is sent back.

The operator and/or the calling subscriber hears the busy tone and releases the connection (see above).

ANNEX 2 (concluded)

Outgoing international exchange System No. 5	International transit exchange System No. 5 to system No. 4	Incoming international exchange System No. 4
	SPECIAL CONDITIONS	
1st Case: SA: Following a call switched automatically to a subscriber, or following a call established via a special number incoming or delay operator, the controlling operator wishes to call in an assistance operator at the incoming international exchange. A forward-transfer signal is sent. 2600 →	Causes the sending of a forward-transfer signal on the next circuit. PYY →	Causes an assistance operator to intervene at the incoming international exchange.
2nd Case: SA: Following a call via code 11 or code 12, the controlling operator wishes to recall the incoming operator at the incoming international exchange. A forward-transfer signal is sent. 2600 →	Causes the sending of a forward-transfer signal on the next circuit. PYY →	Recalls the incoming operator on calls completed via the operator positions of this exchange.

QUESTIONS

for the period 1964-1968

Questions relative to telephone signalling and switching
entrusted to
Study Group XI
for the period 1946-1968

Question 1/XI — Study of C.C.I.T.T. System No. 6

(new question)

Considering

1. that the service features for an international telephone signalling system have been defined by the C.C.I.T.T.;

2. that the proposed service features cannot be met fully by system No. 5 and other existing C.C.I.T.T. signalling systems, particularly in regard to automatic operation;

3. that a new signalling system—to be called C.C.I.T.T. System No. 6—is required which will be capable of providing the service features desired;

4. that system No. 6 shall meet the criteria contained in Annex 1 and provide for the field of application contained in Annex 2;

What design and operating characteristics should be specified for the new signalling system (system No. 6)?

Note 1. — A system having:

a) a separate channel common to a number of speech channels used for the transfer of line and administrative type signals, and

b) individual speech channels used for the transfer of register type signals,

is the preferred solution and initial study should be limited to this type of system.

Note 2. — Annex 3 indicates the possibilities offered by a system No. 6 corresponding to the study approach of Note 1. Annex 4 gives the programme for study of Question 1/XI and lists the points which the Administrations and private operating Agencies should consider when giving their proposals for the first meeting of System No. 6 Working Party.

ANNEX 1

(to Question 1/XI)

Criteria for system No. 6

1. Signalling criteria

1.1 System No. 6 should be able to:

a) meet the requirements drawn up by Study Group XIII at its meetings in Geneva in December 1961 (see COM XI - No. 32) and in Melbourne in October 1963 (see COM XI - No. 134);

b) avoid the shortcomings of system No. 5, particularly the delay in the answer signal transmission and the post-dialling delay.

1.2 In the study of system No. 6, consideration should be given to the provision of the following characteristics, most of which are requirements from Study Group XIII. (Some of these facilities are not given by systems No. 4 and No. 5):

a) automatic repeat attempt (including, for the purpose of this study, consideration of automatic re-routing);

b) signals for echo suppressor control;

c) routing signals, in order to:

- ensure, if necessary, the routing determination by the preceding history of the connection (so-called routing control signals);
- give to the originating exchange the indication about the final routing of the connection (so-called routing monitoring signals);
- provide information for accounting, maintenance, etc.;

d) signals to indicate:

i) congestion of equipment or groups of circuits;

ii) called-party line conditions;

iii) other causes of ineffective call (e.g. error detected, spare level or spare code, etc.);

e) signals to indicate the calling party's category, e.g. subscribers of different classes, data calls, operator calls, special service calls and test calls; calling party number identification (or part of this number, e.g. country code) for maintenance or accounting purposes;

f) network management (administrative) signals, for example to change routing patterns with time, or traffic loads;

g) ability to operate equally well in conjunction with en bloc and with overlap numerical signalling;

h) ability to operate with a variable number of digits both for the country code and the national number (within the limits of the world numbering plan) without increase of post-dialling delay, due, for example, to time-out.

Note about f)

The exchange of network management signals (category *f*) can be considered to carry out modifications in the traffic routes, either at more or less definite time periods (scheduled modifications)—for instance to take into account time differences—or at variable times, to take into account special or exceptional circumstances (unscheduled modifications). Network management can be accomplished manually, as it is done in certain countries, but the present trend is directed to its automatization. A special interest can be given to a continuous exchange of signals to inform at any time about the network conditions, so as to direct the routing under the best conditions. It should be noted that there is no need for management signals to depend upon the availability of each speech path, and it is enough to communicate the information about each of the unavailable (congestion condition) group of circuits outgoing from all exchanges of the supervised network.

1.3 Capacity should be available in system No. 6 for adding signals to cater for unknown future requirements.

1.4 It is recognized that system No. 6 may include new concepts differing from those of existing techniques. Such new concepts might allow some useful extension of the items in 1.2.

2. Utilization criteria

2.1 An economical utilization of system No. 6 should be possible in small as well as in large groups of circuits.

2.2 System No. 6 should be capable of interworking with systems Nos. 4 and 5. In such tandem operation it may, of course, not be possible to take advantage of all the facilities of system No. 6.

ANNEX 2

(to Question 1/XI)

Field of application of system No. 6

1. System No. 6 should be applicable to all types of international circuits to be used in a world-wide connection including particularly:

a) TASI-equipped circuits;

b) satellite systems.

Strictly speaking, given the peculiarities of satellite systems, it would be essential to know the characteristics (which may have influence in the telephone signalling problem) of the systems to be used.

In view of the uncertainty surrounding this question, the Working Party is obliged to base itself on very broad principles which would apply to possible varieties of satellite systems.

2. Traffic routing may be hierarchical or non-hierarchical; the latter requires flexibility of routing, which feature should be given by system No. 6 in addition to fixed order routing provided by the present world-wide routing plan.

3. It must be possible to use system No. 6 on all international circuits until the CT3 is reached. It can be questioned whether in these circumstances system No. 6 should replace system No. 4 in purely continental relations.

In fact, system No. 6 will depend mainly on the more stringent conditions prevailing in the intercontinental service. This may necessitate more complicated signalling and switching equipment, resulting in higher purchase costs.

It is only when system No. 6 has been defined in this respect that we shall know whether its use for continental connections is also economically viable. It may indeed be economical for countries having continental relations over which intercontinental traffic is routed—e.g. in their connection with the CT1—not to provide two groups of circuits using different signalling systems. In other relations, however, the position may be different. As an example the København exchange can be considered where:

a) it is advantageous for the København-London circuits to constitute a single group;

b) the København-Roma group of circuits which will not be used for intercontinental traffic may use a system other than system No. 6.

4. The explosive expansion of intercontinental traffic and the number of circuits earmarked for it were noted, as shown by the results of the world inquiry into this type of traffic which were examined at the Rome meeting of the Plan Committee in December 1963. In these circumstances, the use of system No. 5 equipment does not present any difficulty. Circuit extensions would justify the introduction of a new system No. 6 and would not entail the scrapping of any system No. 5 equipment.

ANNEX 3

(to Question 1/XI)

Possibilities offered by a system No. 6 affording a common channel for line signalling and an individual speech channel for inter-register signalling

The preferred solution for system No. 6 is of a type where the supervisory (line) and administrative signals are transmitted over a separate channel common to a number of speech channels and the signals concerned with the call set-up, e.g. numerical signals (register signals) are transmitted over the individual speech channel.

This approach is based to some extent on known techniques but introduces the new technique of separate common channel signalling. Study of the latter will provide information for further evaluation of the possibilities of this technique.

Since the inter-register signals are transmitted in-band on the individual speech channels, this type of register signalling can be combined with any type of line signalling and thus may be applied, for example, in combination with the line signalling of systems No. 4 and No. 5 in addition to system No. 6.

The combination of system No. 6 inter-register signalling with systems No. 4 and No. 5 line signalling gives the facility of serving small groups of circuits without the requirement of a separate signalling channel. This retains most of the facilities of system No. 6, but it is pointed out that some features facilitated by the separate signalling channel, in particular a faster answer signal, would not be given.

The separate signalling channel of system No. 6 facilitates:

— fast answer signal transfer,

— the transmission of administrative (network management) signals,

— improved arrangements in regard to signalling for satellite speech path channels, for example using signalling paths of shorter circuit propagation times (giving fast line signalling) and the provision of possible additional line signals for satellite purposes.

ANNEX 4

(to Question 1/XI)

Programme for study of Question 1/XI

1. The objective of study of Question 1/XI is to prepare the specifications for system No. 6 for the IVth Plenary Assembly at the end of the study period 1964-1968.

2. The programme envisaged for this study is as follows:

2.1 A first meeting of the System No. 6 Working Party before the end of February 1965.

2.2 The second meeting of the Working Party will take place 6 months after the first one at the latest.

2.3 Regular meetings of Study Groups XI, XIII and Special B will be held 6 months after the second meeting of the Working Party. During these meetings, Study Group XIII will proceed to the " examination of the operating facilities provided for in the planned system No. 6 " as appearing in the list of questions to be studied by this Study Group in the period 1964-1968.

2.4 The later schedule of meetings of the System No. 6 Working Party and of Study Group XI will be decided on during the meetings mentioned in paragraph 2.3.

3. The following points should be covered in the proposals submitted for the first meeting of the System No. 6 Working Party:

a) criteria to be included in supervisory (line signalling);

b) criteria to be included in administrative (network management) signalling, via the common channel used for supervisory signalling;

c) criteria to be included in inter-register signalling;

d) inter-register signalling code arrangement;

e) separate channel signalling code arrangement;

f) type of inter-register signalling (to include consideration of such points as pulse signalling, compelled signalling, frequency shift signalling, link-by-link, end-to-end, etc.);

g) type of separate channel signal (to include consideration of such points as parallel mode, serial mode, etc.);

h) consideration of technique of associating the signalling and speech channels (for example, signals carrying speech channel identity, time division, frequency division, etc.);

i) consideration of error-detecting and error-correcting arrangements;

j) consideration of factors affecting speed of separate channel signalling;

k) any other aspects which would be regarded as important by Administrations or private operating Agencies should be considered.

Note. — Consideration of all of the above factors should bear in mind the interworking of system No. 6 and other systems.

Question 2/XI — Insertion and disablement of echo suppressors

(continuation of Question 5/XI studied in 1961-1964)

For the "New switching plan", it is likely that some form of echo suppressor will be needed for the longest 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. — The conditions of the "New switching plan" are defined in Recommendation G.131, B of Volume III of the *Blue Book.*

Note 2. — Study of Question 2/XI is bound up with that of system No. 6.

Note 3. — Reference to be made to Annexes 1 to 3 hereinafter.

ANNEX 1

(to Question 2/XI)

Reply by Study Group XI to Question 5/XI (period 1961-1964) on insertion and removal of echo suppressors

The reply by Study Group XI was prepared during the Montreal Meeting in June 1962 by its Working Party No. 2 concerning echo suppressors (Chairman: Mr. Martin, of the United Kingdom).

a) Extracts from the report of Working Party No. 2 of Study Group XI

The report by Working Party No. 2 considered the problem of associating echo suppressors on an international connection in the most general terms, within the framework of Question 5/XI: it does not concern itself with the fact that the connection may, or may not, comprise one or more intercontinental sections.

In its report, Working Party No. 2 proposed:

1. that echo suppressors should be inserted in the form of half-echo suppressors (the latter being as defined on page 29 of Volume III of the *Red Book*, though they will be referred to in the abbreviated form of " echo suppressors " in the rest of this reply) at the two most extreme points of the connection, where echo suppressors can be inserted on both the outgoing and the incoming side;

2. that the outgoing country should decide whether echo suppressors are necessary on a connection according to numbering information;

3. that the outgoing country should bring the outgoing echo suppressor into circuit;

4. that a signal should be sent to each international exchange situated further along the line, conveying the instruction: " connect an echo suppressor at the end of this connection yourself, or pass on this instruction to an international centre further along the line which you believe has an echo suppressor available."

Working Party No. 2 also noted:

5. that when the outgoing circuit is of such a length that any connection made over it would need an echo suppressor, one method would consist in systematically associating an echo suppressor with the circuit, it being understood that, if the circuit is used for transit routing,

- the echo suppressor at the incoming end of the circuit must be disconnected, and
- the forward signal mentioned under point 4 must be sent over the second circuit;

6. that transoceanic circuits are of such a length that point 5 applies and that it might be unnecessary to provide the echo suppressor insertion signal in the new intercontinental signalling system.

b) Observations by Study Group XI

1. Study Group XI confirmed the principles defined by the Working Party in points 1 to 4 above. However, it came to different conclusions regarding points 5 and 6.

2. The Montreal meeting of Study Group XI studied the insertion of echo suppressors only with respect to specifications for the intercontinental signalling system.

3. Owing to lack of time, the Montreal meeting of Study Group XI did not seek to study provisions concerning the insertion of echo suppressors on the continental sections of intercontinental connections, i.e.:

a) between the call's origin and the outgoing intercontinental centre;

b) between the incoming intercontinental centre and the call's point of destination.

These provisions have already been defined on the American continent. It is planned that echo suppressors will be permanently associated on very long circuits. When one of these circuits is switched in tandem with a second circuit also including echo suppressors, the echo suppressor at the incoming end of the first circuit and the echo suppressor at the outgoing end of the second circuit are disconnected.

In Europe, international circuits are relatively short and the propagation times are so short that:

a) the insertion of echo suppressors on European international connections has not been justified up to the present;

b) the permanent association of echo suppressors with circuits is not contemplated.

No forward signal for the insertion of echo suppressors has been provided in the international signalling system No. 4.

4. The conclusions reached by Study Group XI relative to an intercontinental signalling system do not refer to the continental sections of intercontinental connections. If an echo suppressor has already been inserted on the outgoing continental section or may be inserted beyond the chain of intercontinental circuits, these echo suppressors will of course have to replace the echo suppressors recommended below for the chain of intercontinental circuits.

5. Study Group XI admits the general principle that one echo suppressor should be inserted in the outgoing intercontinental centre and one in the incoming intercontinental centre.

6.* An exception to this general principle may exist, however: it was pointed out during the discussions of Study Group XI that the intercontinental signalling system could be used on circuits other than intercontinental circuits, when the use of this system is extended to continental circuits (of relatively short length) between a CT1 and a CT2.

(As a purely theoretical example to illustrate this case, Study Group XI referred to a connection United States-Finland, for which it assumed that the circuit London-Frankfurt between a CT1 and CT2, used for a connection London-Frankfurt-Helsinki, would be equipped with the intercontinental signalling system. It was also assumed that this circuit London-Frankfurt could be used for routing purely continental calls.)

If the continental circuits on which the intercontinental signalling system is used do not serve only for routing intercontinental transit traffic, their length does not justify the insertion of echo suppressors and no echo suppressor should be inserted at the end of the circuit when the latter is not associated in tandem with an intercontinental circuit.

7.* To discriminate this exceptional case and characterize the situation in general in which an echo suppressor is required at the incoming end of the intercontinental circuit, Study Group XI envisaged the emission of a forward signal for the insertion of echo suppressors in the intercontinental signalling system.

8.* This signal will be made up with one of the available combinations from the inter-register signals code (forward signals).

The signal will be sent to the incoming international centre after the pulsing signals. In an inter-register end-to-end signalling system, this signal will therefore have no effect on transit registers which will already have released.

9. As proposed by Working Party No. 2 in its report, no backward signal will be provided to confirm the presence of echo suppressors.

10. Study Group XI considered the effect of echo suppressors on line signalling during the setting-up of the call, bearing in mind that line signalling must be ensured with compelled signalling.

To avoid disturbances to signalling, the echo suppressors should be inserted in the circuit only after the moment when the answer signal has been received or at least only after the moment when the registers have released. This means that, when echo suppressors are permanently associated with a circuit, they should be in a " disconnected (blocked) " condition when the circuit is not used for a call.

11. Study Group XI took note of the effect that the distance of the echo suppressor may have on the TASI system when it is not situated at the end of the TASI system (because it is for instance at the end of the intercontinental connection).

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* *Remark.*—Paragraphs 6, 7 and 8 above were approved by Study Group XI in the spirit of the conception of a new world-wide intercontinental signalling system (system No. 6).

There is an " echo protector " device in the TASI system which protects TASI channels against being seized by an echo from the speech currents, but this protection is ensured only during the time in which the echo suppressor is operating.

If the echo suppressor and the terminating set are at a distance from the TASI terminal installation, the echo arrives some time after the speech signal, is not stopped by the echo protector, and occupies a TASI channel to no purpose.

This situation arises at present with TASI circuits extended by circuits fitted with echo suppressors. The effect on the TASI system described above is limited in nature if the number of connections in which a TASI circuit is extended by another circuit fitted with echo suppressors remains small in a given TASI system.

ANNEX 2

(to Question 2/XI)

Inserting echo suppressors using switching equipment at terminal international centres

1. One of the methods envisaged in Recommendation G.131, B, d (Volume III of the *Blue Book*) for inserting echo suppressors is that the outgoing international register should cause half-echo suppressors to be inserted at the terminal international centres, according to the lengths of the connection. The length of the connection could be determined from the country code, the route taken by the call and, possibly, the lengths of the national trunk extensions. Table 1 illustrates how the proposed echo suppressor rules are applied in the case of calls from the United Kingdom to other countries of Europe and the Mediterranean Basin. The columns headed 1% and 10% refer to the percentage of calls likely to exhibit an objectionable echo (see Figure 11 of Recommendation G.131, B).

Table 1 illustrates two kinds of application:

a) Columns A to G — No account is taken of the lengths of the national extensions. For each possible routing between two terminal international centres a single echo suppressor decision is made for all the traffic in a relation following that routing by applying Rule E of Recommendation G.131, B, c;

b) Columns H to S — It is envisaged that for each possible routing between two countries there may be four different echo suppressor decisions depending on whether the originating group centre in the United Kingdom is within or beyond 500 km of London and whether the call terminates in the area immediately surrounding the incoming international centre. 500 km is approximately half the longest United Kingdom national extension. A different separation of long and short extensions might be more convenient for other countries.

2. The national transmission plan of the United Kingdom will be of the 3.5+0+0 db pattern. For the purpose of computing Table 1 it has been assumed that the national plan of the distant country is always of the pattern 2.0+0.5+0.5+0.5 db. Where this is not the case the echo suppressor decision for calls terminating near the distant centre may be different (columns C, J and P). Cases where the transmission plan affects the decision have been marked with an asterisk.

3. It will be seen from Table 1 that in the great majority of cases (27 cases out of a total of 34) the echo suppressor decision based on the 1% objective for centre/centre calls (column C) is the same as the decision based on the 10% objective for extension/extension calls (column F). Similarly,

TABLE 1

Analysis of need for echo suppressors on continental calls from the United Kingdom

DISTANT COUNTRY Centre (national extension, km)	Single echo suppressor for all traffic in one relation							Separate echo suppressor decisions according to the lengths of national extensions											
								Calls originating in, or within 500 km of, London						Calls originating beyond 500 km from London					
	London-Centre			U.K. extension-distant extension			Over-all E/S decision	To distant centre			To distant extension			To distant centre			To distant extension		
	km	db	1 %	km	db	1 %		km	db	1 %	km	db	1 %	km	db	1 %	km	db	10 %
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
Algeria/Algiers (700)	2030	6.5	yes	3730	8.0	yes	YES	2530	6.5	yes	3230	8.0	yes	3030	6.5	yes	3730	8.0	yes
/Oran (650)	2300	6.5	yes	3950	8.0	yes	YES	2800	6.5	yes	3450	8.0	yes	3300	6.5	yes	3950	8.0	yes
Austria/Vienna (640)	1630	6.5	yes	3270	8.0	yes	YES	2130	6.5	yes	2770	8.0	yes	2630	6.5	yes	3270	8.0	yes
Belgium/Brussels (180)	360	6.0	no	1540	7.5	no	NO	860	6.0	yes*	1040	7.5	no	1360	6.0	no	1540	7.5	no
Bulgaria/Sofia (480)	3140	6.5	yes	4620	8.0	yes	YES	3640	6.5	yes	4120	8.0	yes	4140	6.5	yes	4620	8.0	yes
Czechoslovakia/ Prague (680)	1300	6.0	yes	2980	7.5	yes	YES	1800	6.0	yes	2480	7.5	yes	2300	6.0	yes	2980	7.5	yes
Denmark/ Copenhagen (460)	1340	6.0	yes	2800	7.5	no	YES	1840	6.0	yes	2300	7.5	yes	2340	6.0	yes	2800	7.5	no
Finland/Helsinki (1130)	2300	6.5	yes	4430	8.0	yes	YES	2800	6.5	yes	3930	8.0	yes	3300	6.5	yes	4430	8.0	yes
France/Paris (900)	450	6.0	no	2350	7.5	no	NO	950	6.0	yes*	1850	7.5	yes	1450	6.0	no	2350	7.5	no
Germany Fed. Rep./ Berlin (290)	1230	6.0	yes	2520	7.5	no	YES	1730	6.0	yes	2020	7.5	yes	2230	6.0	yes	2520	7.5	no
/Dusseldorf (250)	610	6.0	no	1860	7.5	no	NO	1110	6.0	yes*	1360	7.5	yes	1610	6.0	yes	1860	7.5	no
/Frankfurt (400)	850	6.0	no	2250	7.5	no	NO	1350	6.0	yes	1750	7.5	yes	1850	6.0	yes	2250	7.5	no
/Hamburg (200)	1010	6.0	yes*	2210	7.5	no	YES *	1510	6.0	yes	1710	7.5	yes	2010	6.0	yes	2210	7.5	no
Greece/Athens (900)	3115	6.0	yes	5015	7.5	yes	YES	3615	6.0	yes	4515	7.5	yes	4115	6.0	yes	5015	7.5	yes
Hungary/Budapest (290)	1910	6.0	yes	3200	7.5	yes	YES *	2410	6.0	yes	2700	7.5	yes	2910	6.0	yes	3200	7.5	yes
Iceland/Reykjavik (850)	2500	6.0	yes	4350	7.5	yes	YES	3000	6.0	yes	3850	7.5	yes	3500	6.0	yes	4350	7.5	yes
Ireland/Dublin (340)	550	6.0	no	1890	7.5	no	NO	1050	6.0	yes*	1390	7.5	yes	1550	6.0	yes	1890	7.5	no

TABLE 1 (continued)

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
Italy/Milan (400)	1300	6.0	yes	2700	7.5	no	YES	1800	6.0	yes	2200	7.5	yes	2300	6.0	yes	2700	7.5	no
/Rome (1000)	1840	6.0	yes	3840	7.5	yes	YES	2340	6.0	yes	3340	7.5	yes	2840	6.0	yes	3840	7.5	yes
Luxembourg/ Luxembourg (70)	570	6.0	no	1640	7.5	no	NO	1070	6.0	yes*	1140	7.5	no	1570	6.0	yes	1640	7.5	no
Malta/Valletta (50)	2840	6.5	yes	3890	8.0	yes	YES	3340	6.5	yes	3390	8.0	yes	3840	6.5	yes	3890	8.0	yes
Morocco/Rabat (750)	3000	6.5	yes	4750	8.0	yes	YES	3500	6.5	yes	4250	8.0	yes	4000	6.5	yes	4750	8.0	yes
Netherlands/ Amsterdam (250)	500	6.0	no	1750	7.5	no	NO	1000	6.0	yes	1250	7.5	no	1500	6.0	yes	1750	7.5	no
/Rotterdam (450)	450	6.0	no	1900	7.5	no	NO	950	6.0	yes	1400	7.5	yes	1450	6.0	yes	1900	7.5	no
Norway/Oslo (2070)	1800	6.0	yes	4870	7.5	yes	YES	2300	6.0	yes	4370	7.5	yes	2800	6.0	yes	4870	7.5	yes
Poland/Warsaw (500)	1810	6.0	yes	3310	7.5	yes	YES	2310	6.0	yes	2810	7.5	yes	2810	6.0	yes	3310	7.5	yes
Portugal/Lisbon (460)	2580	6.0	yes	4040	7.5	yes	YES	3080	6.0	yes	3540	7.5	yes	3580	6.0	yes	4040	7.5	yes
Rumania/Bucharest(600)	2760	6.0	yes	4360	7.5	yes	YES	3260	6.0	yes	3860	7.5	yes	3760	6.0	yes	4360	7.5	yes
Spain/Madrid (700)	2000	6.0	yes	3700	7.5	yes	YES	2500	6.0	yes	3200	7.5	yes	3000	6.0	yes	3700	7.5	yes
Sweden/ Stockholm (1150)	1850	6.0	yes	4000	7.5	yes	YES	2350	6.0	yes	3500	7.5	yes	2850	6.0	yes	4000	7.5	yes
Switzerland/Basle (80)	905	6.0	yes*	1985	7.5	no	YES *	1405	6.0	yes	1485	7.5	yes	1905	6.0	yes	1985	7.5	no
/Berne (150)	975	6.0	yes*	2125	7.5	no	YES *	1475	6.0	yes	1625	7.5	yes	1975	6.0	yes	2125	7.5	no
/Zurich (220)	1000	6.0	yes*	2220	7.5	no	YES *	1500	6.0	yes	1720	7.5	yes	2000	6.0	yes	2220	7.5	no
Tunisia/Tunis (600)	2780	6.5	yes	4380	8.0	yes	YES	3280	6.5	yes	3880	8.0	yes	3780	6.5	yes	4380	8.0	yes
Turkey/Ankara (1180)	3420	6.5	yes	5600	8.0	yes	YES	3920	6.5	yes	5100	8.0	yes	4420	6.5	yes	5600	8.0	yes
Yugoslavia/ Belgrade (600)	2190	6.5	yes	3790	8.0	yes	YES	2690	6.5	yes	3290	8.0	yes	3190	6.5	yes	3790	8.0	yes
U.S.S.R./Moscow	3050	6.0	yes	4050	7.5	yes	YES	3550	6.0	yes	4550	7.5	yes	4050	6.0	yes	?	7.5	yes

Notes

* If the national transmission plan of the distant country is 3.5 + 0 + 0 + 0 db the decision is NO.

i) The maximum length of the United Kingdom national extension is 1000 km.

ii) Certain countries of Europe and the Mediterranean Basin are not included in the above analysis either because there is no service to them at present, e.g. Albania, or because the present service is by means of HF radio links, e.g. Egypt, Israel, Lebanon, Libya and Syria.

iii) The connections with a loss of 6.5 db and 8.0 db are connected via one intermediate transit centre. All other connections are on direct circuits from London to the distant centre.

the decision in column J is sometimes the same as in column S (19 cases out of 34). This is because the longer transmission time on extension/extension calls is often compensated by the relaxation from 1% to 10%.

Furthermore, where the decisions are different, it is always the case that the echo suppressor is required for the shorter but not for the longer calls. The conclusion is that for calls originating in the United Kingdom there seems to be little purpose in adopting any system of inserting echo suppressors which takes into account the lengths of national extensions. It would be desirable to confirm whether this conclusion holds for calls between other pairs of countries.

4. The routing assumed in Table 1 for each relation is the primary routing; alternative routing has not been taken into account. In an automatic network a call between two international centres may, of course, follow any one of perhaps four possible routings.

In general, the routings will have differing propagation times because of the different route lengths and different transmission losses because they are not all made up of the same number of circuits in tandem *. Sometimes an overflow route may be no longer than the first choice route, in which case the higher over-all transmission loss may result in no echo suppressor being required on the overflow route whereas one is required on the earlier choice route. Conversely, where an overflow route is significantly longer than an earlier choice route an echo suppressor may be required on the overflow route but not on the earlier choice route. In these circumstances it is clear that when the lengths of national extensions are ignored it may not be sufficient to base the echo suppressor decision on the country code alone; it will be necessary, in many cases, to take account of the actual routing followed by the call. For any given relation the actual routing will usually be completely known either from a knowledge of the number of transit centres in the set-up connection or from the kind of route (high-usage or final) seized at the originating centre.

As an example, the echo suppressor decision, for a given country code, might be made in the originating register according to the scheme shown in Table 2 below.

TABLE 2

Country code	No echo suppressor	Insert echo suppressor
AB, AD, CF, etc.	No or 1 transit centre	2 transit centres
AC, BX, CY, etc.	No transit centre	1 or 2 transit centres
AE, CZ, etc.	1 or 2 transit centres	No transit centre
BA, CX, etc.	2 transit centres	No or 1 transit centre
AF, BC, etc.	Final route	High-usage route
AG, CB, etc.	High-usage route	Final route
AJ, BP, etc.	Never	Always
AK, BR, etc.	Always	Never

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* In many cases in Europe the alternative routing is over the same geographical route as the primary route, the difference being that the alternative connection is made via intermediate transit centres. This is an arrangement which simplifies tariffs and it leads to the situation in which the alternative routing has more transmission loss but substantially the same transmission time as the primary route and may not need an echo suppressor, although the primary route might. This may not apply in other continents.

ANNEX 3

(to Question 2/XI)

Inserting echo suppressors by permanently equipping international circuits

1. One of the possible solutions envisaged by the C.C.I.T.T. in Recommendation G.131, B, d (Volume III of the *Blue Book*) of the problem of inserting the echo suppressor in a connection is to permanently equip certain international circuits with echo suppressors, the circuits being selected in such a way that every connection requiring an echo suppressor would include at least one such circuit. If each international exchange were directly connected to every other international exchange this solution would clearly be the most simple and economical. Each route would be carrying all the traffic in a given relation and no traffic of any other relation. If, in order to comply with Rule E in Recommendation G.131, B, c, echo suppressors were required for the calls in a certain relation then they could be permanently fitted to the circuits of the appropriate international route. The number of echo suppressors is reasonably related to the number of connections in which they are required and none are fitted where not required.

2. However, a network built up in such a way would be wasteful because of the low traffic carrying capacity of small groups of circuits. Under fully- or semi-automatic conditions, much more so than under manual operating conditions, traffic will tend to be concentrated into streams and routed through one or more international transit exchanges. A telephone call between two countries may pass over any one of perhaps as many as four routings; also, the circuits of a particular route may carry calls of a number of different international relations.

3. This situation complicates the choice of circuits to be permanently fitted with echo suppressors and may lead to the number of echo suppressors required by this method being uneconomically great. This and other problems are exemplified in Figure 1, which illustrates part of an international network: high-usage routes are shown as interrupted lines and final routes as solid lines.

4. The route outgoing from 10 to 20 takes some part of the traffic in all the relations between the countries numbered on the one hand in the range 10-15 and on the other hand in the range 20 to 24, 30 different international relations in all. Echo suppressors may be required for only a few of these relations when using the route 10-20; also, only a small fraction of the traffic in each of these few relations may overflow to that route. For example, the traffic in the relation 12-24 will divide, during the busy hour, among the four possible routings approximately as follows:

Choice	*Routing*	*Proportion of busy hour traffic*
First choice	12-24	$^1/_3$
Second choice	12-20, 20-24	$^1/_3$
Third choice	12-10, 10-24	$^1/_6$
Last choice	12-10, 10-20, 20-24	$^1/_6$

The proportion of the daily traffic overflowing to the last choice route will be even less, perhaps one-twentieth. It will be noted that half-echo suppressors fitted to circuits 12-10 or 20-24 do not comply with rule F of Recommendation G.131, B, c so far as traffic 12-24 is concerned. On the other hand, the number of echo suppressors required to permanently equip all the circuits of the routes 10-20 would be much greater than is justified by the number of connections requiring echo suppressors.

5. Rule G of Recommendation G.131, B, c, provides an alternative method to fully equipping a substantial final route such as 10-20 with echo suppressors when only a small percentage of the traffic passing over it requires them. If traffic in the relation 12-24 requires echo suppressors then circuits of the direct route 12-24 could be permanently fitted with echo suppressors and by arranging for the insertion of a full echo suppressor at 12 when a call to 24 overflows to one of the alternative routes.

6. Another method, mentioned in Recommendation G.131, B, d, *iii*, would be to split the route 10-20 into two groups, one fitted with echo suppressors the other not, and routing the different connections over these groups according to whether they need echo suppressors. In addition to the necessary means of arranging such selective routing it would be desirable for this to be done in such a way as not to affect the traffic-carrying capacity of the entire group 10-20.

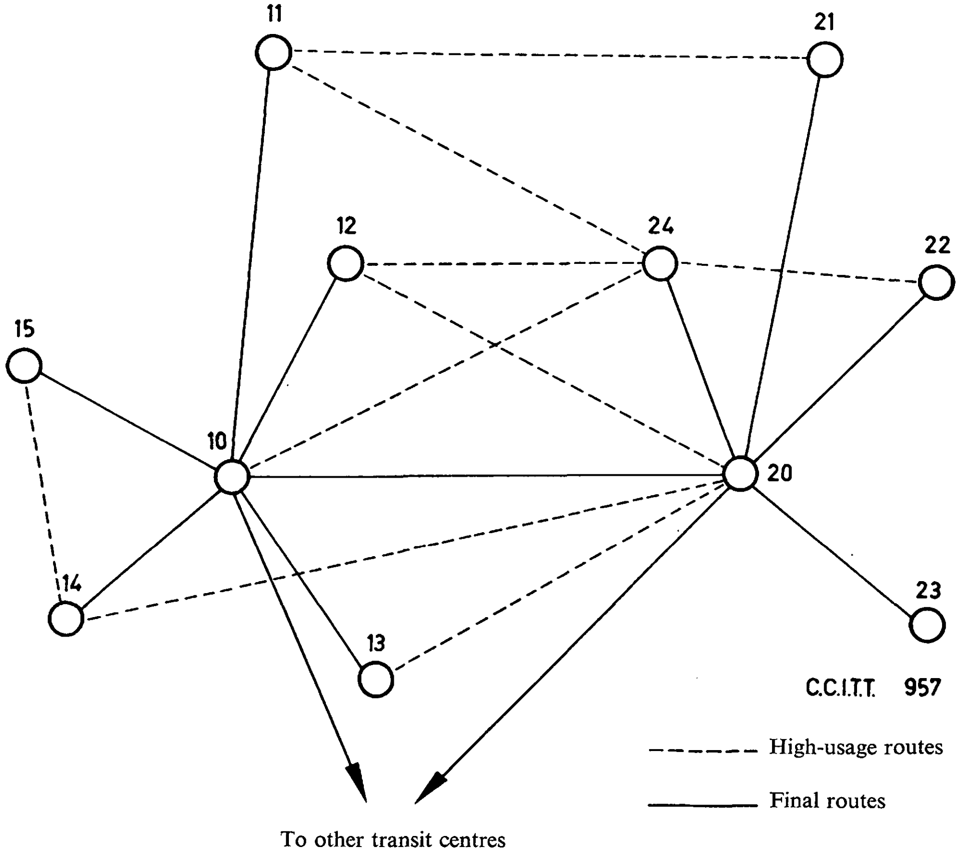


Figure 1. — **Part of a hypothetical international network**

7. As with the switching method of inserting echo suppressors, account has to be taken of the differences in the length and over-all transmission equivalents of the possible routings which may be used by the traffic in a given relation. (See Annex 2 to this Question 2/XI, paragraph 4.) However, the method of permanently equipping circuits with echo suppressors permits of a simpler solution to this problem than is the case with the switching method. For example, suppose that for traffic in the relation 14-15 it has been calculated, using the methods illustrated in Annex 2 to this Question, that an echo suppressor is not required when the direct route 14-15 is used but is required for the overflow route 14-10, 10-15. This case is met quite easily by not equipping the route 14-15 and by fitting echo suppressors to the route 14-10 or 10-15 as the more advantageous, taking account of the requirements of other traffic using those routes.

8. Centre 15 may be the terminal of an intercontinental route, the circuits of which are permanently equipped with half-echo suppressors. Assuming that the route 10-20 is also permanently equipped with echo suppressors it would be desirable, in the case of a call for centre 22, say, arriving over the intercontinental route, for the two half-echo suppressors at 15 and 10 to be disabled; such disablement might even be necessary in order to comply with rule K of Recommendation G.131, B, c. This sort of situation may also arise on continental calls involving two transit centres where the circuit connecting the two transit centres (the intermediate circuit) is not fitted with echo suppressors.

Question 3/XI — Frequency for the disablement of echo suppressors for data transmission

What frequency should be used for an echo-suppressor disablement device when the link in which the echo suppressor is inserted is to be used for data transmission?

Note. — When Study Group XV met in 1964, before the IIIrd C.C.I.T.T. Plenary Assembly, no agreement could be reached about a frequency for an echo-suppressor disablement device, since 2100 c/s (which seemed to have found favour with Special Study Group A) may cause disturbance in certain national signalling systems.

Question 4/XI — Transmission conditions with which an international exchange must comply

(new question)

Noting that Recommendations have been made for transmission features of international exchanges, such as crosstalk and noise, is it desirable to make Recommendations for other transmission features such as:

switching loss:

— variation of loss with time,

— variation of loss with routing through the exchange,

attenuation/frequency distortion,

impedance—return loss—unbalance,

(Question 4/XI)

non-linear distortion,
group delay,
harmonic ratio,
and so on?

If so, what limits should be specified?

Note. — Reference to be made to Annexes 1, 2 and 3 hereinafter.

ANNEX 1

(to Question 4/XI)

Transmission conditions to be fulfilled in Australia by an international switching centre

N.B.: Some of the characteristics specified are provisional and may be modified in the light of further studies and progress made in technique.

The telephone network within the Commonwealth of Australia is based on a channel bandwidth of 300-3400 c/s. The stipulations in the following are applicable to international exchanges in this and similar areas. In the case of intercontinental exchanges it may be appropriate to stipulate better performance, in particular the performance requirements covering the 200-300-c/s range to enable circuits utilizing this frequency range (for example, submarine cables) to be switched with minimum degradation in that range. The performance of the Australian intercontinental exchange in Sydney has in fact been specified in that frequency band, and the delay distortion performance for that exchange is stipulated over the 200-3400-c/s band in lieu of the 500-3000-c/s band stipulated in § 6.

1. Introduction

The type of exchange equipment considered is the " electromechanical " type as distinct from " electronic " exchanges of the various varieties.

The exchange shall switch on a true four-wire basis. If any two-wire lines are switched, those lines must be converted by means of a hybrid arrangement to four-wire for purposes of switching. The two/four-wire converting hybrid is considered as not belonging to the exchange for the purposes of this proposal.

In four-wire switched exchanges, where two two-wire lines (converted to four-wire circuits by means of hybrids) may be switched together, the possibility of incorrect relative phasing of the two paths through the exchange exists (*Note:* This problem is similar to the phasing problem in tail-eating exchanges) and it must be ensured:

– that the wiring and switching devices associated with the two paths are so arranged that correct phasing is maintained,

– that unidirectional devices (such as amplifiers) are incorporated both in the GO and RETURN four-wire paths of all possible connections involving two two-wire lines. Any such amplifiers and other devices, such as low-pass filters to ensure stability, are considered as not belonging to the exchange for the purposes of this proposal.

Switched pads may be encountered in four-wire transit exchanges for the purpose of achieving the correct circuit losses for all types of lines (two-wire and four-wire lines). Where this is the case the pads should be situated in the four-wire paths, and the performance requirements should be met with these pads switched " in " as well as " out ".

The following transmission requirements apply to any path through a four-wire exchange after the necessary signalling and switching operations required to establish the path have been completed. The path shall be defined to incorporate all exchange equipment and wiring between and including the incoming and outgoing signalling sets permanently associated with the switched lines. The signalling sets referred to include line and/or information signalling sets as may be necessary for the establishment of the path. The term " path " shall be taken as meaning either the GO direction or RETURN direction unless specifically stated otherwise. Where the path includes major units of equipment such as an echo suppressor, this equipment shall be replaced by an equivalent ideal transmission network for the purpose of this proposal.

Injection and pick-off of signalling tones, such as 1-V.F., 2-V.F. and multifrequency code signalling, shall be on a true four-wire basis.

The circuit arrangements shall provide for wetting of all contacts in the transmission path.

2. Transmission loss

The path loss through any four-wire exchange will vary with time. The mean loss over any period of time measured at 800 c/s of a particular path shall not differ from the nominal value appropriate to that path by more than ± 0.2 db with a standard deviation of 0.2 db.

The nominal loss appropriate to a particular path will be dependent on the type of transmission equipment employed on the incoming and outgoing circuits and may be different for paths interconnecting different types of incoming and outgoing circuits. The appropriate nominal path loss is obtained by the use of building-out pads.

3. Loss/frequency characteristics

The permissible variation in the loss versus frequency characteristic of any path measured between 600 ohms is ± 0.2 db relative to the value at 800 c/s over the frequency range 300 to 3400 c/s.

4. Linearity, harmonic distortion and intermodulation

The path should be linear to within 1 db for levels up to +12 dbm0 and 0.1 db for levels up to +5 dbm0 for any frequency in the range 300-3400 c/s.

The total harmonic distortion of any " fundamental " frequency in the range 300-3400 c/s and at any level up to +5 dbm0 shall be better than 26 db below the fundamental.

Third-order products of intermodulation falling in the frequency range 540-1980 c/s, when the equipment is loaded with two tones of equal level in the range –38 to –5 dbm0 (representing extreme levels encountered in the operation of end-to-end multifrequency signalling equipment) and each in the frequency range 540-1980 c/s, shall each be not less than 40 db below the level of each of the test frequencies.

5. Crosstalk

5.1 *Between the two paths of the same four-wire circuit*

The crosstalk ratio shall not be less than 55 db at any frequency in the 300-3400-c/s range.

5.2 *Between any two paths of different four-wire circuits*

The crosstalk ratio shall not be less than 70 db in the worst case. 90% of the combinations of a large number of measurements shall not be less than 80 db.

6. Phase distortion (group delay)

The group-delay distortion shall not exceed 100 microseconds. The group-delay distortion is defined as the time difference between the maximum and minimum group delays in the frequency range 500 to 3000 c/s.

7. Impedance

The return loss measured against 600 ohms at the input or output of any path with the output or input terminated in 600 ohms shall not be less than 26 db at 800 c/s, not less than 20 db in the frequency range 300 to 3400 c/s and not less than 15 db between 200 and 300 c/s.

8. Degree of balance to earth

The impedance balance ratio at the input and output of each path when the other end is terminated in 600 ohms shall be not less than 40 db over the frequency range 600-4000 c/s, not less than 26 db over the range 200-600 c/s and not less than 15 db over the range 50 c/s-50 kc/s.

The impedance balance shall be measured in accordance with the provisions of Chapter XVI of the 1963 edition of the *Directives concerning the protection of telecommunication lines against harmful effects from electricity lines*, published by the I.T.U.

9. Noise

It is essential to consider the following types of noise:

a) Noise of very low frequencies, for instance due to ripple on the d.c. supply to the exchanges, which may prevent the proper operation of the associated carrier telephone equipment (notably pilot channels and out-of-band signalling channels).

b) Noise of high frequencies, say at frequencies above 5 kc/s, which by modulation and demodulation processes in the carrier telephone equipment is frequency-translated into the audio-band and finally appears as audio-noise at the far end of the circuit.

c) Noise at audio-frequencies, which may interfere with any type of communication over the channel.

d) Impulse noises, which may interfere with the transmission of signalling and data (notably inter-register signalling and high-speed data transmission).

By the choice of a suitable weighting network and suitable type of indicating meter, all four types of noise may be ascertained at any instant by a single measurement. The measuring instrument should be a peak-reading voltmeter similar to the U.K. peak programme meter (C.C.I.T.T. *Red Book*, Volume III, Annex 49, p. 429) having a charging time constant of 0.25 ms, in lieu of 2.5 ms, and used in conjunction with the following weighting characteristics:

0-150 c/s: 29.0 db (C.C.I.T.T. 1951 weighting figure at 150 c/s is 29.0 db).

150-4700 c/s: in accordance with the 1951 table of weights for the C.C.I.T.T. 1951 psophometer.

above 4700 c/s: 29.4 db (C.C.I.T.T. 1951 weighting figure at 4700 c/s is 29.4 db).

The mean noise introduced into any path during any hour when measured on an instrument as described herein should not exceed a level of –70 dbm0. Occasional peaks of up to –40 dbm0 may occur.

These noise figures are to be met when the exchange is operated from power supplies with noise voltages as prescribed by the Administration concerned. Furthermore, the noise which the exchange equipment causes on the power supply busbars with impedance characteristics as specified by the Administration should not exceed prescribed limits.

10. Automatic test access

In the exchanges arranged for automatic access for testing of circuits, the access must be so arranged that measured quantities give a direct indication of the relevant performance characteristics of the circuit under test, the " circuit " being defined in accordance with C.C.I.T.T. Recommendation M.70 (*Red Book*, Volume IV): that is, the line including the equipment permanently associated with it at both ends. This requirement can be met if test access is given at the switchbanks.

In some types of exchanges the switching equipment may be so arranged that the switches used for transit switching may be used also as test access switches, and in this case the arrangement indicated in Figure 2 is permissible. This arrangement illustrates the case in which test access has been made to circuit A (a level measuring set has by the switching processes been associated with the RETURN path of circuit A and an oscillator has been associated with the GO path). The connections shown dotted apply if test access is to be made to circuit B.

The losses over the paths:

B1-C1, B1-C2, B2-C1, B2-C2, and
B1′-C1′, B1′-C2′, B2′-C1′, B2′-C2′,

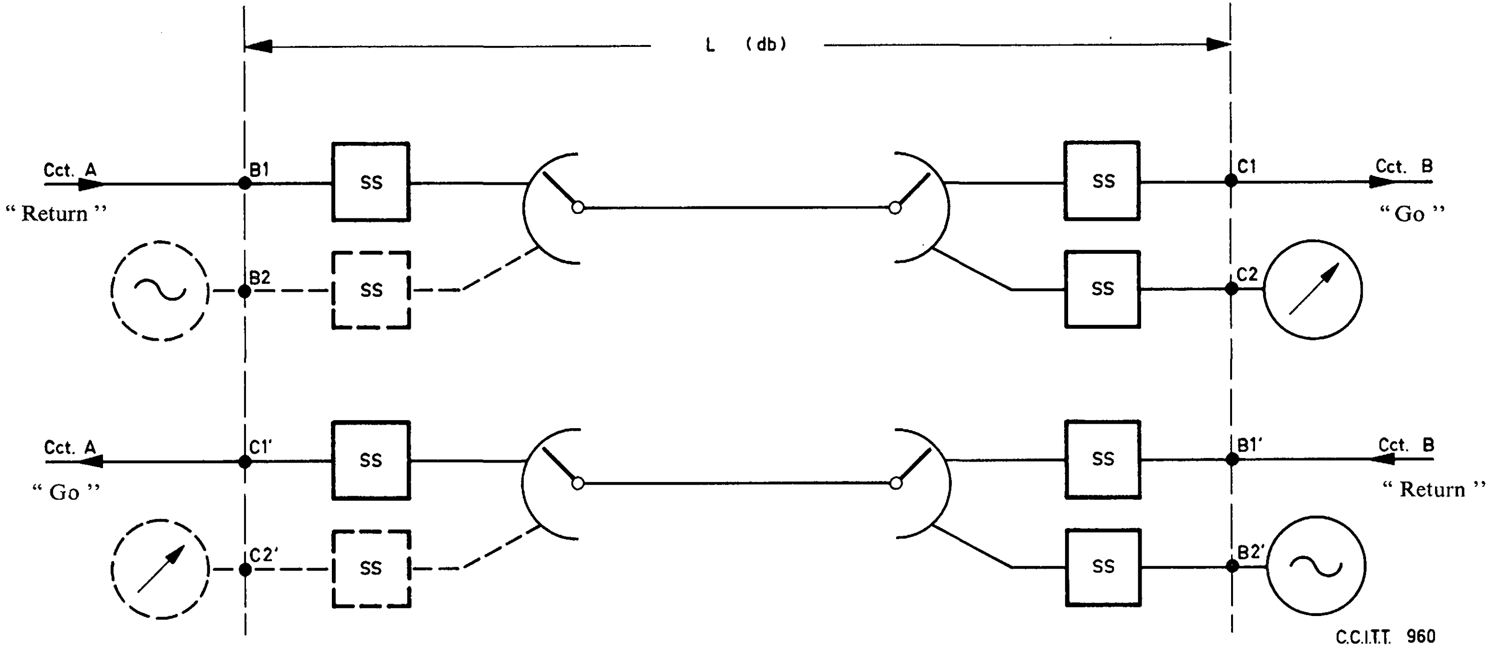
are identical and may be referred to as L (db) It follows that measurements taken in this manner are directly indicative of circuit characteristics if a compensating gain of 0.5 L (db) is incorporated with both the level-measuring set and the oscillator (this gain would normally be provided as an integral part of the test access paths).

It should be noted that the use, for test access purposes, of the switching equipment normally used for transit switching may not be attractive to some Administrations for the following reasons:

a) access to incoming one-way circuits may not be readily obtainable,

b) access to busy circuits may not be readily obtainable,

c) access to other points, such as for instance to the line-side of signalling relay sets, may not be readily obtainable.



SS = signalling set (relay set).

FIGURE 2. — **Test access, using the same switching equipment as used for transit switching**

ANNEX 2

(to Question 4/XI)

Conditions to be satisfied by an international transit centre in the United States (American Telephone & Telegraph Co.) as regards transmission

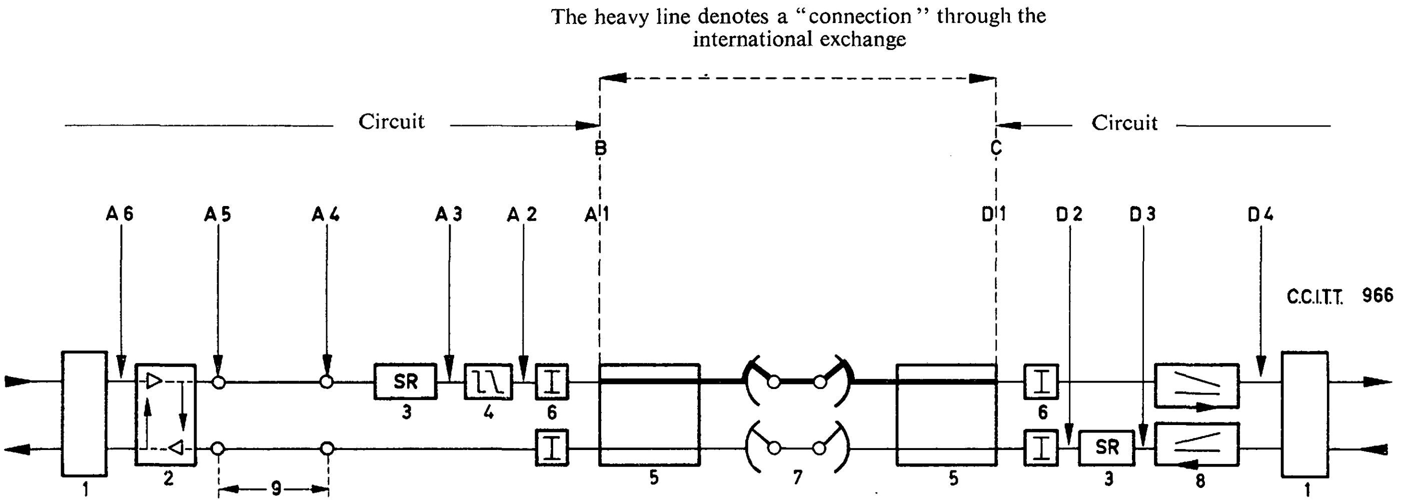
The approach now preferred by the A. T. & T. Company in specifying the conditions to be satisfied by a switching centre is the result of recent work aimed at controlling transmission on switched connections. While this work was directed primarily at the control of 1000-cycle loss, the principles which evolved are equally applicable to other transmission parameters. It is expected that future specifications of switching centres will conform with this approach. Figure 11 in Recommendation Q.45 is suitable for a discussion of the method with the minor exception that the pads (6) should appear on the line side of the relays (5) (Figure 3).

The basic assumption is that the transmission characteristics of a trunk are what is measured from the outgoing switch in one office to the outgoing switch in the other office. From a transmission standpoint a trunk includes all that is between points C of Figure 3 in two connected offices. This convention is in minor conflict with equipment-oriented definitions of trunks as telephone lines or channels between central offices or switching devices. However, the characteristics of connections can now be estimated by summing the characteristics of the trunks involved without separate allowance for the characteristics of switching offices.

Two-way trunks are considered outgoing from the office which has responsibility for maintenance. This introduces the possibility of a difference between actual and measured characteristics on calls originated from the other end. As long as the impairment introduced by switching offices is small, this inaccuracy does not warrant correction.

It is not practical or convenient to locate test access jacks for measuring over-all trunk characteristics at the outgoing switches. Instead, access is obtained over test pairs from a centrally located testboard as shown in Figure 4. At the originating office this access can be by means of a permanently connected multiple of the trunk which appears at jacks on the testboard or by means of a connection through the switching network. In either case, the loss of the measuring circuit is built out to give a loss which is 2.0 db more than that to the outgoing switch. In the case of Figure 4, since there may be a small loss between the outgoing switch and the point of multiple connection, the measuring circuit is adjusted so that the difference in transmission level between the outgoing switch and the point of application of the measuring equipment is 2.0 db. At the terminating office, the test call is completed to a test line extended to a jack appearance at the testboard. Again this test path is accurately adjusted to a loss of 2.0 db. By these means it is possible to make measurements within ±0.1 db of what would be measured directly at the switches.

In practice, the measuring circuits at both ends also include the equivalent of the switchable pads in the trunk circuits. Measurements are normally made with the trunk pads switched out and the measuring pads switched in, thereby giving a check on the operation of the pad-switching relay. This is not an essential feature of an office and can be ignored in this discussion.



1. Channel translating equipment
2. Echo suppressor
3. Line signal receiver
4. Equalizer
5. Outgoing and incoming relay sets
6. Switchable exchange pads
7. Automatic switching equipment
8. Compressor and expander
9. Tie cable

Some of the elements may be in a different order from that shown, e.g. the echo suppressor may be on the exchange side of the signalling receiver.

The international *circuit* extends from point C of one exchange to point B of the next.

The international *line* extends from any point $D_1 \ldots - D_4$ to any point $A_1 \ldots - A_6$.

FIGURE 3

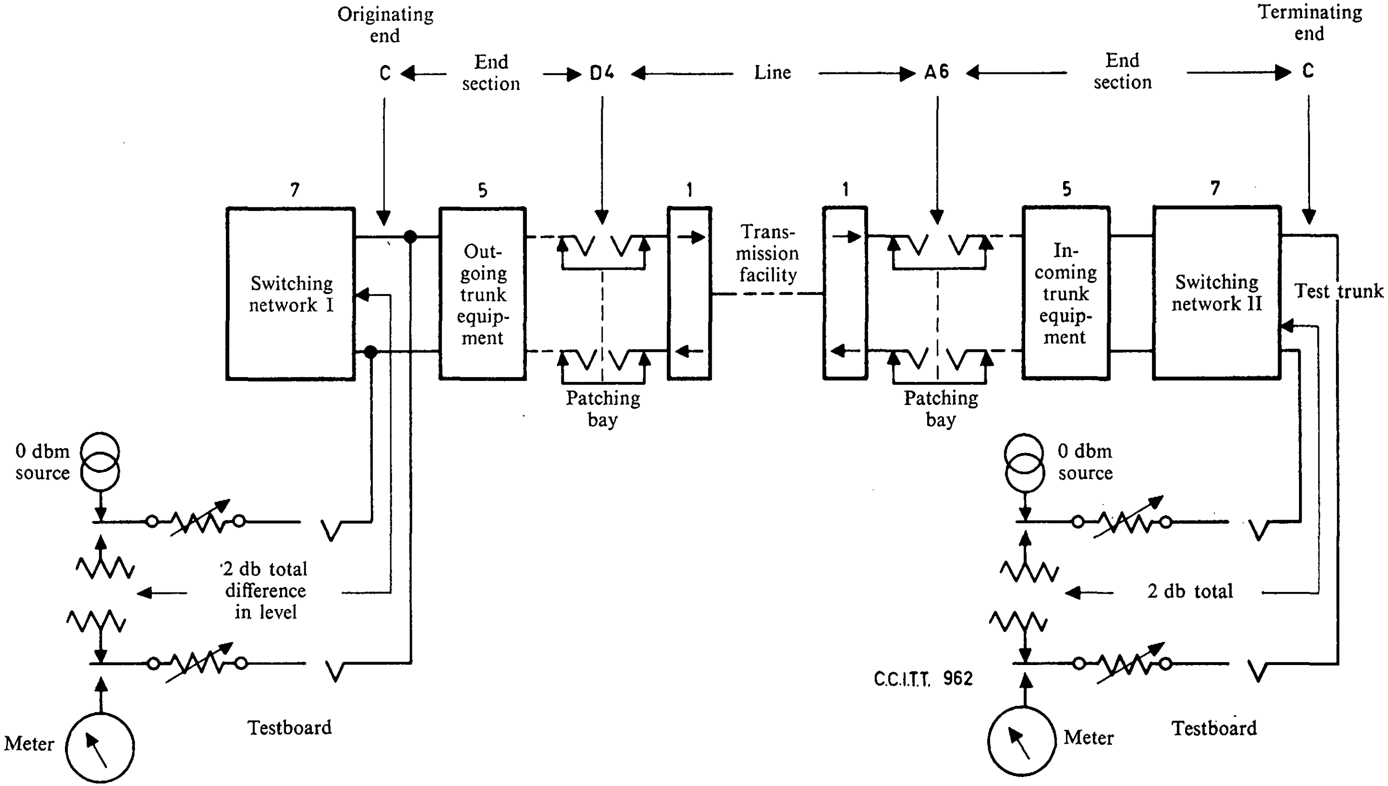
The 1000-cycle test signals are applied so that the level is equivalent to 0 dbm at 0 transmission level on the transmission facilities. Since the transmitting switches in our systems are defined as a –2 db level point, the source at the testboard must be 0 dbm. The 1000-cycle test power expected at the testboard over a trunk is –4.0 dbm reduced by the loss of the trunk. Clearly, other combinations of switch level, test circuit loss, and test power which give the equivalent of 0 dbm at 0 level could be used. These should be selected on the basis of other considerations beyond the scope of this discussion.

If two connected trunks are to provide the sum of their individually measured characteristics, each trunk must offer an impedance very close to that of the measuring circuit to the other trunk. In a 600-ohm, four-wire office, the transmitting and receiving equipment in the testboard should provide a return loss of about 40 db from 200 to 3500 cycles against a 600-ohm resistor. The impedances looking both ways from point C of Figure 3 should provide a return loss of at least 20 db against 600 ohms over most of the same frequency band. In our systems departures of these impedances from 600 ohms are due principally to office cabling and the bridged impedances and series capacitors of the trunk relay circuits. By proper design of the switching equipment and reasonable limitations on the resistance and capacitance of office cabling, including test multiples, this requirement can be met.

The complete trunk is divided into three readily measured segments by the patching bays at each end of the transmission facility, as shown in Figure 4. In the process of establishing a trunk, signals are sent between these patch bays over the facility. Adjustments in the transmission equipment are so made that the desired levels, such as –16 db transmit and +7 db receive, are achieved within about ±0.1 db. Other transmission parameters, including attenuation distortion, are checked against the transmission facility's share of the over-all trunk objectives.

The end sections of the trunk are tested separately by measurements between the patching bays and testboards. The loss is adjusted at 1000 c/s within about ±0.25 db of the difference between the nominal levels at the patching bay and the desired levels at the switches. Combining the tolerances on the three segments on an r.m.s. basis and assuming little drift of the transmission facilities, the loss of the over-all trunk should be within ±0.5 db of the desired loss at 1000 c/s when completely assembled.

The share of the over-all trunk transmission impairments, other than loss, allocated to the end sections of the trunk is usually small, perhaps 5 to 15% of the total. A larger portion could be allocated if there were sound technical and economic reasons for doing this. Typical objectives suitable for present circumstances are given in the table below. These objectives apply to *each* end section of a trunk, as defined by points A6 and C and by points C and D4 in the diagrams of Figures 3 and 4.



Note. — Number and letter designations have the same meanings as in Figure 3.

FIGURE 4

TABLE OF OBJECTIVES

Loss deviation from nominal at 1000 c/s	±0.25 db		
Loss/frequency characteristic relative to 1000 c/s	200 c/s	−0.5	+1.0 db
	300 c/s	−0.2	+0.5
	3200 c/s	−0.2	+0.5
	3400 c/s	−0.5	+1.0
Linearity			
Loss increase due to overload	−0, +0.2 db at +10 dbm0		
Total harmonic distortion for 0 dbm0, 1000 c/s fundamental	less than −30 dbm0		
Message weighted noise at zero level	less than 13 dbRNC (−77 dbm, psophometric)		
Equal level crosstalk coupling loss [1]			
to separate circuit	at least 75 db		
to return path	at least 60 db		
Envelope delay distortion [2]	600-3000 c/s	20 μs	
	500-3200 c/s	40 μs	
Return loss against 600 ohms [3]	200-3500 c/s	15 db	
	300-3000 c/s	20 db	
		Min.	*Aver.*
Balance to longitudinal voltages [4]	200 c/s	64 db	69 db
	1000 c/s	58 db	63 bd
	3000 c/s	56 db	61 db
Impulse noise peaks	Maximum of 10 impulses above −35 dbm0 per ½-hour		

Remarks:

[1] Averaged on current basis at 500, 1000, and 2000 c/s.

[2] These objectives exclude any equalizers included in the end sections to compensate for distortions in the transmission facility.

[3] Applicable at each end (e.g., at A6 and C) with the other end terminated.

[4] Also applicable at each end and defined as

$$20 \log_{10} \frac{\text{open circuit voltage to ground}}{\text{voltage across balanced termination}}$$

ANNEX 3

(to Question 4/XI)

Transmission requirements for an international transit centre in the United Kingdom

Note. — The points between (or at) which the parameters are to be measured (TA, TB, etc.) are illustrated in Figure 5.

1. Switching loss (RB-TC, RC-TB)

1.1 *Switching loss variation according to the path followed in the automatic switching equipment*

If M db is the nominal value of the losses at 800 c/s of all these paths the mean loss of any path through the automatic switching equipment shall be within the limits of $M \pm 0.2$ db at 800 c/s.

1.2 *Switching loss variation as a function of time*

The standard deviation of the switching loss variation at 800 c/s as a function of time for a given path shall not exceed 0.2 db.

1.3 *Switching loss variation as a function of frequency*

The loss-frequency characteristic of a given path shall be such that if S db is the loss at 800 c/s the loss shall be not less than $S-0.1$ db nor more than $S+0.1$ db at any frequency throughout the band 200-4000 c/s.

2. Relay set loss (RA-RB, TB-TA, TC-TD, RD-RC)

2.1 *Relay set loss variation between relay sets*

If R db is the nominal value of the relay set loss at 800 c/s the mean loss of any relay set shall lie within the limits $R \pm 0.2$ db at 800 c/s.

2.2 *Relay set loss variation as a function of time*

The standard deviation of a relay set loss variation at 800 c/s as a function of time shall not exceed 0.2 db.

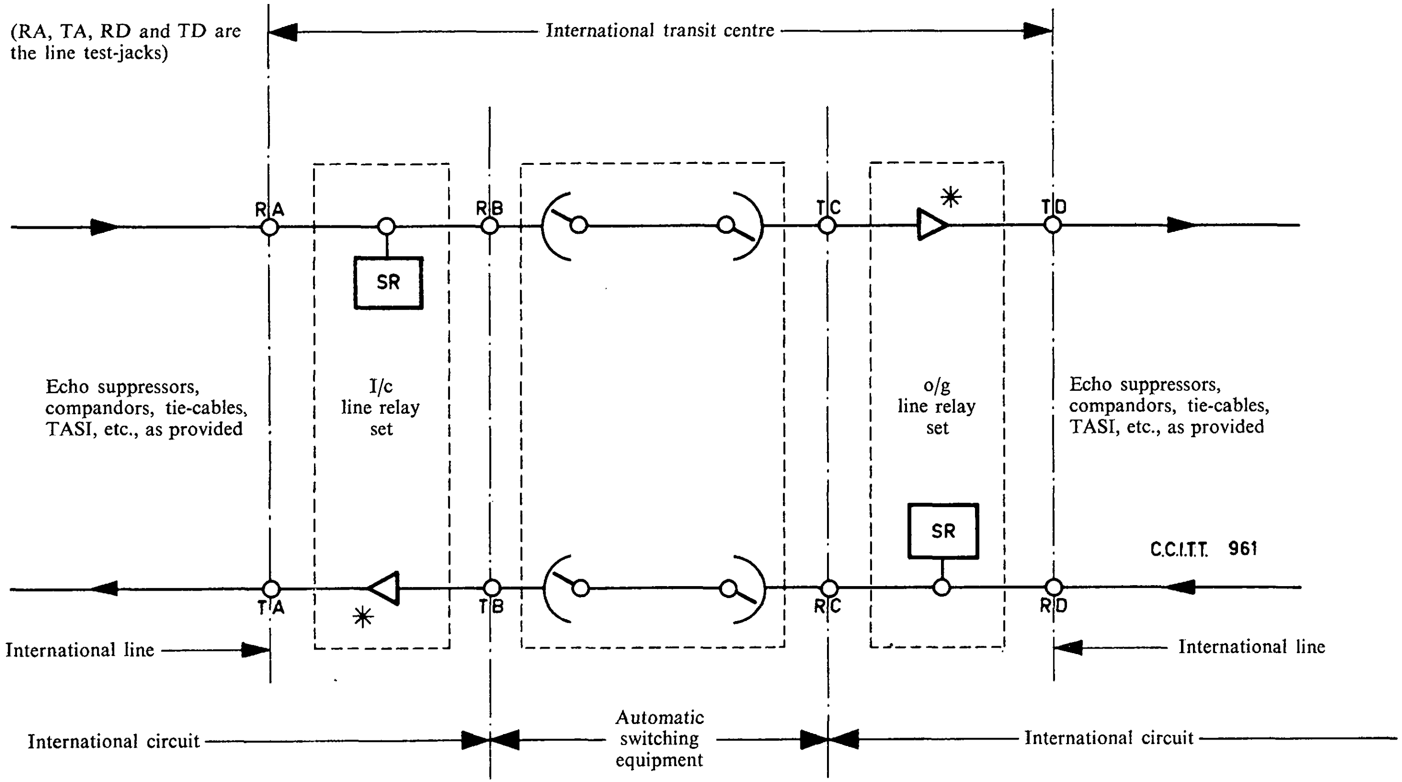
2.3 *Relay set loss variation as a function of frequency*

The loss-frequency characteristics of a relay set shall be such that if Q db is the loss at 800 c/s the loss shall not be less than $Q-0.2$ db nor more than $Q+0.2$ db at any frequency throughout the band 200-4000 c/s.

3. Impedance

3.1 *Return loss*

Impedance is specified in terms of return loss versus a non-reactive impedance of 600 ohms. The requirements for various points are summarized in the table below:



* Buffer amplifier—provided on only some routes.

FIGURE 5

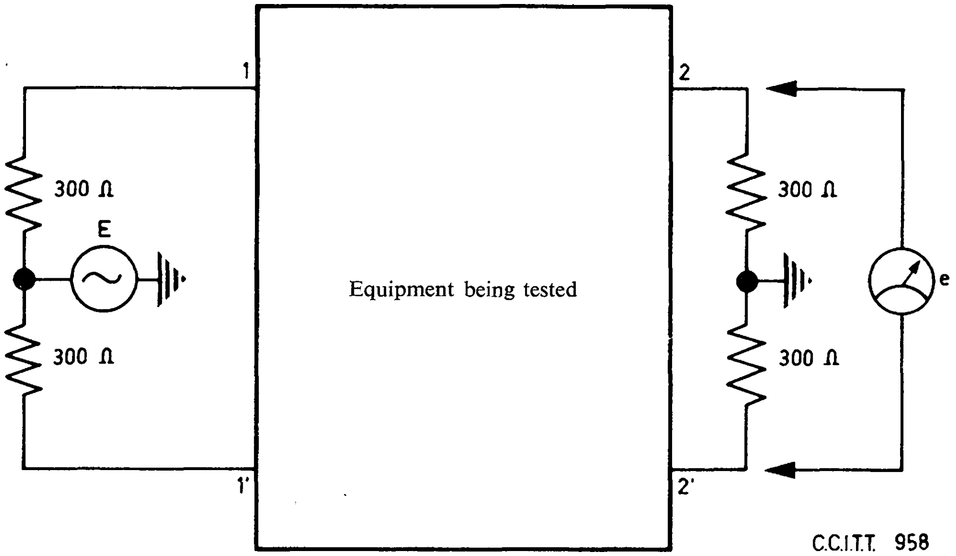


Figure 6 A

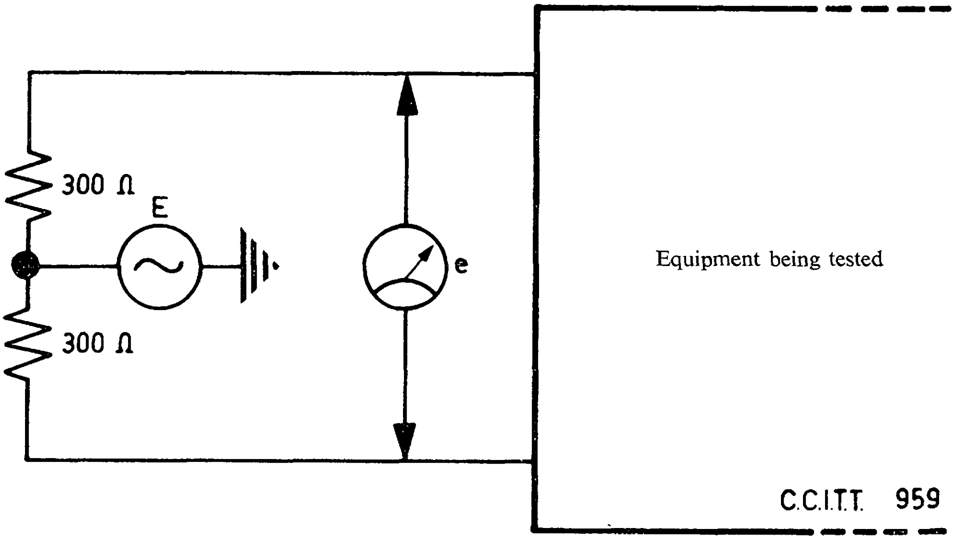


Figure 6 B

FIGURE 6. — **Methods of measuring the degree of unbalance**

Impedance presented at point	Point terminated with 600-ohm non-reactive resistor	Return loss not less than
TA	TB	20 db over the frequency range 300-3400 c/s 15 db over the frequency range 200-4000 c/s
TB	TA	
RA	RB	
RB	RA	
RC	RD	
RD	RC	
TC	TD	
TD	TC	
Any TB	Any RC	25 db over the frequency range 200-4000 c/s
Any RC	Any TB	
Any TC	Any RB	
Any RB	Any TC	

3.2 *Degree of unbalance*

The degree of unbalance is defined as the ratio e/E measured as shown in Figure 6A. The reciprocal of this ratio may be expressed in transmission units.

The two pairs of 300-ohm resistors used in the measurement must be accurately matched at all significant frequencies.

The requirements are summarized in the table below:

Input	Output	Degree of unbalance	Frequency range
TA	TB	0.01 (40 db)	600-4000 c/s
TB	TA		
RA	RB		
RB	RA		
RC	RD		
TC	TD		
TD	TC		
Any TB	Any RC	0.05 (26 db)	200-600 c/s
Any RC	Any TB		
Any TC	Any RB		
Any RB	Any TC		
Any TA	Any RD		
Any RD	Any TA		
Any RA	Any TD		
Any TD	Any RA		

If the output of the equipment being measured is at a relative transmission level x db higher than the input the limits must be increased by x db.

4. **Linearity** (RD-TA, RA-TD)

The variation of loss (or gain) of the apparatus of any path TA-RD or TD-RA shall be such that if S db is the loss at 800 c/s at a level of 0 dbm0 the loss shall lie within the limits $S \pm 0.1$ db at any signal level in the range –60 to +5 dbm0.

5. Noise

5.1 The mean weighted psophometric power introduced during any hour by the exchange should not exceed –70 dbm0p; the unweighted psophometric hourly-mean power level should not exceed –40 dbm0.

5.2 In the design of the exchange, care should be taken to ensure that transmission interruptions are negligible and that impulse noise is at low enough level not to introduce an appreciable error rate on data transmission.

6. Crosstalk

The relevant clauses of Recommendation Q.61 should be complied with (*Red Book*, Volume VI, pages 101-102, paragraphs 3.5.1 and 3.5.2).

7. Group delay distortion (RA-TD, RD-TA)

The group delay distortion introduced by any path through the exchange over the frequency range 200-4000 c/s shall not exceed 100 microseconds.

Impedance exhibited by international four-wire lines at an international transit centre

1. Return loss

The return loss versus 600 ohms, non-reactive, of the impedance exhibited under normal working conditions of the transmit and receive paths of an international four-wire line at the test-jack board shall lie within the following limits:

Over the range 200-4000 c/s: not less than 15 db.
Over the range 300-3400 c/s: not less than 20 db.

2. Degree of unbalance

The degree of unbalance is defined as the ratio e/E measured as shown in Figure 6B. The reciprocal of this ratio may be expressed in transmission units. The two resistors in this measuring arrangement shall each be 300 ohms, non-reactive, and be accurately matched at all significant frequencies. The degree of unbalance shall lie within the following limits:

Over the range 200-600 c/s: not more than 5% (or 26 db)
Over the range 600-4000 c/s: not more than 1% (or 40 db).

Notes. — a) These same limits should be met if possible for return loss and degree of unbalance by any four-wire national lines connected to the international exchange (e.g. tie-circuits to other national automatic switching units).

b) With the suggested limits for return loss the greatest difference between the transit loss of the connection and the sum of the transit losses of the individual circuits due to this cause alone would be of the order of ±0.3 db over the frequency range 200-4000 c/s and +0.1 db over the frequency range 300-3400 c/s (this assumes a theoretically perfect exchange introducing neither loss nor impedance change).

c) One source of incorrect impedance is unloaded tie-cables between the repeater station and the telephone exchange. The following are some methods by which the impedance presented to the exchange can be improved:

i) using buffer attenuators,

ii) using buffer amplifiers,

iii) loading the cable (if it is long enough),

iv) fitting impedance-correcting networks at the ends of the cable.

The last two methods introduce a cut-off frequency and may also require the use of line transformers.

d) Echo suppressors, companders, etc. are not included in the measurement. The impedance of these items is closely specified in terms similar to those above.

Question 5/XI — New objectives for reduction of exchange noise

(new question)

Considering

— the continuing extension of the international semi-automatic and automatic services, in the intercontinental services in particular, with the increasing number of exchanges in a connection;

— that each exchange in a connection will contribute to the total noise of the over-all connection;

— the trend to improved noise performance of transmission systems, such as microwave radio-relay systems and cable systems;

— the advances in switching system technology, and the need for the highest quality of service to develop the maximum utilization of the world-wide facilities;

1. To what extent is it desirable to reduce the noise contributed by automatic exchanges by imposing more severe noise limitations as design objectives for new switching centres than those recommended in Recommendation Q.31 and Q.45, part D of Volume VI of the *Blue Book*?

2. What noise objectives should be recommended?

3. What changes or additions can be made to the means for the reduction of noise in telephone exchanges (Recommendation Q.29 of Volume VI of the *Blue Book*) to make it practical to meet these objectives?

Note. — This question should be studied for:

a) international and four-wire national automatic exchanges;

b) two-wire national automatic exchanges.

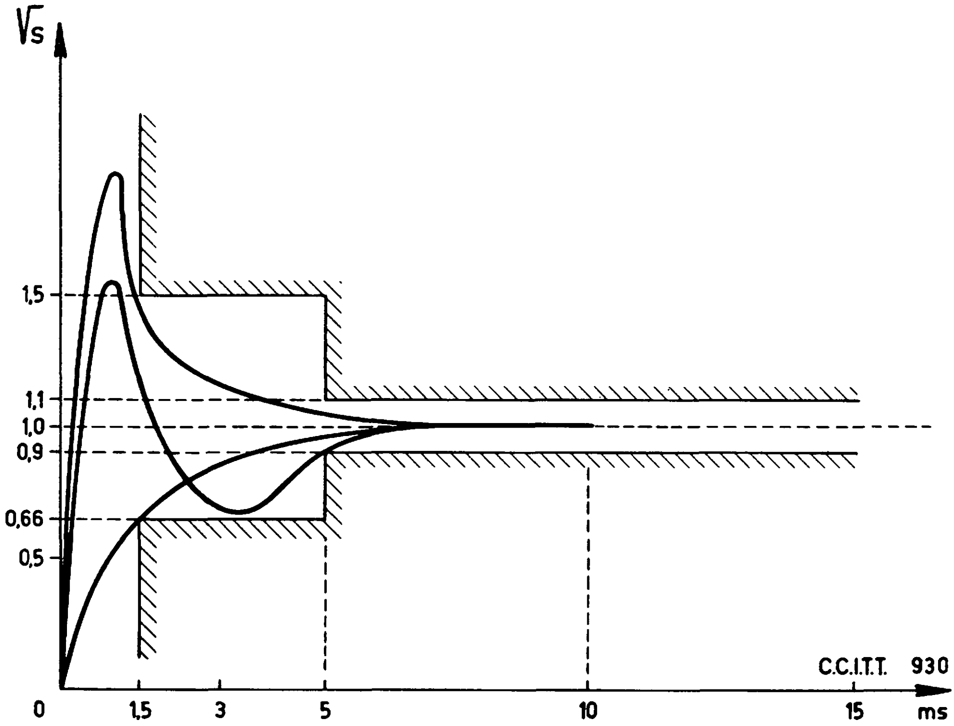
Question 6/XI — Signalling system requirement allowing for the transient response of a compandor

(new question)

Recommendation G.162, part C, paragraph 7, advocates the measurement of the over-all transient response of the compandor as a whole with an infinitely growing step, and limits have been set for the overshoot as from 10 ms.

What are the requirements of the various types of signalling systems regarding the limits to be set during the first 10 milliseconds following application of the step signal?

Note. — An assembly composed of a compressor, a long-distance carrier circuit and an expander will not necessarily satisfy the limits set for an assembly composed of a compressor connected direct to an expander.



Graph showing the tolerances for the transient distortion of a compandor

($\sqrt{S}$ is the final steady-state voltage; as an example, two curves have been drawn which comply with the tolerances in the graph.)

Question 7/XI — Automatic test devices for system No. 5

(new question)

Noting the recommendations for manual testing in Volume VI of the *Blue Book*, is it desirable to recommend the tests to be made, using automatic testing devices, on circuits equipped with C.C.I.T.T. signalling system No. 5?

If so, what should be the recommended characteristics of the automatic testing device (or devices)?

Question 8/XI — Impulsive noise generated in national and international exchanges

(continuation of Question 2/XI, studied between 1961-1964)

What clauses should be provided in the specifications of national and international exchanges to ensure that impulsive noise generated in these exchanges does not disturb telephone signalling or data transmission over the general telephone network, using telephone signalling or data transmission methods recommended by the C.C.I.T.T.?

Note. — It would be desirable if any Recommendations which might be evolved as a result of study of this question could be related to standard measuring instruments and testing methods, especially to any instrument and test method which may be standardized by Special Study Group C, further to its study of new Question 6/C.

Question 9/XI — Technical features of push-button telephone sets

(new question)

Considering

the introduction of push-buttons on telephone sets for conversion of the selection information into electrical equivalents, which is to be expected in the immediate future in a number of countries,

will this have an effect on the operation of international circuits and, if so, what will this effect be and how will it have to be dealt with?

Is it desirable to standardize the technical features of push-button telephone sets and, if so, what recommendations can be adopted regarding:

a) the signalling technique to be used for transmitting and receiving selection information;

b) the possible use of the push-buttons for signalling directly from one subscriber set to another subscriber set via the established national and/or international connection;

c) the functions of push-buttons other than those required for transmitting the numerical information, if such additional functions are to be provided?

Question 10/XI — Physical features of push-button telephone sets

(new question)

(is also Question 4/XIII)

Considering

that efforts have been made to have dials arranged according to uniform principles all over the world, see Recommendation Q.11;

that the need for uniformity in the operation of telephone sets by subscribers is increasing with increased international travel and communications;

that a partial conversion to push-button sets must be expected in the immediate future in a number of countries; and finally

that uniformity is best achieved by having a recommendation at the earliest possible time;

What recommendations can be adopted regarding:

a) the number of push-buttons on a telephone set;
b) the geometric arrangement of the push-buttons;
c) the symbols used on the push-buttons; and
d) the allocation of these symbols to the push-buttons?

SUMMARY OF QUESTIONS SET FOR STUDY GROUP XI

Question No.	Short title	Remarks
1/XI	Study of system No. 6	
2/XI	Insertion and disablement of echo suppressors	Continuation of Question 5/XI, studied in 1961-1964
3/XI	Frequency for the disablement of echo suppressors for data transmission	Concerns also Sp.A.
4/XI	Transmission conditions with which an international automatic exchange must comply	
5/XI	New objectives for reduction of exchange noise	
6/XI	Signalling system requirement allowing for the transient response of a compandor	Results of study to be sent to Study Group XV
7/XI	Automatic test devices for system No. 5	
8/XI	Impulsive noise generated in national and international exchanges	Continuation of Question 2/XI, studied between 1961-1964
9/XI	Technical features of push-button telephone sets	
10/XI	Physical features of push-button telephone sets	Same as Question 4/XIII

Questions about automatic telephone operation
entrusted to
Study Group XIII
for the period 1964-1968

Question 1/XIII — Examination by Study Group XIII of the operating facilities provided in the C.C.I.T.T. system No. 6 plan

(new question)

Question 2/XIII — Language digit and discriminating digit for the international automatic and semi-automatic service

(new question)

What arrangements can be made to provide the functions now furnished by the language and discriminating digits by other means so that the design of international switching equipment may be simplified and quality of service improved?

Note. — The points to be considered are mentioned below:

a) C.C.I.T.T. current Recommendations for systems No. 3, No. 4 and No. 5 require the transmission of a language digit on all international semi-automatic telephone calls, and a discriminating digit on all international automatic calls;

b) that the language and discriminating digits are inserted as part of the address information of a call and are transmitted as inter-register signals;

c) that the addition of the language and discriminating digits increases the time required to transmit the address information on all calls and therefore increases the post-dialling delay;

d) that world-wide semi-automatic and automatic telephony may entail an increase in the possible number of switched links which will require the repetition of the address information and, therefore, still further increase the post-dialling delay;

e) that the probability of switching-machine errors tends to increase with the number of digits transmitted;

f) that the use of 1-, 2- and 3-digit country codes introduces difficulties in locating the position of the language and discriminating digits.

Note. — The use of line signals might be considered in the solution of this problem. It is to be noted that, in the case of the new C.C.I.T.T. signalling system No. 6, it may be possible to provide additional line signals with relative ease. Furthermore, it is contemplated that these line signals may be transmitted over separate high-speed facilities using data-link techniques.

Question 3/XIII — Language difficulties in the semi-automatic international telephone service

(new question)

(is also Question 13/II)

Does experience with semi-automatic service reveal a need for any changes in operating methods to reduce difficulties arising from language difference? Would such changes require any modification of semi-automatic operating facilities, such as the forward transfer signal, which might entail alterations in C.C.I.T.T. signalling systems?

Notes:

1. It would be interesting to have information, obtained from service observations for example, about the type of difficulty encountered, the class of call and the relations on which it arises, and the proportion of calls seriously hindered by an unsuccessful first attempt.
2. The answer might indicate the extent to which the caller is allowed to identify the called subscriber, as envisaged in Recommendation E.55 *bis.*
3. This question should be studied first by Study Group II.

Question 4/XIII — Physical features of push-button telephone sets

(new question)

(is also Question 10/XI)

Considering

that efforts have been made to have dials arranged according to uniform principles all over the world (see Recommendation Q.11);

that the need for uniformity in the operation of telephone sets by subscribers is increasing with increased international travel and communications;

that a partial conversion to push-button sets must be expected in the immediate future in a number of countries; and finally

that uniformity is best achieved by having a recommendation at the earliest possible time;

What Recommendations can be adopted regarding:

a) the number of push-buttons on a telephone set;

b) the geometric arrangement of the push-buttons;

c) the symbols used on the push-buttons; and

d) the allocation of these symbols to the push-buttons?

(Question 4/XIII)

Question 5/XIII — Effect of the leasing or purchase of a telephone circuit on the world routing plan

(new question)

What limitations, if any, in the optimum economic pattern of traffic routing are likely to result from the growing practice of terminal Administrations, jointly or severally, to buy or rent transit circuits rather than pay transit rates for the use of such circuits?

Question 6/XIII — Effect of satellite communications on the world routing plan

(new question)

How should the principles of the world routing plan be modified to take into account the arrival of satellite communications?

Note. — Transit centres of CT1 status are in general located at the focus of wideband submarine and transcontinental transmission systems. When satellite earth stations are established in other countries it will be necessary to consider whether new CT1's should be appointed in those countries, either in addition to or instead of CT1's already chosen: This will be a matter for the Plan Committee. The present question is concerned rather with any change in routing plan principles that may be necessary in such circumstances.

Question 7/XIII — Determination of the source of congestion

(new question)

Is it desirable to have a way of discriminating, at the outgoing exchange, between cases where there is a congestion at the output of a transit exchange and those where there is a congestion at the input (common equipment) of the following exchange (incoming exchange or second transit exchange) and, if so, can specifications of systems No. 4 and No. 5 be modified to that end?

Question 8/XIII — Flexibility in the world telephone routing plan

(new question)

Considering

that, especially for very long and expensive circuits, a high traffic utilization is important;

that such high utilization might be prevented if the routing plan were too rigid;

that advantage should be taken of the non-coincidence of busy traffic periods arising from the significant differences in time that are particularly evident on intercontinental circuit groups;

that special arrangements may be justified to meet emergency conditions;

What extension is desirable in the existing recommendations on the world routing plan?

(Question 8/XIII)

ANNEX

(to Question 8/XIII)

In the study of this question, at least three interrelated possibilities are seen to warrant particular study:

1. The status of a transit centre (CT) would depend on the traffic stream being handled

Thus:

a) If a CT3 has a low-loss probability group of circuits direct to its home CT1, or to another CT1, may it be regarded as a CT2 in the CT1 zone concerned, serving other CT3's directly connected to it with a low-loss probability group, for both outward and inward traffic?

Example: Brussels CT3 has a low-loss probability group of circuits to both Luxembourg CT3 and London CT1; may calls between, say, North America and Luxembourg be routed via London and Brussels, as if Brussels were a CT2?

b) If a CT2 has a low-loss probability group of circuits direct to a CT1 in another zone, may it be regarded as a second CT1 in its own zone, serving that for traffic to and from and through the other zone?

Example: Paris CT2 has a low-loss probability group of circuits to both New York CT1 and Madrid CT2; may calls to and from Madrid be routed via New York and Paris, as if Paris were a CT1?

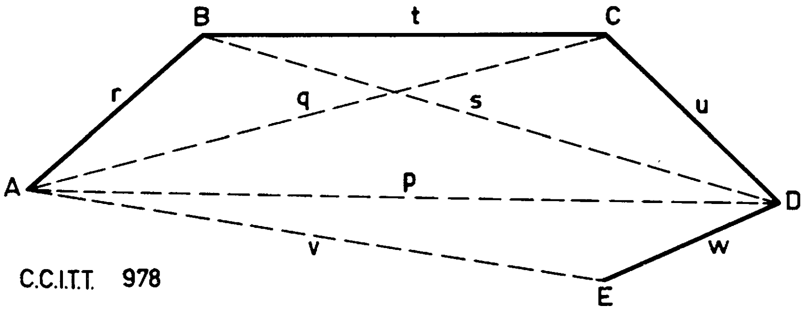
2. Change in routing pattern according to the time of the day

May such changes in CT status be made temporarily, by making use of the fact that outside the busy hours a high-usage group may have adequate capacity without overflow?

3. Change in routing pattern according to instantaneous traffic loading

May departures from the strict order of routing from a CT be permitted for a particular call, in the light of data supplied to, or available in, the CT in regard to the instantaneous traffic load, or equivalent grade of service, over all available alternatives? In other words, may a routing be sought by parallel assessment of loss probability before search for free circuits, instead of by sequential search?

Example. —



Instantaneous grade of service (probability of loss) over the various links is p, q, r, s, t, u, v, w. The choice of routes and of their " through " grade of service is then:

AD: p;
ACD: $1 - (1 - q)\ (1 - u)$; etc.

The route to be chosen would depend on the instantaneous loading factor of the different circuit groups, provided it was a legitimate routing in other respects.

Question 9/XIII — Protection of service quality when there is a sudden surge of terminal traffic overflowing into a transit route and vice versa

(new question)

What precautions should be taken to safeguard transit and terminal traffic between two international transit centres against the degradation of services that might otherwise be suffered by one of these components in the event of a surge of traffic being offered to the other?

Note. — It has to be considered whether in the first place both terminal and transit traffic between two CT1's or CT2's, or between a CT1 and a dependent CT2, may overflow on to a common group of circuits. If so, it may be necessary to control the access, or limit the amount of overflow from each source, in such a way as to safeguard the grade of service given on both terminal and transit service.

Question 10/XIII — Number of circuits to be included in a high-usage route

(new question)

How should the number of circuits to be provided on a high-usage group in the world routing plan (Recommendation E.15, Volume II of the *Blue Book*) be determined?

Note. — The two alternative methods advocated in Recommendation E.93 *bis* (Volume II of the *Blue Book*) are theoretically sound, but would have to be systematically applied to the world switching network in which traffic overflowing from one high-usage group could be routed over a series of several routes in tandem, on each of which provision for such overflow traffic would have to be made; some of the overflow groups may themselves be high-usage groups. A simpler approximate method may be sufficient, at least during the earlier stages of implementing the routing plan. A procedure based on some predetermined proportion of traffic overflowing from the high-usage group might perhaps be adequate during the initial stages of implementing the routing plan. Such a procedure would avoid the need for economic calculations (see the notes on pages 148 and 150 of Volume II *bis* of the *Red Book*) to determine the precise optimum number of the high-usage circuits. Some factor would have to be applied to allow for the "peaky" incidence of the overflow traffic, but the calculations, as indicated in E.93 *bis*, are no more burdensome than the collection of traffic data for the different busy hours and seasons of the various circuit groups.

Question 11/XIII — Acceptable reduction in the number of circuits in the event of a breakdown

(new question)

What is the maximum proportionate reduction that can be suffered on a final route in the world routing plan (Recommendation E.15, Volume II of the *Blue Book*) in the event of a breakdown in a wideband transmission system while still enabling an acceptable automatic service to be maintained; and how can a greater reduction be avoided in practice?

Note 1. — A breakdown affecting circuits on a final route would have a widespread effect, since in principle such a route governs the grade of service on all high-usage routes that depend (overflow) on it. Experience in national services should be a good guide to what subscribers will endure in the international automatic service during temporary breakdowns without complaint or excessive recourse to the manual service.

Note 2. — There are various ways in which the effect of a breakdown can be minimized: before the event, by dispersal of circuits over all available media; after the event, by increasing TASI output, altering the routing of transit traffic, opening H.F. radio circuits for manual traffic, patching circuits borrowed from unaffected routes, etc. When all such expedients are taken into account the question still remains whether the available number of circuits will be sufficient to avoid excessive congestion, which might spread to other routes over which attempts would be made to secure a free circuit on the affected final routes.

Note 3. — If the diversion of traffic were to be adopted as a major means of relieving the affected routes it might be desirable to have the facility of continuous traffic measurement on both the affected and the relieving routes and, when signalling system No. 6 is available, of remotely controlling the amount of traffic diverted: this is the subject of Questions 12/XIII and 16/XIII (relating to Recommendation E.97, Volume II of the *Blue Book*) and 1/XI (on the design of signalling system No. 6).

Question 12/XIII — Use of automatic traffic-measuring apparatus for modifying routings

(new question)

Considering

that it is expected that equipment for measuring traffic is likely to become more and more automatic;

that such equipment is likely to be in day-to-day operation;

that such equipment will incorporate a 24-hour clock;

Is it desirable to use such equipment to provide information for modifying routings? If so, in what form should these facilities be provided?

(Question 12/XIII)

Note 1. — This question should be studied with respect to time differences throughout the world as well as to traffic variations even for short periods.

Note 2. — Annexes 1 and 2 below reproduce the contributions which the Administrations of the United Kingdom and Australia submitted to Study Group XIII in 1963 concerning the influence of differences in local time on traffic.

ANNEX 1

(to Question 12/XIII)

THE UNITED KINGDOM ADMINISTRATION

World routing plan—Patching of circuits on long intercontinental routes

1. The world routing plan envisages that the overflow traffic in peak periods would finally pass to the CT1 network. This CT1 network would be global in range but, carrying in principle only this overflow traffic, would be a comparatively small network and lightly loaded to ensure the standard grade of service. Furthermore the natural " peakiness " of the overflow traffic would be accentuated on the longest east-west routes where the differences between the local times at the two ends reduce but do not eliminate the period of the day when traffic can be passed conveniently.

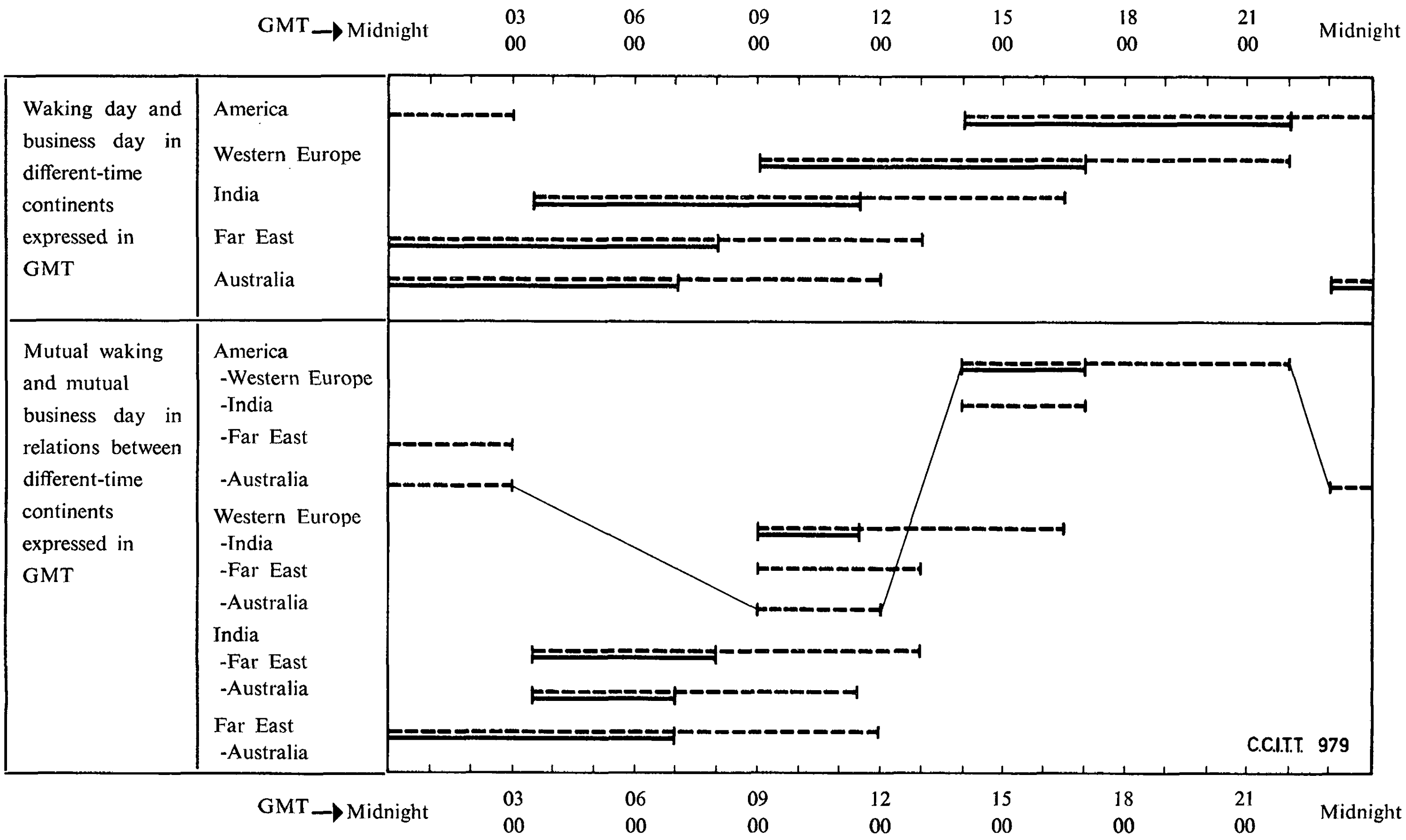
2. It has already been suggested that the high cost of handling final choice traffic over the CT1 network would need to be recognized by the application of special accounting rates. Such a need emphasizes the importance of seeking the most efficient means of exploiting expensive plant.

3. A promising method of improving circuit exploitation presents itself in relations between countries of widely different longitude: advantage might be taken of the distribution round the clock of the heavy traffic periods of the day. The situation is illustrated by the annexed diagram and the Western Europe–Australia relation is a good example. Virtually the whole of the Western Europe–Australia traffic will be carried between the hours of 0900 and 1200 GMT. Outside these hours the subscribers at one end or the other will not be available to make or to receive calls conveniently owing to the local time of day (i.e. before 9 a.m. or after 10 p.m. local time at one end or the other). There is no coincident business period whatever in this relation. It can therefore be expected that, however traffic develops, it will be concentrated to a large extent within a sharply defined peak period lasting only three hours in every 24 and that circuits provided at great expense to carry this traffic alone with a small probability of loss would be very little used during the remaining 21 hours.

4. Any tariff adjustments to effect a spread of traffic over a longer period of the day can have only limited success since business customers will scarcely be willing to make or receive calls during the night. It will therefore not be possible to spread much of the traffic over a longer period. It may be possible, however, to utilize the circuits in intermediate relations during the light traffic

Diagram showing coincidence of waking and business hours in certain intercontinental relations

(For illustrative purposes only)



" Waking " day (0900 – 2200 local time) - - - - - - -   " Business " day (0900 – 1700 local time) ________ periods by patching or by itranst switching. The horizontal lines in the diagram opposite representing the Western Europe–Australia, the Western Europe–America and the America–Australia relations have been linked by oblique lines to show that there is no coincidence in their mutual waking days. A group of channels could therefore be employed in tandem or separately as follows:

a) Western Europe–America: 1400 to 2200 GMT

b) America–Australia: 2300 to 0300 GMT

c) Western Europe–Australia: 0900 to 1200 GMT

The channels used to provide Western Europe to Australia circuits from 0900 to 1200 GMT could be terminated in America during the remainder of the 24 hours of the day to give circuits between Western Europe and America from 1400 to 2200 GMT and from America to Australia from 2300 to 0300 GMT. Other long relations could be similarly treated. Traffic fluctuation even within the mutual waking day might well afford a further opportunity of circuit economy by transit switching.

5. It is considered that a CT1 network of permanent circuits as envisaged in the draft plan would be cheapened by making up the long intercontinental routes between CT1's with patched sections. There would of course be some patching costs and possibly some transmission problems both of which need to be studied for the sake of increased efficiency in exploitation.

6. There need be no effective increase in the number of links in any connection since the division of the long channels at patching centres will be made only during the light traffic periods when the transverse (high-usage) routes are capable of carrying the whole of the traffic.

ANNEX 2

(to Question 12/XIII)

THE AUSTRALIAN ADMINISTRATION

Effects of the time differences on world routing plan principles

Although proceeding with the development of the fixed hierarchical routing plan to the stage of tentatively applying it to the world system at the 1962 meetings in Montreal, Study Group XIII has indicated that the possibility of capitalizing on the traffic effects of the time differences between countries warrants further study.

This Annex contains an estimate of these effects viewed from the Asian Region and some conclusions are drawn on methods of developing the routing plan to capitalize on them.

Basis of the study

The study was carried out in the following steps:

i) traffic between countries in the Asian Region was estimated for 1975;

ii) feasible distributions of traffic of daily traffic throughout the 24 hours were estimated for all possible time differences, in hourly steps, between countries;

iii) alternative routing plans were applied to handle the point-to-point traffic estimated from i) and ii). The traffic which would flow on each of the links in these networks was calculated for each hour of the day and the number of circuits and approximate circuit miles were assessed to compare the effectiveness of the plans;

iv) conclusions were drawn on features which appear desirable in the future world routing plan.

Estimates of traffic from countries in the Asian Region

The study was made for 1975, at which date it was considered reasonable to assume a fair degree of semi-automatic operation and some automatic operation in the world system.

Estimates of traffic for 1968 which were assembled by the meeting of the Plan Sub-Committee for Asia in Geneva during February 1963 were used as a basis for the 1975 estimates. The traffic between Europe and North America was estimated separately. The magnitude of this latter estimate is not critical in this study, which is primarily concerned with the location of peaks in the daily distribution of the traffic and their relationship to the peaks of traffic between Asia and Europe.

These 1975 estimates in minutes per day are contained in Appendix 1.

Daily traffic distributions

It was assumed in estimating the daily traffic distributions that by 1975 sufficient circuits would be available on all routes for on-demand operation and that as a result the traffic between two countries would be concentrated into the periods of greatest mutual convenience with the busy hour being the hour most convenient to both countries.

The traffic distributions estimated for the thirteen possible hourly time differences are shown in Appendix 2. In the case of countries in the same time zone (i.e. coincidence of time) a daily traffic pattern similar to that experienced within a national system was assumed. In the other cases, the magnitudes of the traffic peaks were related to the degree of concentration which occurred with the various time differences. The approximate busy-hour to day-traffic ratios estimated were:

Coincidence	1/9	4-hour difference	1/5	8-hour difference	1/5
1-hour difference	1/8	5-hour difference	1/6	9-hour difference	1/5
2-hour difference	1/7	6-hour difference	1/5	10-hour difference	1/5
3-hour difference	1/7	7-hour difference	1/5	11-hour difference	1/6
				12-hour difference	1/7

The daily traffic distributions of Appendix 2 are estimates only as no data are yet available for international traffic between countries separated by several time zones, which has been handled on a demand basis for any appreciable time. The percentages allotted to the various hours will therefore undoubtedly vary although the location of the peaks should be reasonably accurate. The distributions will be distorted in practice by such things as differing national customs, daylight saving, concessional tariff schemes and data transmission demands. However, it is considered that the assumptions are sufficiently realistic to show the nature of the effects inherent in a world-wide system.

Alternative networks to carry the estimated traffic

In order to get a measure of the advantage to be gained by capitalizing on these traffic effects, two alternative networks were dimensioned to cater for the estimated traffic. The first network corresponds approximately to the one which resulted from the tentative application at Montreal of the current Study Group XIII routing plan principles. The second is one which makes greater use of transit switching to capitalize on obvious non-coincidence of traffic peaks. The networks are shown in Appendix 3.

The traffic that would be carried on each of the links in these networks during each hour of day (using Greenwich Mean Time as the reference) was calculated using the estimated traffic shown in Appendix 1 and estimated traffic distributions shown in Appendix 2. The results are shown in Appendix 4.

The circuit quantities required to carry this traffic at a grade of service of $^1/_{50}$ on each final link are shown in Table 1.

TABLE 1

Route	Approx. length (naut. miles)	Network 1			Network 2		
		Peak traffic	Number of circuits	Circuit miles	Peak traffic	Number of circuits	Circuit miles
Indonesia-Singapore	600	6.3	12	7 200	6.3	12	7 200
India- „	2 500	3.5	8	20 000	8.0	14	35 000
Thailand- „	800	7.1	13	10 400	7.1	13	10 400
Hong Kong- „	1 400	5.3	10	14 000	13.5	21	29 400
Japan- „	3 000	2.0	5	15 000	—	—	—
Australia- „	2 500	6.3	12	30 000	13.8	21	52 500
„ -New Zealand	1 200	20.9	29	34 800	20.9	29	34 800
„ -India	6 000	5.3	11	66 000	—	—	—
„ -Hong Kong	4 000	10.1	17	68 000	—	—	—
„ -Philippines	3 800	2.3	4	15 200	—	—	—
„ -Japan	4 300	3.5	8	34 400	—	—	—
„ -North America	8 000	27.1	36	288 000	31.9	41	328 000
„ -Europe	13 000	27.3	36	468 000	—	—	—
Hong Kong-Japan	1 500	13.4	21	31 500	16.0	24	36 000
Philippines- „	1 700	3.6	8	13 600	6.1	12	20 400
China- „	1 500	12.9	20	30 000	12.9	20	30 000
Korea- „	200	21.5	30	6 000	21.5	30	6 000
Europe- „	10 000	4.7	10	100 000	—	—	—
North America- „	5 500	66.7	78	429 000	71.3	83	456 500
Philippines-North America	7 000	11.4	18	126 000	11.2	18	126 000
	Totals for the Asian area		386	1 807 000		338	1 172 000
Europe-North America	3 000	385.0	424	1 272 000	389.0	429	1 287 000

It will be seen that, based on the assumptions of this study, Network 2 is the more efficient considering the Asian Region alone.

Network 1 requires 386 circuits and 1 807 000 circuit miles.

Network 2 requires 338 circuits and 1 172 000 circuit miles.

A saving in circuit miles of approximately 30% is obtained for the Asian Region and only marginal increase is required in trans-Atlantic circuits.

It is not suggested that this is the best network which could be selected to handle the Asian traffic even if the time difference effects have been accurately estimated. It is simply intended to show that gains are to be made from these effects and that the routing plan principles must be flexible enough to permit them to be taken.

Other possible situations where economies in circuits can be made can be seen by examining the traffic patterns occurring on the links, as calculated in Appendix 4, in the light of the routing of intercontinental facilities. For example the arrangement of the circuits between Australia and New Zealand is considered on the basis of the estimated traffic. The COMPAC cable is to carry both the Australia-New Zealand traffic and the traffic between Australia and North America and Europe. Under the trunking of Network 2 a total of 70 circuits would be required on the Australia-New Zealand section of this cable. If the trunking were changed so that all traffic from Australia to North America and Europe is transit-switched in New Zealand the estimated traffic could be carried with 57 circuits. The savings come jointly from effects of non-coincidence of busy hours and from the greater efficiency of the larger group. Similar savings should be possible from switching at centres of interest on long submarine cables particularly where their routing is in an East-West direction.

In practice advantage will be gained by applying alternate routing in these situations. Direct circuits, with transmission advantages of less demodulation and switching points, and perhaps wider bandwidth, may be used being more economical and the remaining traffic transit switched.

Conclusions

It is considered that this study gives reasonable evidence that additional transit switching and scheduled patching of circuits will provide significant economies in the future world system. Conditions will also prevail for the effective application of a network management concept to cater for emergencies due to the failure of plant or to unusual traffic demands in certain sectors of the system.

The second network shown in this study has only capitalized on the situations where clear-cut effects appear. In practice, when traffic measurements are possible, advantage will be able to be taken of traffic effects of a less important nature arising from non-coincidence of daylight hours.

It is considered that the routing plan principles finally adopted must be sufficiently flexible to enable advantage to be taken of these effects wherever they arise. This implies a minimum of rigid constraints on the routing of calls. Further investigation on the routing plan principles is required, along the following lines:

i) investigation and specification of the maximum number of links which may be interconnected in order to prescribe an upper bound to the extent of transit switching. The recent statement by the Chairman of Study Group XVI on the transmission limitation on the number of links indicates that transit switching is practicable to a greater extent than envisaged in the current routing plan. This upper bound will vary with the state of the art of transmission system design and will therefore be subject to review;

ii) investigation of means of controlling the routing of calls to avoid repeated routing over the same link other than by the routing rules at present proposed. If it is desired to do this through the signalling system this would be a factor which would need to be specified for the Study Group XI study of a new intercontinental signalling system.

Transit switching should be permissible wherever economic advantages can be obtained regardless of the status of the intermediate centre, so long as the transmission limits on the number of links which may be connected in tandem are not exceeded for the call being established;

iii) network management methods will need to be examined;

iv) traffic data should be gathered wherever adequate international facilities are provided to enable the effects of non-coincidence of daylight hours to be fully investigated.

APPENDIX 1

Both-way traffic in 1975 (minutes/day)

1975	Australia +10	China +8	Korea +8	Hong Kong +8	India +5	Indonesia +7	Japan +9	Malaya +7	New Zealand +12	Pakistan +5	Philippines +8	Thailand +7	North America Time Zone –5	North America Time Zone –6	North America Time Zone –8	Europe Time Zone 0	Europe Time Zone +1
Australia +10		0	0	475	208*	64	663	293	8011	144	24	31	3630	2178	1452	4984	748
China +8			36	2208	0	0	3264	0	0	36	56	0	404	242	162	9	9
Korea +8				312	0	0	6816	0	0	0	0	0	1360	816	544	0	0
Hong Kong +8					130	400	4472	1640	20	24	1344	1088	1204	723	482	370	54
India +5						60	424	370	0	0	0	0	696	418	278	2480	1032
Indonesia +7							704	1224	0	0	0	628	53	32	21	37	200
Japan +9								224	0	128	1744	616	10168	6111	4067	608	928
Malaya +7									0	620	0	1000	171	102	68	1050	408
New Zealand +12										0	0	0	522	313	209	850	122

APPENDIX 1 (continued)

1975	Australia +10	China +8	Korea +8	Hong Kong +8	India +5	Indonesia +7	Japan +9	Malaya +7	New Zealand +12	Pakistan +5	Philippines +8	Thailand +7	North America Time Zone –5	North America Time Zone –6	North America Time Zone –8	Europe Time Zone 0	Europe Time Zone +1
Pakistan +5											0	200	160	96	64	1236	648
Philippines +8												0	2105	1263	826	0	0
Thailand +7													27	15	11	0	0
North America East Coast –5														0	0	36000	36000
North America Central –6															0	21600	21600
North America West Coast –8																14400	14400
Europe (0 T. Zone) 0																	
Europe (+1 T. Zone) +1																	

* Includes traffic to Ceylan.

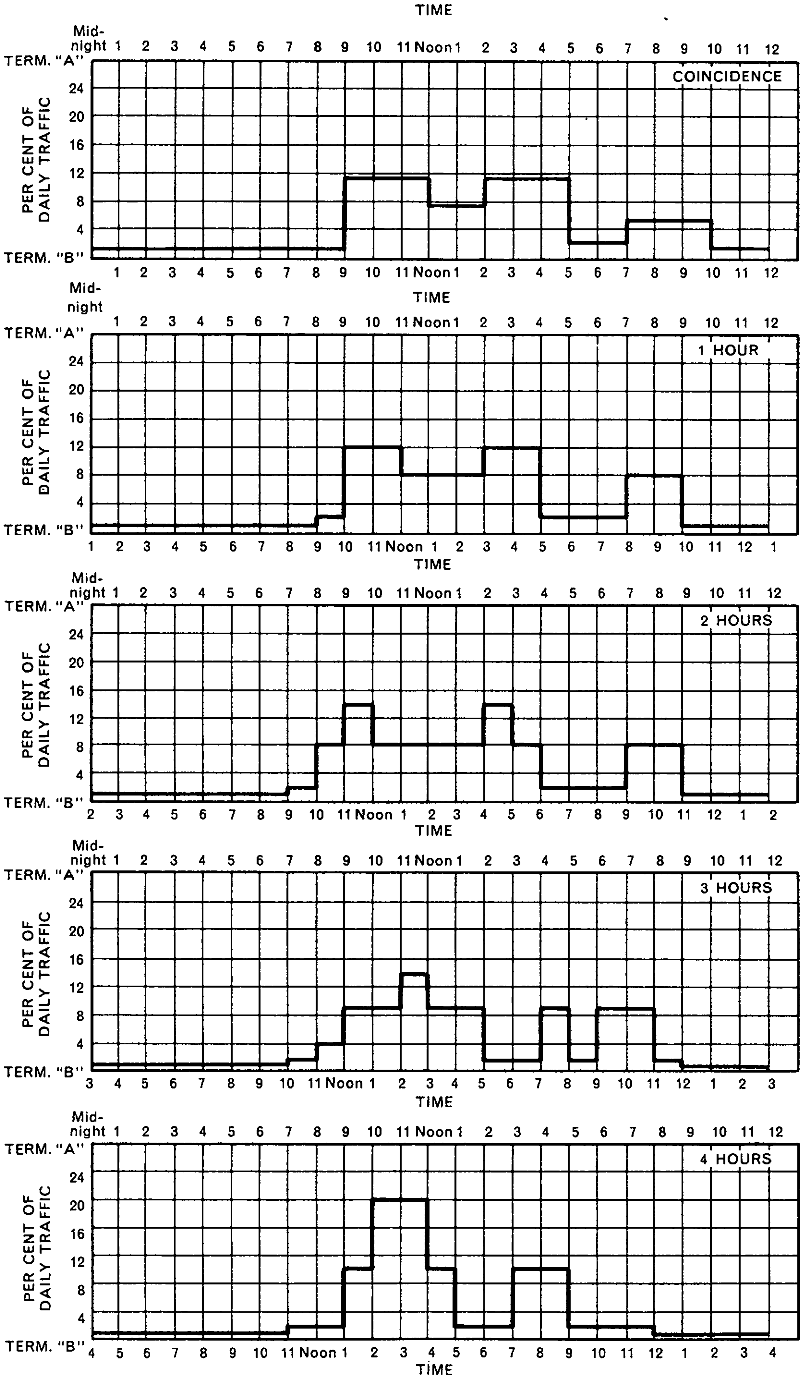
Notes:

1) Australian traffic as in Plan Contribution for Rome Meeting November 1963. Other traffic based on figures produced at the Plan Asia Meeting February 1963.

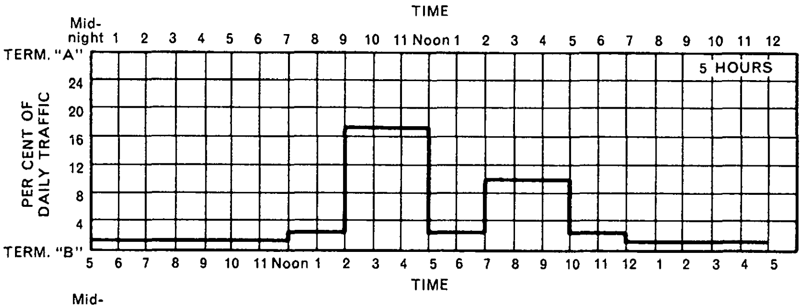
2) Traffic between America and Europe estimated.

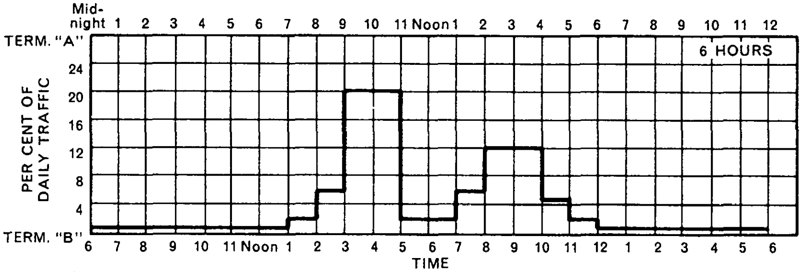
APPENDIX 2

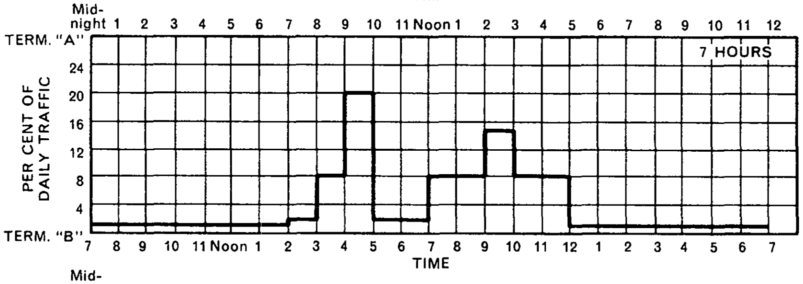
Estimated daily traffic distributions where time differences exist between terminals

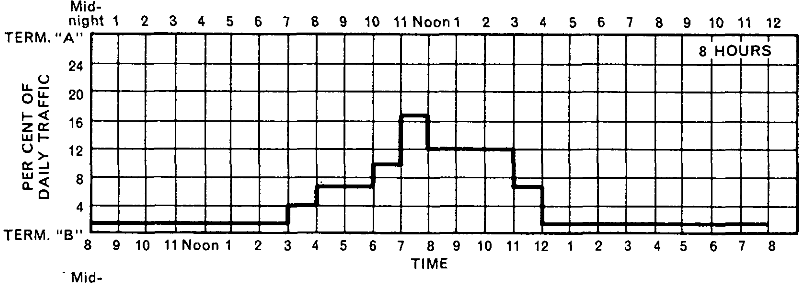


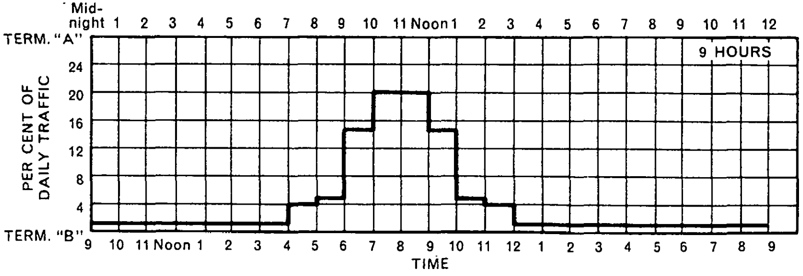
APPENDIX 2 (continued)



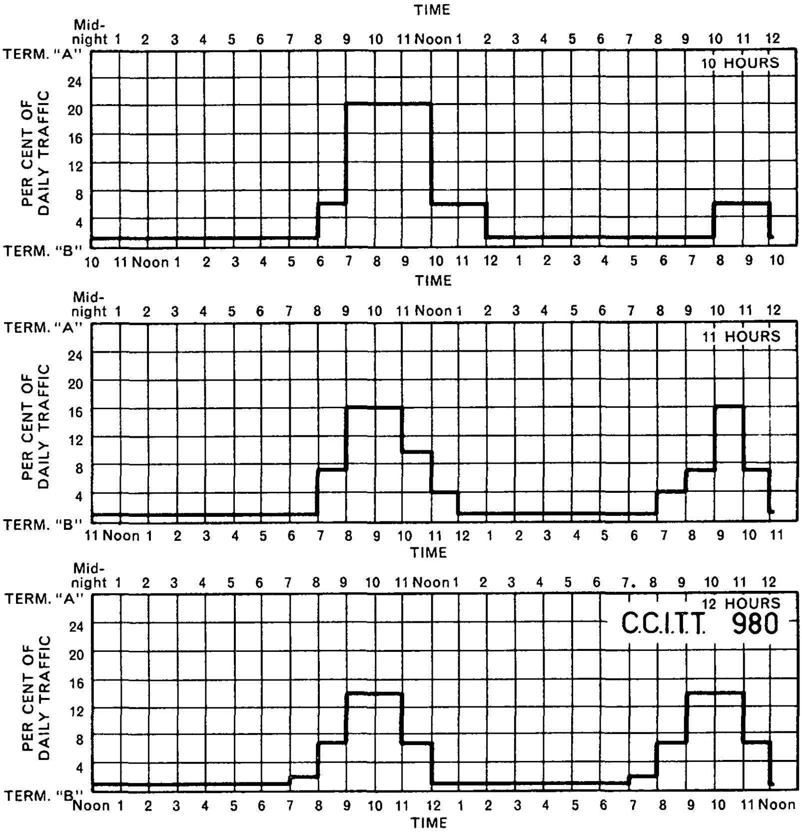








APPENDIX 2 (concluded)



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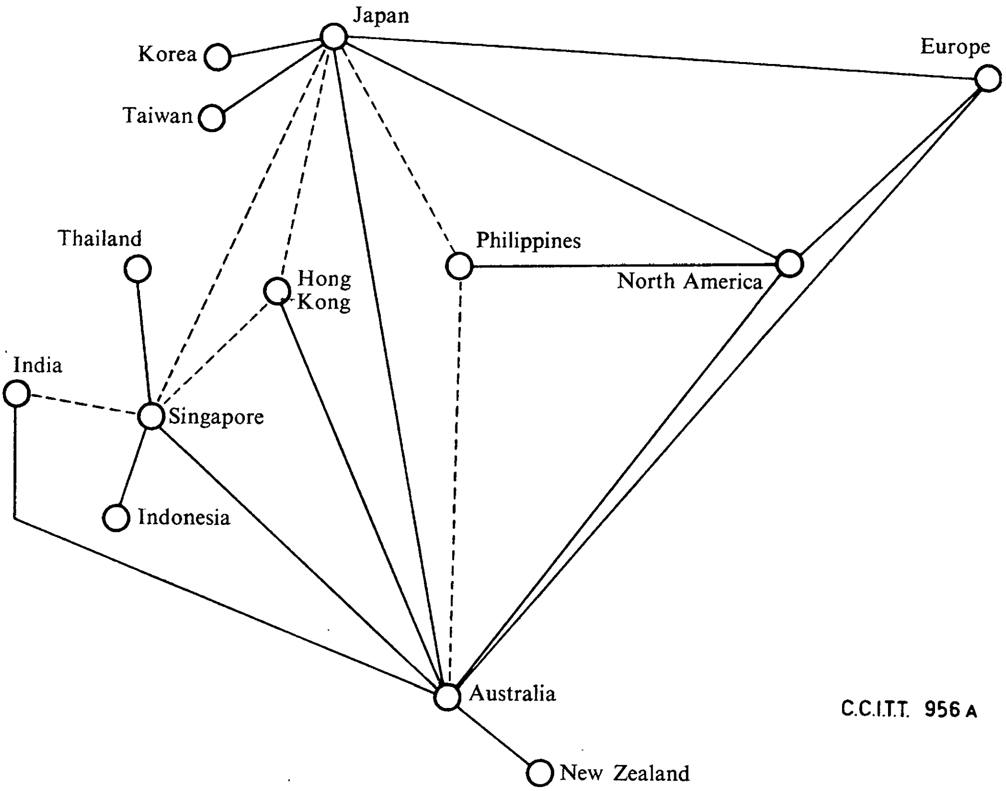
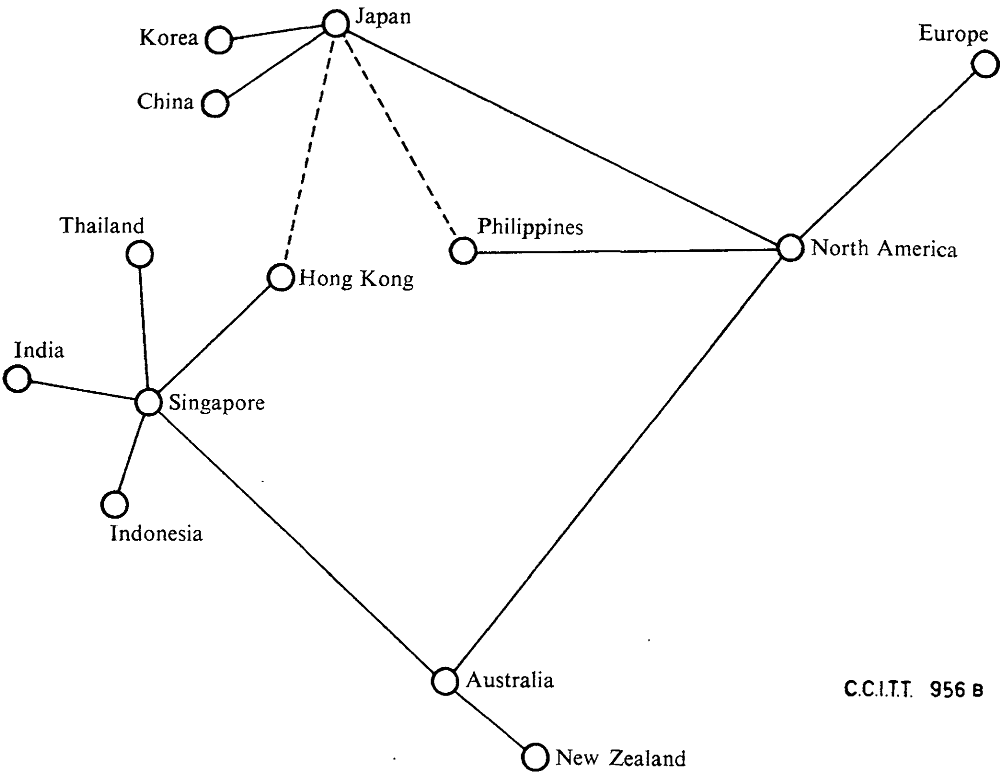
APPENDIX 3



NETWORK 1. — **Approximately the tentative network for Asia contained in contribution COM XIII—No. 65**

APPENDIX 3 (continued)



Note. — Pakistan–Europe } Traffic not routed via these networks
India–Europe

NETWORK 2. — **Additional transit switching**

APPENDIX 4

Traffic in 1975 in erlangs on each link for each of the 24 hours of the day

See note

NETWORK 1

Calculation of international link loads

1. Indonesia-Singapore

GMT

hour 01	.7	1.6	6.3	5.6	5.4	3.9	hour 06
„ 07	3.9	6.2	6.0	4.8	1.2	1.2	„ 12
„ 13	2.7	3.6	2.4	1.0	.7	.6	„ 18
„ 19	.6	.6	.6	.6	.6	.6	„ 24

2. Thailand-Singapore

.7	1.6	6.9	6.5	6.1	5.0
4.9	7.1	6.3	4.1	1.6	1.4
3.2	3.8	1.8	1.0	.7	.6
.6	.6	.6	.6	.6	.6

3. India-Singapore

.3	.3	1.2	2.5	3.5	2.2
2.2	2.5	2.5	3.1	1.8	.6
1.0	1.0	.5	1.7	.3	.3
.3	.3	.3	.3	.3	.3

4. Singapore-Hong Kong

.5	.9	5.3	5.3	3.6	3.6
3.6	5.3	5.3	.9	.9	.9
3.6	3.6	.5	.5	.5	.5
.5	.5	.5	.5	.5	.5

5. Singapore-Japan

.5	2.1	2.0	2.1	2.1	2.1
2.1	2.0	2.1	.5	.5	.5
.5	2.1	.3	.3	.3	.3
.3	.3	.3	.3	.3	.3

6. Singapore-Australia

.6	1.1	3.9	2.2	2.1	1.3
1.1	3.0	3.7	6.3	1.1	1.6
2.8	3.2	4.8	3.1	2.2	.4
.4	.4	.4	.4	.4	.4

Note. — Traffic on each link for each of the 24 hours of the day is shown above. The figures are assembled in four rows for each link, and commence from hour 01 and read from left to right, as shown for link 1.

APPENDIX 4 (continued)

7. Hong Kong-Australia

3.7	10.1	10.1	9.1	5.0	4.4
5.5	4.8	3.9	1.5	1.7	3.0
3.6	3.9	5.4	3.1	.8	.8
.8	.8	.8	.8	.8	1.1

8. Hong Kong-Japan

1.9	13.4	13.4	10.6	8.9	8.9
13.4	13.4	6.1	2.3	2.3	8.1
8.1	2.8	1.2	1.2	1.2	1.2
1.2	1.2	1.2	1.2	1.2	1.2

9. Australia-Japan

1.4	1.6	2.9	1.1	1.9	3.2
3.5	3.0	.5	.4	1.8	1.9
.3	.3	.3	.2	.2	.2
.2	.2	.2	.2	.2	.2

10. Philippines-Australia

.3	2.3	2.3	2.3	1.6	1.6
2.3	2.3	2.3	.5	.5	1.1
1.2	1.1	.2	.2	.2	.2
.2	.2	.2	.2	.2	.2

11. Australia-New Zealand

12.0	12.0	12.9	12.6	20.2	11.1
3.1	3.3	4.2	5.2	13.1	2.6
1.7	1.7	1.7	1.7	1.7	1.7
1.7	2.1	3.6	8.1	14.9	20.9

12. Australia-Europe

1.5	1.5	1.5	1.5	1.5	1.5
1.9	3.1	12.2	27.3	22.6	21.2
8.5	9.2	5.7	2.5	2.6	1.4
1.3	1.7	2.4	3.6	7.6	6.5

13. Australia-North America

24.9	27.1	24.3	19.6	17.5	10.2
5.1	3.3	2.3	2.2	2.2	2.2
2.8	4.4	9.7	9.0	6.9	4.5
3.5	2.3	3.1	8.3	9.9	18.6

14. Philippines-Japan

.6	3.6	3.6	2.4	2.4	2.4
3.6	3.6	.7	.6	.6	2.4
2.4	.3	.3	.3	.3	.3
.3	.3	.3	.3	.3	.3

APPENDIX 4 (continued)

15. **Japan-North America**

66.7	66.0	66.4	39.3	24.3	18.7
10.0	9.4	4.0	4.0	4.0	4.0
4.9	14.2	17.7	6.6	4.0	4.0
4.0	4.0	4.0	4.0	7.7	21.6

16. **Japan-Europe**

.3	.3	.3	.3	.3	.3
.7	1.5	1.6	3.1	4.7	3.9
3.4	2.4	1.5	.3	.3	.3
.3	.3	.3	.3	.3	.3

17. **Korea-Japan**

5.4	21.3	21.5	16.3	12.3	11.6
15.7	15.3	3.4	2.8	2.8	9.8
10.5	3.2	5.7	3.7	1.7	1.7
1.7	1.7	1.7	1.7	1.7	1.9

18. **China-Japan**

2.4	12.8	12.9	10.5	7.9	7.7
11.3	11.1	5.5	2.0	2.0	6.5
6.6	3.1	2.4	1.7	1.1	1.1
1.1	1.1	1.1	1.1	1.1	1.2

19. **North America-Europe**

24.0	24.0	24.0	24.0	24.0	24.0
24.0	24.0	24.0	24.0	24.0	24.0
36.0	67.2	277.2	385.2	229.2	98.4
156.0	271.2	294.0	208.8	112.8	48.0

20. **Philippines-North America**

4.7	11.0	11.4	10.2	4.3	3.3
2.4	1.7	.7	.7	.7	.7
1.8	2.8	7.0	3.9	.7	.7
.7	.7	.7	.7	.7	1.1

21. **India-Australia**

.5	.5	0.9	2.3	5.3	4.8
4.1	1.7	0.8	0.9	1.6	1.8
0.6	1.6	3.9	3.5	4.5	2.8
1.6	0.5	0.5	0.5	0.5	0.5

APPENDIX 4 (continued)

NETWORK 2

Calculation of international link loads

1. **Indonesia-Singapore**

GMT							
hour/ 01	.7	1.6	6.3	5.6	5.4	3.9	hour 06
„ 07	3.9	6.2	6.0	4.8	1.2	1.2	„ 12
„ 13	2.7	3.6	2.4	1.0	.7	.6	„ 18
„ 19	.6	.6	.6	.6	.6	.6	„ 24

2. **India-Singapore**

.7	.7	1.3	3.9	8.0	6.0
5.3	3.2	2.5	4.0	3.3	2.3
1.0	2.0	4.4	6.3	5.0	3.0
2.0	.7	.7	.7	.7	.7

3. **Thailand-Singapore**

.7	1.6	6.9	6.5	6.1	5.0
4.9	7.1	6.3	4.1	1.6	1.4
3.2	3.8	1.8	1.0	.7	.6
.6	.6	.6	.6	.6	.6

4. **Singapore-Hong Kong**

3.9	8.5	13.5	12.9	7.6	7.0
7.0	8.4	7.7	2.1	2.3	3.0
6.7	7.0	5.7	3.4	1.1	1.1
1.1	1.1	1.1	1.1	1.1	1.4

5. **Singapore-Australia**

4.9	11.0	13.8	13.0	12.5	10.5
9.4	8.3	7.6	8.9	4.7	5.6
6.3	9.2	13.7	10.8	7.8	4.0
3.0	1.7	1.7	1.7	1.7	2.0

6. **Australia-New Zealand**

12.0	12.0	12.9	12.6	20.2	11.1
3.0	3.3	4.2	5.2	13.0	2.6
1.7	1.7	1.7	1.7	1.7	1.7
1.7	2.1	3.5	8.1	14.9	20.9

7. **Australia-North America**

28.3	31.9	30.3	24.1	23.0	17.0
12.2	11.1	16.9	30.6	27.4	26.1
12.3	16.0	16.2	13.2	10.2	6.4
5.4	4.5	6.0	12.3	17.9	25.7

APPENDIX 4 (concluded)

8. Philippines-North America

4.7	10.8	11.2	10.1	4.4	3.3
2.3	1.6	.7	.7	.7	.7
1.8	2.8	7.0	3.9	.7	.7
.7	.7	.7	.7	.7	1.1

9. Philippines-Japan

.8	6.1	6.1	4.9	4.0	4.0
6.1	6.1	3.1	1.0	1.0	3.5
3.5	1.5	.5	.5	.5	.5
.5	.5	.5	.5	.5	.5

10. North America-Europe

25.7	25.7	25.7	25.7	25.7	25.7
26.7	28.7	37.9	54.6	51.6	49.5
48.0	78.7	284.6	389.2	232.3	100.1
157.7	273.1	296.7	212.7	120.6	54.7

11. Japan-North America

68.9	69.8	71.3	42.7	28.5	24.2
16.1	15.7	8.1	8.0	11.0	10.3
9.1	19.0	19.9	7.4	4.7	4.7
4.7	4.7	4.7	4.7	8.4	22.5

12. China-Japan

2.4	12.8	12.9	10.5	7.9	7.7
11.3	11.1	5.5	2.0	2.0	6.5
6.6	3.1	2.4	1.7	1.1	1.1
1.1	1.1	1.1	1.1	1.1	1.2

13. Korea-Japan

5.4	21.3	21.5	16.3	12.3	11.6
15.7	15.3	3.4	2.8	2.8	9.8
10.5	3.2	5.7	3.7	1.6	1.6
1.6	1.6	1.6	1.6	1.6	1.9

14. Hong Kong-Japan

2.1	16.0	16.0	13.0	10.5	10.5
16.0	16.0	8.6	2.8	2.8	9.2
9.2	4.0	1.4	1.4	1.4	1.4
1.4	1.4	1.4	1.4	1.4	1.4

Question 13/XIII — Service quality observation

(new question)

a) What are the most appropriate methods for carrying out the (manual or automatic) observations specified in Recommendations E.83 to E.83 *quater* (Volume II of the *Blue Book*) and which points of access are to be recommended?

b) How many tests and observations should be recommended and how often should this information be exchanged?

c) In what form can the service grade statistics be assembled? (In this connection, see Annexes 1 and 2.)

ANNEX 1

(to Question 13/XIII)

Service observation tables and graphs prepared in 1964 by the Secretariat of the C.C.I.T.T. according to information received from various Administrations

1. The service observation graphs consist of four curves, listed as curves A, B, C, D and giving the number of:

- Curve A: successful calls,
- Curve B: ineffective calls without fault,
- Curve C: calls ineffective due to plant failure,
- Curve D: calls ineffective due to incorrect procedure by caller (operator or subscriber).

All the data are expressed as percentages for A, B, C, D of the total of monitored calls.

Typical examples of this type of graph showing the monitored telephone performance of automatic connections from Amsterdam to two countries (cited here as Country A and Country B) are given below in Figures 1 and 2 respectively.

Figure 3 gives for the various routes observed outgoing from London curves A and C, concerning:

A—successful calls

C—calls ineffective due to plant failure

since they are the two important factors for monitoring the quality of service.

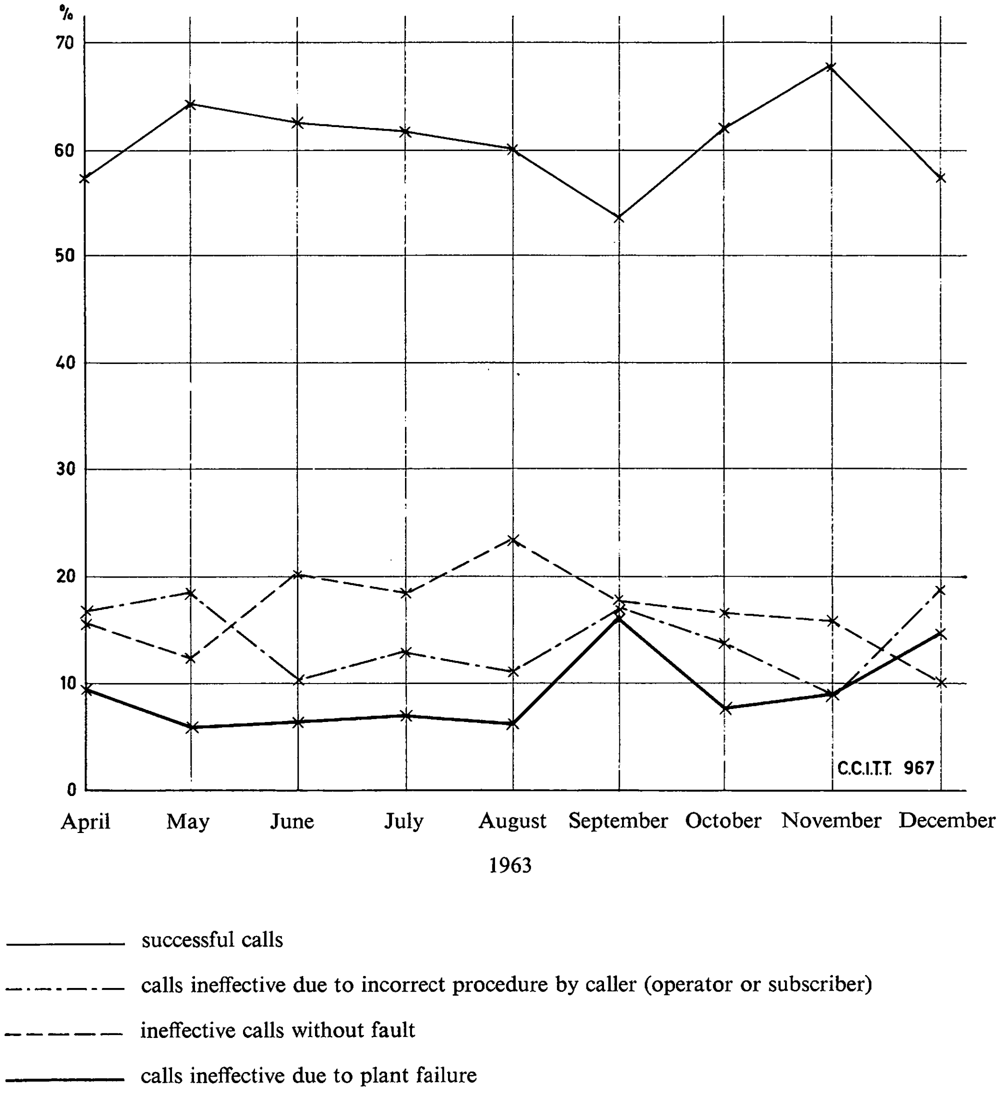


FIGURE 1. — **Telephone performance monitoring for the automatic routes from Amsterdam to Country A**

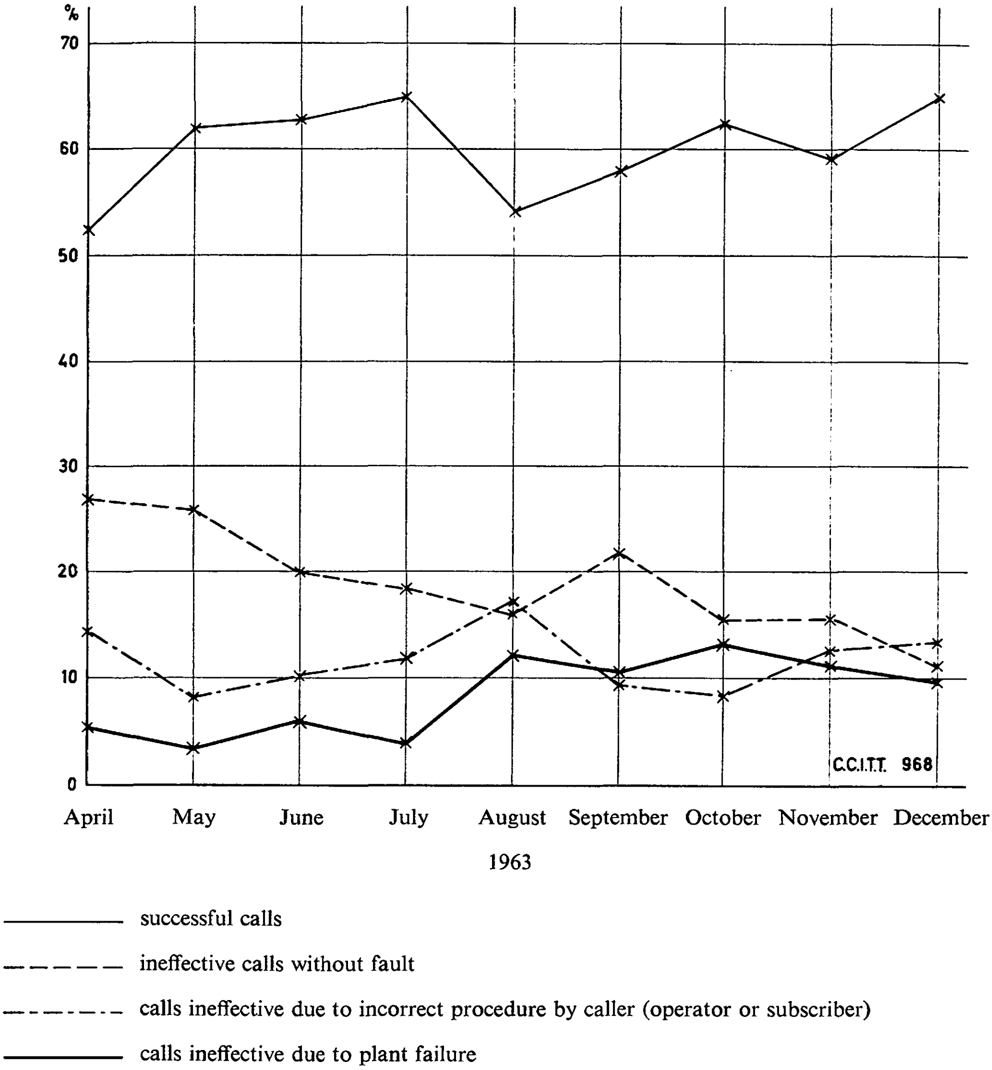


FIGURE 2. — **Telephone performance monitoring for the automatic routes from Amsterdam to Country B**

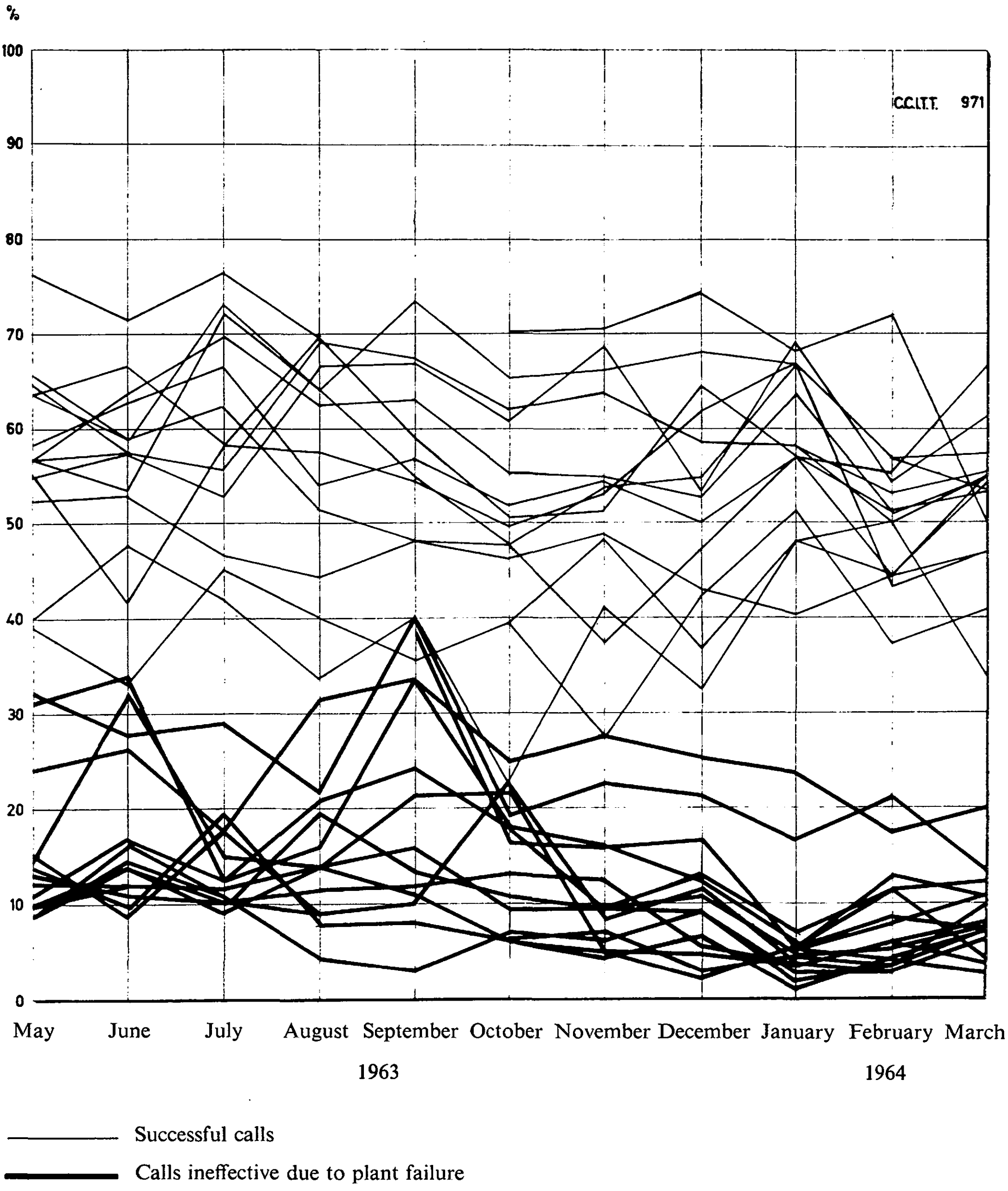


FIGURE 3. — **Telephone performance monitoring for all the international routes outgoing from the United Kingdom (London)**

2. Table 1 shows the importance of the mean values of holding time of circuits for preparation of calls with respect to the mean call duration. The traffic handled by operators in the international routes outgoing from the United Kingdom (London) is given in the example.

TABLE 1

Data on traffic handled by operators on international routes outgoing from the United Kingdom

Month	Mean holding time for preparation of calls (A)		Mean call duration (conversation time) (B)			
	Ordinary calls (A_1)	Personal calls (A_2)	Ordinary calls (B_1)	Personal calls (B_2)	$\frac{A_1}{A_1+B_1}$	$\frac{A_2}{A_2+B_2}$
1963 September	183	223	292	307	0.385	0.420
October	117	195	288	303	0.289	0.391
November	118	246	274	321	0.392	0.434
December	109.3	223	382	316	0.220	0.413
1964 January	89.1	199	269	317	0.249	0.380
February	100.6	219	311	314	0.385	0.410

ANNEX 2

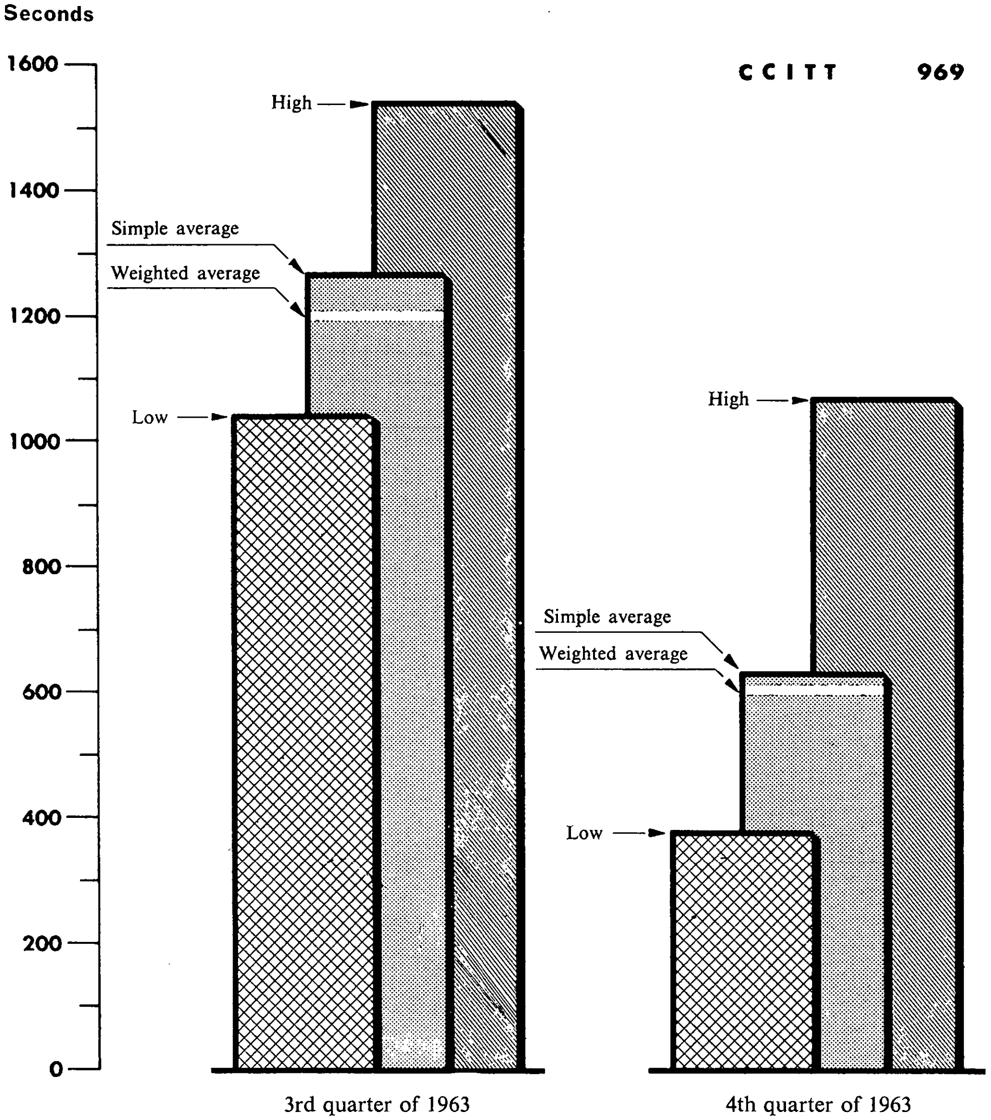
(to Question 13/XIII)

Charts prepared by the American Telephone and Telegraph Company on

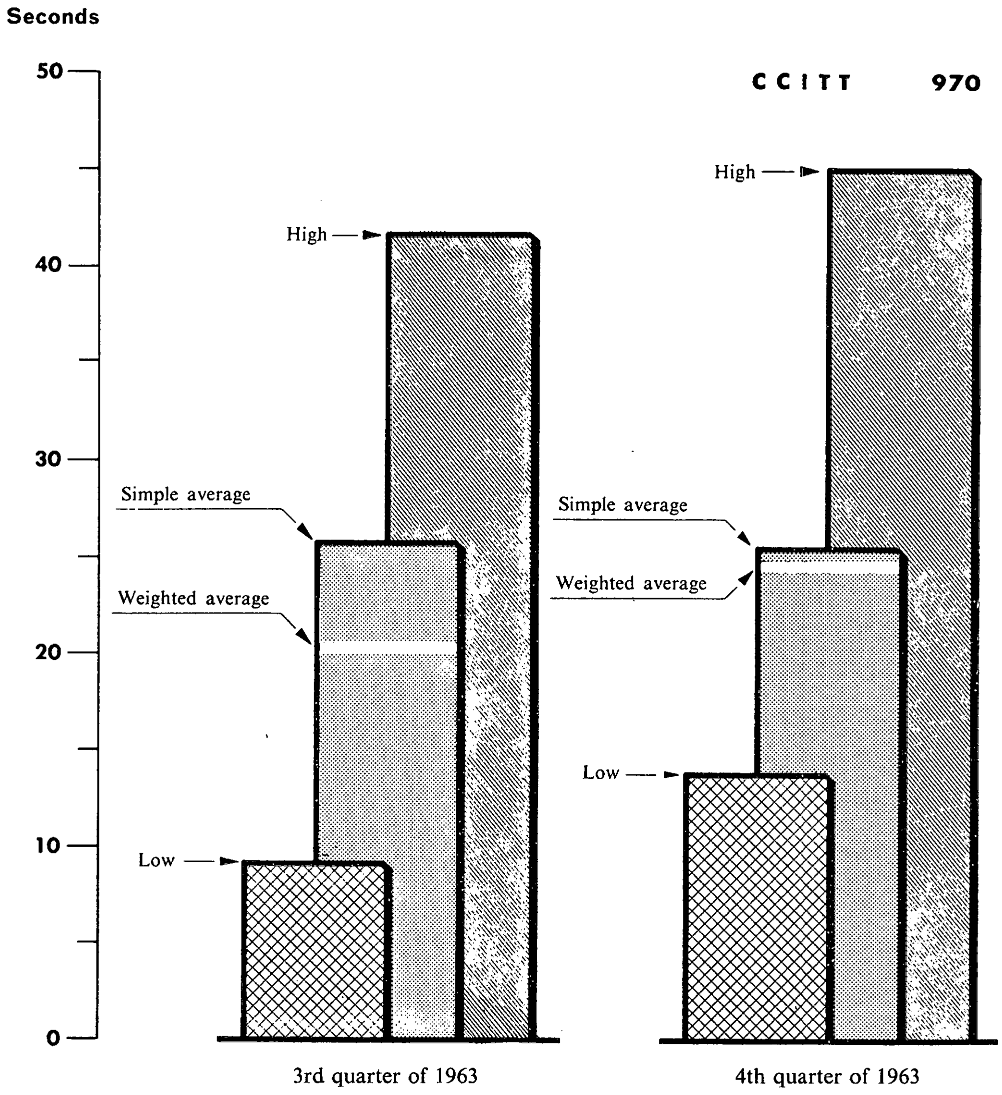
a) **Mean holding time of overseas circuits for manœuvres and preparation of calls,**

b) **Mean time to answer by incoming operators in ten European countries.**

Note. — These charts are for the third and fourth quarters of 1963.



Mean holding time of overseas circuits for manœuvres and preparation of calls (ten European services)



Mean time to answer by incoming operators in ten European countries

Question 14/XIII — Standard methods for the evaluation of service quality. Action to be taken

(new question)

Considering

1. the rapid increase in the volume of international semi-automatic and automatic telephone traffic;

2. the proposed extensive use of alternative routing through more than one transit centre;

3. that international connections consist of constituent parts in national and international networks maintained by different Administrations to different limits with different practices;

4. that semi-automatic and automatic connections require the operator or subscriber in the outgoing country to establish the connection into a distant national network;

What methods are used for the evaluation of service quality and the initiation of appropriate action where necessary, and is it desirable to standardize methods for application to all parts of the world-wide connection from subscriber to subscriber?

Question 15/XIII — Determination of grade of service

(new question)

The following factors are decisive in determining the grade of service:

1. A grade of service ("qualité d'écoulement du trafic") standard depends *inter alia* on:
   - — the specified congestion value,
   - — the parameters chosen to characterize the traffic (e.g. the offered or carried traffic, the duration of congestion),
   - — the choice of a traffic sample for measurement;
   - — the type of measuring equipment, and
   - — the accuracy of the traffic growth estimate;

2. The tolerable error margins in respect to these parameters are interrelated;

3. There is a large variation in the annual charges for circuits of different lengths and types;

4. The tolerable congestion probabilities on the intercontinental, continental and national circuits need not necessarily be the same.

(Question 15/XIII)

In view of these factors, how should the grade of service be determined to provide an arrangement taking proper account of both the interest of subscribers and of the Administrations?

Note. — See Supplements No. 10, No. 11 and No. 12 in the Documentary Part of this volume referring to the work of Study Group XIII.

Question 16/XIII — Use of automatic traffic-measuring apparatus for traffic forecasts

(new question)

Considering

that it is expected that equipment for measuring traffic is likely to become more and more automatic;

that such equipment is likely to be in day-to-day operation;

How can such traffic measurements be best used in forecasting general growth trends?

Note. — See Supplements No. 13 and No. 14 in the Documentary Part of this volume referring to the work of Study Group XIII.

Question 17/XIII — Revision of Recommendation Q.31

(new question)

Considering

that it is desirable to issue C.C.I.T.T. Recommendations for standard audible tones for automatic and semi-automatic services, what should be the recommendations concerning the use of the different audible tones and their meaning to the customer, and what should be the recommended and accepted values for the frequency content, the cadence and the power?

Note 1. — Annex 1 below shows the new plan for audible tones in North America.

Note 2. — In reviewing Recommendation Q.31 the following factors should be considered:

1. Should the "accepted" frequency limits be widened to permit more freedom in the selection of distinctive and readily identifiable precision tones?
2. Should limitation on the range of cadences for audible tones be reconsidered to facilitate customer recognition?
3. What should the characteristics of the tone plan be to facilitate machine recognition of tones?
4. What should the power level versus frequency relationship be to facilitate recognition of the audible report tones, taking into account the characteristics of circuits and telephone sets?

ANNEX

(to Question 17/XIII)

Description of audible tones in North America

Table 1 is a description of a new audible tone plan which is being considered in the North-American network and which is expected to:

1. achieve uniformity in the quality of audible tones,
2. minimize customer confusion as to meaning of audible tones,
3. enable machine recognition of audible tones for purposes of service observing, etc.

Basically, the new plan provides four frequencies that are used singly or in combination with varying cadences to form the audible tone signals shown in Table 1.

TABLE 1

Use	*Frequencies*[4] *(c/s)*				*Power per frequency at exchange where tone is applied*	*Cadence*
	350	*440*	*480*	*620*		
Dial tone	●	●			–13 dbm0	Continuous
Busy tone			●	●	–24 dbm0	0.5 s “ on ” 0.5 s “ off ”
Re-order tone[1]			●	●	–24 dbm0	0.2 s “ on ” 0.3 s “ off ”, or 0.3 s “ on ” 0.2 s “ off ”
Audible ringing tone		●	●		–16 dbm0	2 s “ on ” 4 s “ off ”
High tone[2]			●		–16 dbm0	Varies according to use
Pre-emption tone[3]		●		●	–18 dbm0	Single 200-500-ms pulse
Call waiting tone		●			–13 dbm0	Single 500-ms pulse

Notes:

1. A possible alternative is the use of a call failure tone which would identify the office and type of condition which prevented the successful completion of the call.

2. High tone is used in many ways. For example:

a) spurts of tone to indicate specific orders to operators in the manual service (order tones);
b) to inform operators of lines that are temporarily out of service (permanent signal tone);
c) to alert customers that their receiver is in a permanent off-hook condition.

3. Pre-emption tones are used in certain private switched networks which may interconnect with national networks.

4. Frequency limits are ± 0.5% of nominal.

Question 18/XIII — Revision of Recommendations Q.41 to Q.44

(new question of permanent interest)

Revision of the C.C.I.T.T. Recommendations on the maintenance of international signalling and switching equipment (Recommendations Q.41 to Q.44 in Volume VI of the *Red Book* or Recommendations Q.70 to Q.73 in Volume VI of the *Blue Book*).

On the occasion of this revision, the following three points will have to be considered:

a) In connection with corrective maintenance, is it advisable to draw up statistical tables to be exchanged between Administrations, possibly with the assistance of the C.C.I.T.T.?

b) If so, how should these tables be prepared and the faults listed?

c) Is it reasonable to resort to the practice of blocking the connections in order to investigate faults when it is easy to create the required conditions to do this?

SUMMARY OF QUESTIONS SET FOR STUDY GROUP XIII

Question No.	Short title	Remarks
1/XIII	System No. 6 operating facilities	
2/XIII	Language digit and discriminating digit for the international automatic and semi-automatic service	
3/XIII	Language difficulties in the semi-automatic international telephone service	To be studied first by Study Group II (Question 13/II); then by Study Group XIII
4/XIII	Physical features of push-button telephone sets	Same as Question 10/XI
5/XIII	Effect of the leasing or purchase of a telephone circuit on the world routing plan	
6/XIII	Effect of satellite communications on the world routing plan	
7/XIII	Determination of the source of congestion	
8/XIII	Flexibility in the world telephone routing plan	Opinion of Study Groups XI and XVI especially to be sought
9/XIII	Protection of service quality when there is a sudden surge of terminal traffic overflowing into a transit route and vice versa	
10/XIII	Number of circuits to be included in a high-usage route	
11/XIII	Acceptable reduction in the number of circuits in the event of a breakdown	
12/XIII	Use of automatic traffic-measuring apparatus for modifying routings	
13/XIII	Service quality observation	
14/XIII	Standard methods for the evaluation of service quality. Action to be taken	Proposed by Special Study Group B. Could be associated with Question 13/XIII
15/XIII	Determination of grade of service	
16/XIII	Use of automatic traffic-measuring apparatus for traffic forecasts	
17/XIII	Revision of Recommendation Q.31 of the *Red Book*	Study Group XIII first, then Study Group XI
18/XIII	Revision of Recommendations Q.41 to Q.44 of the *Red Book*	Joint study with Study Groups IV and XI

Question concerning the world-wide automatic network
entrusted to
Special Study Group B
in 1964-1968

Question 1/Sp.B

(continuation of Question 1/B studied in 1961-1964)

What changes are necessary to existing recommendations, or what new recommendations are necessary, to provide for semi-automatic and ultimately fully automatic telephone traffic operation on a world-wide basis?

Note. — Reference should be made to the new and amended recommendations relating to semi-automatic and automatic operation of the world network in Volumes II, III, IV and VI of the *Blue Book*.

DOCUMENTARY PART

SUPPLEMENTS

SUPPLEMENTS CONCERNING THE WORK OF STUDY GROUP XI

SUPPLEMENT No. 1

REPORT ON THE ENERGY TRANSMITTED BY CONTROL SIGNALS AND TONES

This report dates from 1956. It was used for designing signalling system No. 3 and signalling system No. 4.

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 over-all 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 networks.

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 microwatts × seconds during the busy hour, for system No. 3, and
- a value which is slightly below half of the above, for system No. 4.

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)	Number 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 s

Thus, in the busy hour and in the most unfavourable conditions, a total energy of

$$300\ \mu W \times 80\ s = 24000 \text{ microwatts} \times \text{seconds}$$

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 system No. 3 is used in the automatic international service, the value to be expected for the combination of both directions of transmission is about 21000 microwatts × seconds.

In the case of system No. 4, the energy of the control signals is appreciably less.

Hence, if the calculated energy for national tones assuming the most unfavourable conditions, say 24000 microwatts × seconds, is added to the higher of the two calculated values (i.e. 21000 microwatts × seconds for system No. 3), a total energy (for the two directions of transmission) of 45000 microwatts × seconds is obtained, which is much lower than the value of

$$2 \times 36000 = 72000 \text{ microwatts} \times \text{seconds}$$

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.

SUPPLEMENT No. 2

TASI CHARACTERISTICS AFFECTING SIGNALLING

During a normal telephone conversation each party usually speaks for only about 40% of the time (speech activity), 60% of his channel time being idle. TASI (Time Assignment Speech Interpolation) is an equipment which rapidly switches channels to talkers on a time-shared basis to make use of the otherwise idle channel time and thus permits a greater number of simultaneous calls than would otherwise be possible with the available channels in the cable.

TASI interpolates to associate a trunk (circuit) with a transmission channel when speech is detected on a trunk at one end and is required to be transmitted, over a channel, to the same trunk at the other end. The trunk/channel association is ceased, and the channel made available to other trunks when the cessation of a burst of speech is detected.

When the interpolation begins and a free channel is available, but not yet associated, a time (the initial clip) elapses before detection of the speech (or signal) by the TASI speech detector and trunk/channel association at each end. Should the TASI system be heavily loaded, a free channel may not be immediately available. In this situation a time (extended clip) in addition to the initial clip elapses before trunk/channel association.

To reduce the number of times clipping occurs, the TASI speech detector is given a hangover, maintaining trunk/channel association, to bridge the shorter gaps in speech, and thus reduce the interpolation. This feature permits the transmission of a sequence of short-pulse short-gap signals without signal clipping.

As signals must be detected by the TASI speech detector before transmission over the TASI system and as the total clip (initial clip + extended clip) reduces the duration of the received signal, TASI affects signalling.

The characteristics of TASI affecting signalling may be summarized as follows:

1. TASI speech detector sensitivity: −40 dbm0 (−4.6 Nm0);

2. To minimize speech activity on the RETURN channel due to reflection from the GO channel, the TASI speech detector on the RETURN channel is desensitized in the presence of speech on the GO channel. This also applies to signalling. Thus in situations where simultaneous forward and backward signalling is required, the level of the backward signalling must be such as to take account of a reduction of some 15 db (1.7 N) in the sensitivity of the speech detector at the end receiving the forward signal;

3. Nominal duration of speech detector hangover;

   a) 50 ms for input signals of 50 ms or less,

   b) 240 ms for input signals greater than 50 ms;

4. Nominal duration of clip of a signal (including the 5 ms response time of the TASI speech detector):

   a) initial clip: 18 ms,

   b) total clip when TASI is heavily loaded and a free channel is not immediately available, expressed as a probability that a signal will be clipped for a certain time or longer:

Total clip	Number of TASI systems in series on one circuit		
	1	2	3
125 ms	1/100	1/20	1/10
250 ms	1/700	1/140	1/60
500 ms	1/15 000	1/5000	1/1500

A total clip of 500 ms was assumed for the No. 5 system design, and the duration (850 ± 200 ms) of the forward-transfer pulse line signal concerned includes a 500-ms TASI prefix for TASI trunk/channel association;

5. A maximum duration of gaps between short-pulse signals has been determined to maintain continuous operation of the speech detector and thus continuous trunk/channel association. The maximum allowable duration of the gaps is twice the pulse duration over the pulse range 10 to 60 ms and over the operate level range of the speech detector.

This assumes prior energization of the speech detector to give the 240 ms hangover (see item 3 *b* above) before the short-pulse short-gap signalling is applied.

The register short-pulse short-gap multifrequency signalling adopted for the No. 5 system takes advantage of this continued speech detector operation and is transmitted without a TASI prefix, reliance being placed on the trunk/channel association due to the seizing signal.

SUPPLEMENT No. 3

INFORMATION RECEIVED ON NATIONAL VOICE-FREQUENCY SIGNALLING SYSTEMS

Tables 1 and 2 hereafter give the data on national voice-frequency signalling systems for European countries and extra-European countries

TABLE 1. — **Europe and Mediterranean Basin**

	Germany (Federal Republic)		Algeria	Austria	Denmark	Spain	France	Great Britain	
Frequency (c/s)	3000	(2280)*	2000	2280	3000	2500	2280	600-750 separate	2280
Tolerance at the generator terminals (c/s)	±7.5	±6	±6	±6	±6	±3	±3	±3	±6
Frequency variation possible at the entry to the international circuit (c/s)	±15	±15	±12	±15	±8	±15	±6	±5	±8
Splitting time (milliseconds)	20	20	15 then 35 with attenuated 18 db	30	35	10	35	140 or 400 320	35
Absolute level of the power of signals at the point of zero relative level (decibels)	−8	−8	−6	−6	−8	−6	−6	+3	−6

* for narrow-band circuits

	Ireland		Italy	Morocco	Norway	Netherlands	Poland	Portugal		Sweden	Switzerland	Czechoslovakia	Tunisia	U.S.S.R.		Yugoslavia
Frequency (c/s)	2040-2400 compound	2280	2040-2400 compound	2280	2400	2400-2500 separate	2280	2400	2040-2400 compound *	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	±6	±6	±6	±3	±6	±5	±5	±5	±6
Frequency variation possible at the entry to the international circuit (c/s)	—	—	±15	±10	—	±5	±8	±15	±15	±11	±6	±15	—	±15	±15	—
Splitting time (milliseconds)	60	35	40-60	25-35	35	30-55	45	35-40	40-60	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	−6	+3.5	−6	−9	−9	−6	−3.5	−6	−6	−4	−6	−6

*standardization considered

TABLE 2. — **Extra-European countries**

	Argentina	Australia		Canada and United States of America	Cuba	East African Post and Telecomm. Admin. (Kenya, Uganda and Tanzania)
Frequency (c/s)	2040-2400 compound 500	600-750 separate	2280	2600 (for 2 wires: 2400-2600)	2150	2040-2400 separate and compound
Tolerance at the generator terminals (c/s)	±6	±5	±6	±5	±3	±6
Frequency variation possible at the entry to the international circuit (c/s)	±15	±15	±15	±15	±15	—
Splitting time (milliseconds)	60	160-210	35	35 maximum	60	30-40
Absolute level of the power of signals at the point of zero relative level (decibels)	−9	0	−6	−8 and after attenuation −20	−10	−9

	Mexico	India	New Zealand		Rhodesia		South Africa (Rep. of)		Syria	Thailand
Frequency (c/s)	2400	2400	600-750	2280	3250 Tone-on-idle signalling	2280*	600-750 separate	2280	2040-2400 compound standardization proposed =2280	2280
Tolerance at the generator terminals (c/s)	±5	±2	±3	±3	±7.5	±6	±2	±6	±6	±6
Frequency variation possible at the entry to the international circuit (c/s)	±15	±10	—	—	—	—	—	—	—	±8
Splitting time (milliseconds)	35 maximum	25 filter loss at 2400 c/s → 50 dbm	160-210	20-30	filter loss at 3250 | 2280 → 30 dbm		50	70	70	35 maximum
Absolute level of the power of signals at the point of zero relative level (decibels)	−8 and after attenuation −20	−10	−6	−6	−14	−14	−7	−11 ±1	−11±1	−6

* For narrow-band circuits

VARIOUS TONES USED IN NATIONAL NETWORKS

TABLE 1. — RINGING TONE

Country		Frequency (c/s)
ALGERIA		25 or 50
GERMANY (F.R.)	at present	450
	in future	
AUSTRIA		450
BELGIUM	Brussels-Antwerpen	450 / 50
	Other networks	450 / 50
DENMARK		450
SPAIN		400
FINLAND		400 or 450
FRANCE	Paris	25 / 400
	Province	50 / 450
IRELAND		400 / 450
ITALY		400 / 450
LEBANON		435
MOROCCO		25 or 50 + harmonics
NORWAY		400 / 450
NETHERLANDS		450
POLAND		400
PORTUGAL		400
ROUMANIA		400 or 450
UNITED KINGDOM		400 / 450
SWEDEN		425
SWITZERLAND		400
SYRIA		450 / 50
CZECHOSLOVAKIA		450
TUNISIA		400 ± 80
U.S.S.R.		450 ± 50
YUGOSLAVIA		450 + 20
		450

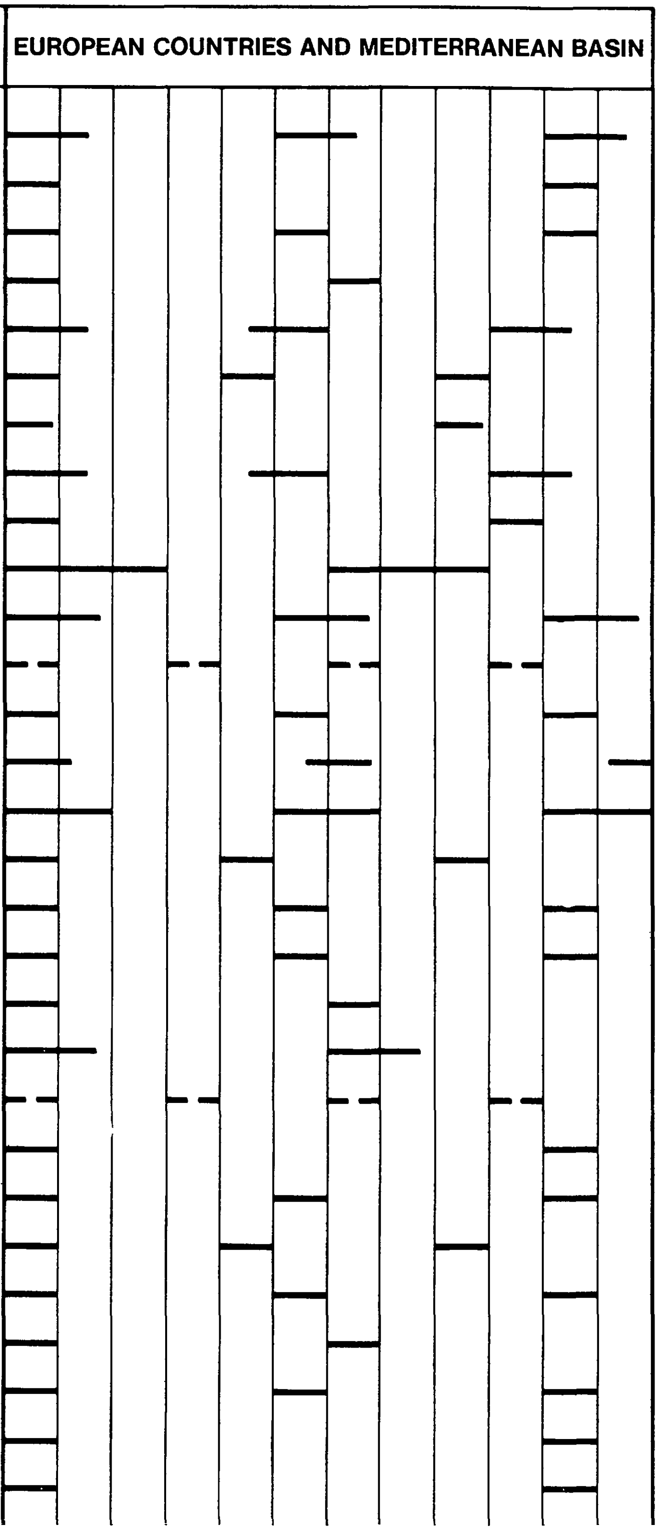


TABLE 1. — **RINGING TONE** (continued)

Country	Frequency (c/s)
ARGENTINA	16 ⅔ + 400 450 / 350
AUSTRALIA	400 + 16 ⅔
CANADA	420 + 40
CHILE	16 ⅔
IVORY COAST	450 / 50
CUBA	420 + 40
EAST AFRICAN P. and T. Adm. (KENYA, UGANDA, TANZANIA)	133 / 17 or 400 / 17 or 400 / 450
UNITED STATES	420 / 40
INDIA	133 + 16 ⅔ 400 + 16 ⅔
JAPAN	350 + 16 ⅔ 400 + 16 ⅔
KUWAIT	400 + 16 ⅔ 400 + 450
NEW ZEALAND	400 / 17 400 / 450
PAKISTAN	450 400 + 16 ⅔
SOUTHERN RHODESIA	400 / 450
SOUTH AFRICA (Rep. of)	400 + 33
THAILAND	400

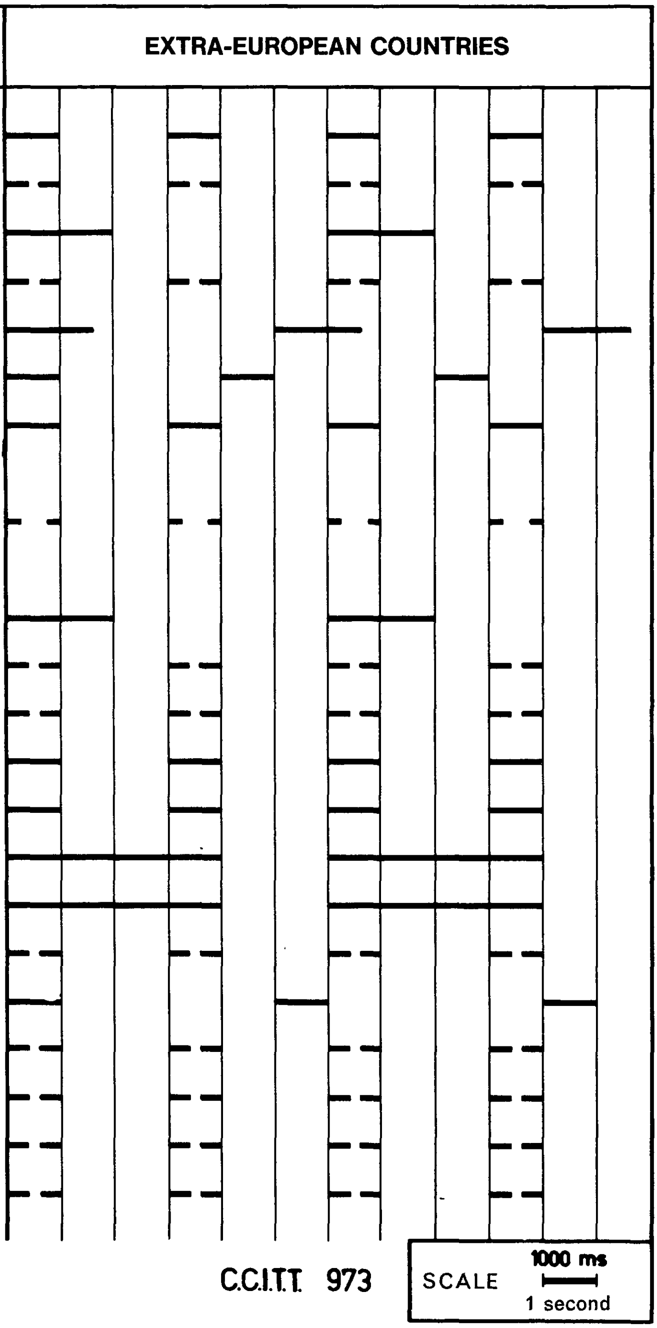


TABLE 2. — BUSY TONE

Country	Frequency (c/s)	EUROPEAN COUNTRIES AND MEDITERRANEAN BASIN
ALGERIA	450	
GERMANY (F.R.)	450	
AUSTRIA	450	
BELGIUM	450	
DENMARK	450	
SPAIN	400	
FINLAND	400 or 450	
FRANCE	400 or 450	
IRELAND	400	
ITALY	400 / 450	
LEBANON	435	
MOROCCO	400 / 450	
NORWAY	400 / 450	
NETHERLANDS	450	
POLAND	400	
PORTUGAL	400	
ROUMANIA	133	
UNITED KINGDOM	400	
SWEDEN	425	
SWITZERLAND	400	
SYRIA	450	
CZECHOSLOVAKIA	450	
TUNISIA	400 ± 80	
U.S.S.R.	450 ± 50	
YUGOSLAVIA	450	

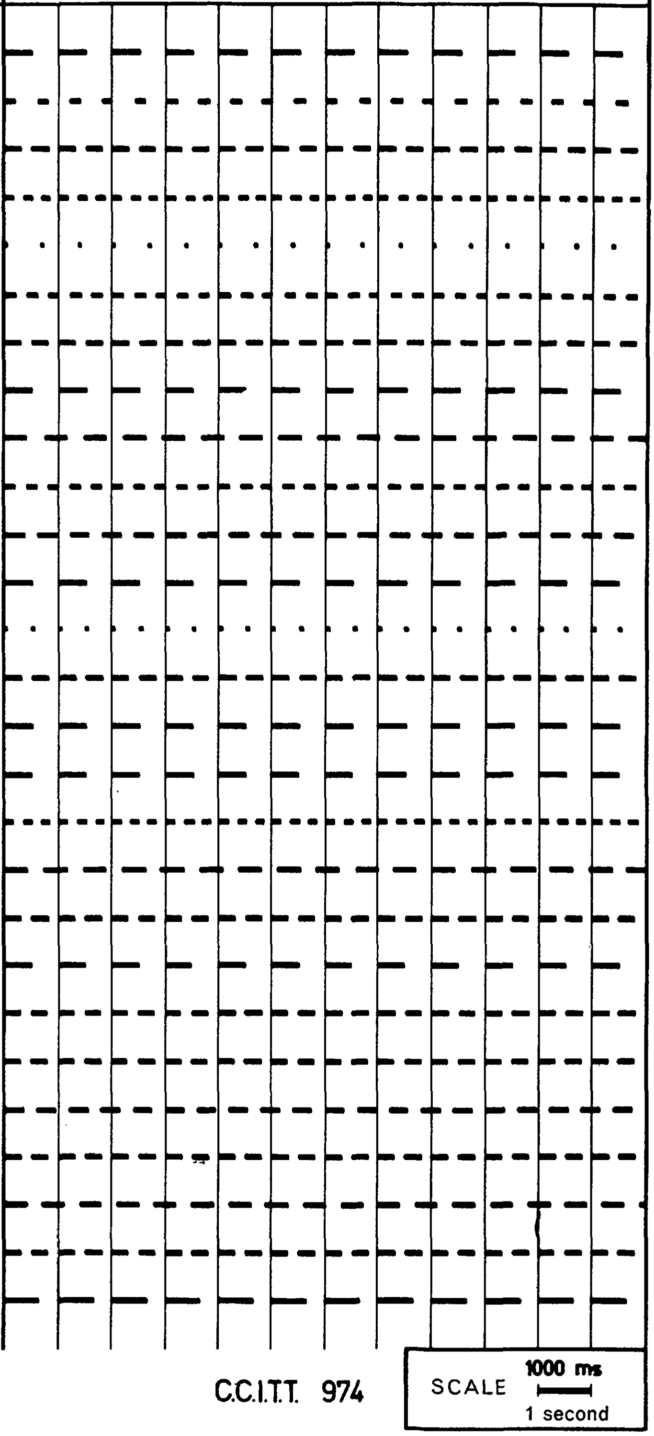


TABLE 2. — **BUSY TONE** (continued)

Country	Frequency (c/s)	**EXTRA-EUROPEAN COUNTRIES**
ARGENTINA	400 / 450	
AUSTRALIA	400	
CANADA	600 + 120	
CHILE	400	
IVORY COAST	450	
CUBA	600 + 120	
EAST AFRICAN P. and T. Adm. (KENYA, UGANDA AND TANZANIA)	400	
UNITED STATES	600 / 120	
INDIA	400	
JAPAN	400	
KUWAIT	400	
NEW ZEALAND	400	
PAKISTAN	450	
	400	
SOUTHERN RHODESIA	400	
SOUTH AFRICA (Rep. of)	400	
THAILAND	400	

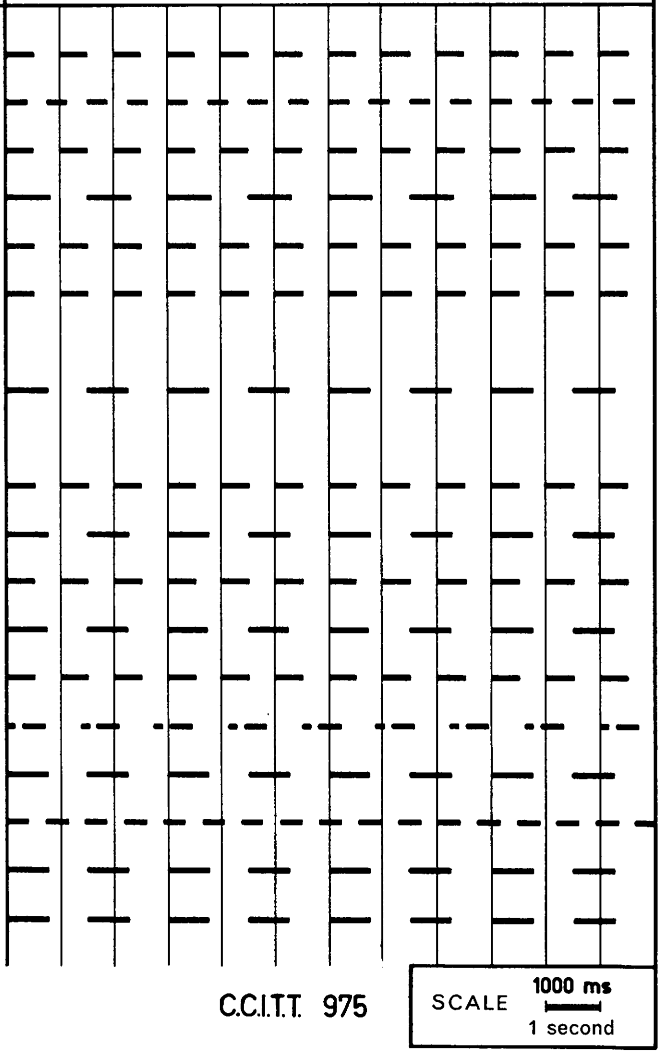


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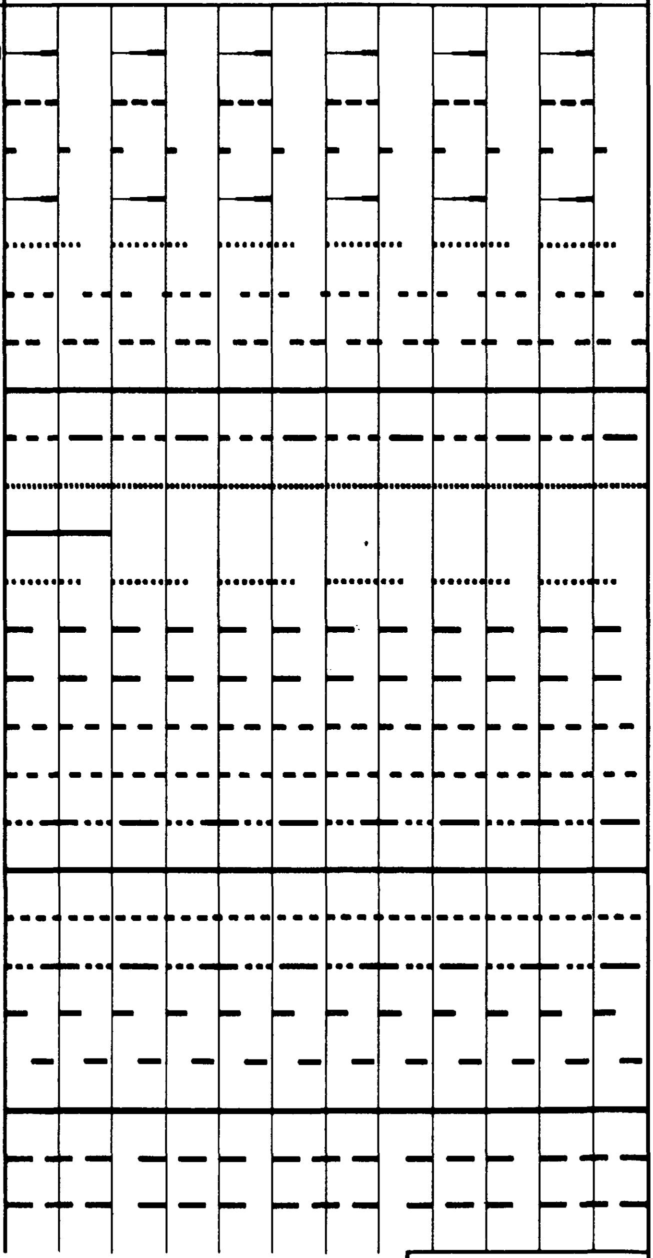
TABLE 3. OTHER TONES
(Reference, information, number unobtainable, congestion tones *)

Country		Frequency (c/s)	EUROPEAN COUNTRIES AND MEDITERRANEAN BASIN
GERMANY (F.R.)		950/1400/1800	
AUSTRIA	Information tone	950/1400/1800	
BELGIUM	Spare level	450	
	Information tone ...	900/1380/1860	
DENMARK	Information tone	450	
SPAIN	Information tone	400	
	Spare level	400	
IRELAND		400	
LEBANON		435	
MOROCCO	Waiting tone	450	
	Pre-metering tone ..	450	
NORWAY		400 / 450	
NETHERLANDS	Frequency F1 .	150	
	Frequency F2 .	450	
POLAND		400	
PORTUGAL	Number unobtainable .	400	
ROUMANIA	Reorder	400	
UNITED KINGDOM	Number unobtainable	400	
	Pay tone	400	
SWEDEN	Re-call tone	425	
	Congestion tone	425 Normal level	
		Reduced level	
SYRIA	Re-call tone	450	
	Number unobtainable	450	
	Barred level	450	



* 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.

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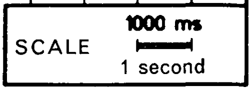
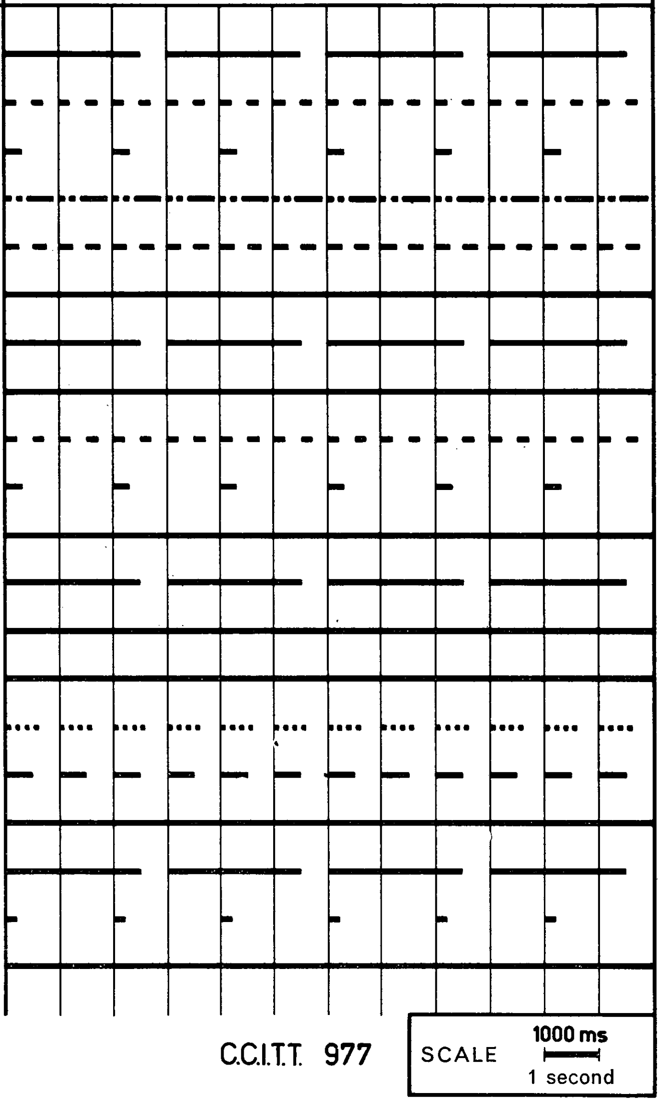


TABLE 3. — OTHER TONES (continued)

Country		Frequency (c/s)
AUSTRALIA	Number unobtainable tone	400
CANADA	Reorder	600 + 120
	No circuit	600 + 120
CUBA	Number unobtainable	520
	Congestion tone	600 + 120
EAST AFRICAN P. and T. Adm. (KENYA, UGANDA and TANZANIA)	Number unobtainable	400
		400
	Dial tone	33
UNITED STATES	Reorder	600 / 120
	No circuit	600 / 120
INDIA	Number unobtainable	400
		400
KUWAIT	Dial tone	33
	Number unobtainable	400
NEW ZEALAND	Number unobtainable	400
	Congestion tone	900
SOUTHERN RHODESIA	Number unobtainable	400
SOUTH AFRICA (Rep. of)	Number unobtainable	400
	Call office pay tone	900
THAILAND	Number unobtainable	400

EXTRA-EUROPEAN COUNTRIES



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

ALGERIA	FRANCE	TUNISIA
CHILE Telephone Company	ITALY	U.S.S.R.
FINLAND (at present not in general use —will be introduced later)	JAPAN	YUGOSLAVIA

SUPPLEMENT No. 5

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
Algeria	Operator or ringing tone Recorded announcement proposed		Busy tone	Operator	Operator or busy tone or ringing tone			Busy tone
Germany (Federal Republic)	Special information tone, alone or with a recorded announcement (use according to Q.31, 5.1, cases a and c, Volume VI, *Red Book*)			Operator	Ringing tone or busy tone	Ringing tone (alone, without any other indication)	Special information tone, alone or with a recorded announcement (use according to Q.31, 5.1, cases a and c, Volume VI, *Red Book*)	Busy tone
Argentina	Ringing tone		Normally, operator; exceptionally, ringing tone	—	Ringing tone		Busy tone	
Australia	Operator, recorded announcement or check number tone		Operator or recorded announcement		Ringing tone, try again tone or recorded announcement	Check number tone, ringing tone or recorded announcement	Recorded announcement or check number tone	Try again tone or recorded announcement

N.B. In Australia, busy tone is now known as try again tone whilst number unobtainable tone is known as check number tone.

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 or special information tone, the latter if necessary also at the initiative of the operator	Busy tone or special information tone	Operator or recorded announcement or busy tone or special information tone; the latter may also be transmitted during the intervals of the announcement or if necessary at the initiative of the operator	Operator or recorded announcement or special information tone to be transmitted during the intervals of the announcement or at the initiative of the operator	Ringing tone or busy tone	Busy tone or special information tone	Busy tone	
Belgium	Operator (information tone complemented by recorded announcement proposed)		Operator for individual cases; recorded announcement in case of transfer of groups of subscribers	Operator	Ringing tone. In certain cases information tone complemented by recorded announcement	Ringing tone	In principle, no indication; special tone in certain networks (information tone complemented by recorded announcement proposed)	Recorded announcement incoming to Brussels. At other points on the trunk network where congestion can be expected, the sending of information tone complemented by recorded announcements is proposed

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
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 impulsions per minute tone or recorded announcement
Chile Telephone Company	Ringing tone	Ringing tone or recorded announcement	Operator or recorded announcement	Service not provided	Ringing tone or busy tone	Ringing tone	Busy tone	
Ivory Coast	Regular ringing tone or operator			Service not provided. Ringing tone	Ringing tone or busy tone	Busy tone or re-call of an operator		
Cuba	Ringing tone		Operator for individual cases; operator or recorded announcement in case of transfer of groups of subscribers	Service not provided	Ringing tone or busy tone	Ringing tone	Number unobtainable tone or congestion tone	No tone is provided

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

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
Denmark	Information tone or ringing tone, or operator or recorded announcement			Operator or recorded announcement	Ringing tone	Information tone or ringing tone	Information tone	Busy tone
Spain	Special tone		Operator or recorded announcement	Service not provided	Busy tone or ringing tone	Ringing tone	Special tone	
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 impulsions per minute tone or recorded announcement
East African P. & T. Ad. (Kenya, Uganda and Tanzania)	Number unobtainable tone		Operator		Number unobtainable tone			Busy tone

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

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
Finland	Ringing tone or operator or recorded announcement	Ringing tone or busy tone or recorded announcement	Operator or recorded announcement or ringing tone	Operator or recorded announcement	Ringing tone or busy tone	Ringing tone or busy tone	No special indication; busy tone in some cases. Information tone or recorded announcement will probably be introduced	Busy tone. In certain cases no tone
France	Operator or recorded announcement			Operator	Operator or recorded announcement	Operator or recorded announcement or busy tone		Busy tone or recorded announcement
India	Number unobtainable tone		Operator or recorded announcement or number unobtainable tone	Service not provided	Number unobtainable tone			Busy tone
Ireland	Number unobtainable tone		Operator	Service not provided	—	Number unobtainable tone		Busy tone
Italy	Busy tone or ringing tone		Operator or recorded announcement	Operator	Busy tone or ringing tone	Busy tone		

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
Japan	Busy tone or ringing tone		Operator or recorded announcement	Service not provided	Recorded announcement or busy tone or no tone	Operator or recorded announcement	Recorded announcement	Busy tone or recorded announcement
Lebanon	Ringing tone (recorded announcement proposed)			Operator	Ringing tone (recorded announcement proposed)	Ringing tone	Special tone	Busy tone
Norway	Operator or recorded announcement			Operator	Ringing tone		Information tone or no tone	No tone or busy tone
New Zealand	Number unobtainable tone	Busy tone or ringing tone	Operator	Service not provided	Busy tone or ringing tone	Number unobtainable tone		Congestion tone
Netherlands	Information tone			Operator or information tone	Information tone or ringing tone		Information tone or busy tone	Busy tone
Poland	Ringing tone						Special tone or busy tone	

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
Portugal	Busy tone or number unobtainable tone	Busy tone or number unobtainable tone	Operator or busy tone for individual cases; recorded announcement in case of groups of subscribers	Service not provided	Ringing tone or busy tone	Busy tone or number unobtainable tone	Operator or busy tone or number unobtainable tone	Busy tone
Southern Rhodesia	Operator or number unobtainable tone	Number unobtainable tone	Operator or recorded announcement	Service not provided	Number unobtainable tone			Busy tone or recorded announcement
Roumania (P. R.)	“ Spare line tone ” or operator			Service not provided	Busy tone or ringing tone	“ Spare line tone ” or operator		—
United Kingdom	Operator or number unobtainable tone	Number unobtainable tone	Operator or recorded announcement	Call answered by an operator or a private answering service or a call transferred to another subscriber	Number unobtainable tone			Busy tone or recorded announcement

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
South Africa (Rep. of)	Number unobtainable tone		Operator or recorded announcement	Operator	Ringing tone or busy tone	Number unobtainable tone		Busy 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	
Syria	Ringing tone. Operator (proposed)	Number unobtainable tone	Operator or ringing tone	Ringing tone. Operator (proposed)	Ringing tone		“ Barred level ” tone	—

SUPPLEMENT No. 6

APPLICATION OF SIGNALLING SYSTEMS No. 3, No. 4 AND No. 5 IN THE INTERNATIONAL NETWORK

Figures 1, 2 and 3 of this Supplement show the applications of the standard C.C.I.T.T. systems No. 3, No. 4 and No. 5.

These figures are extracted from the Plan Committee Book (Roma, December 1963).

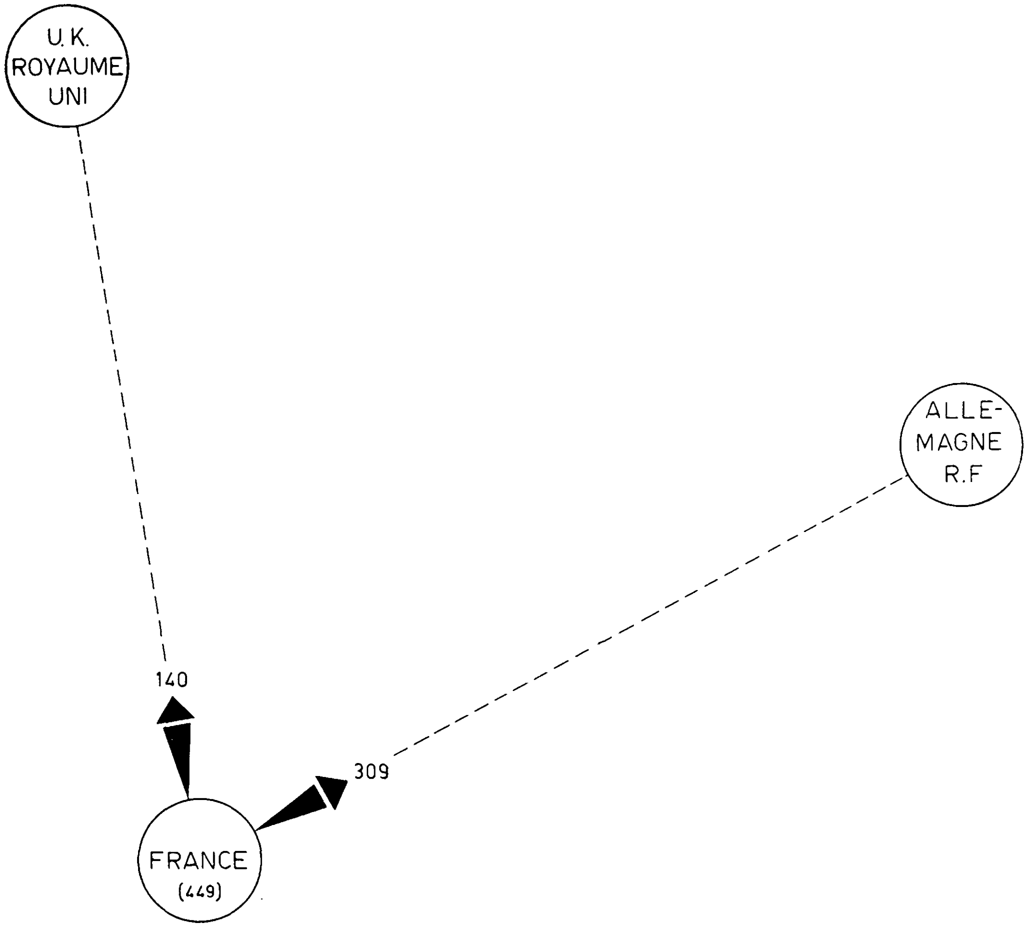
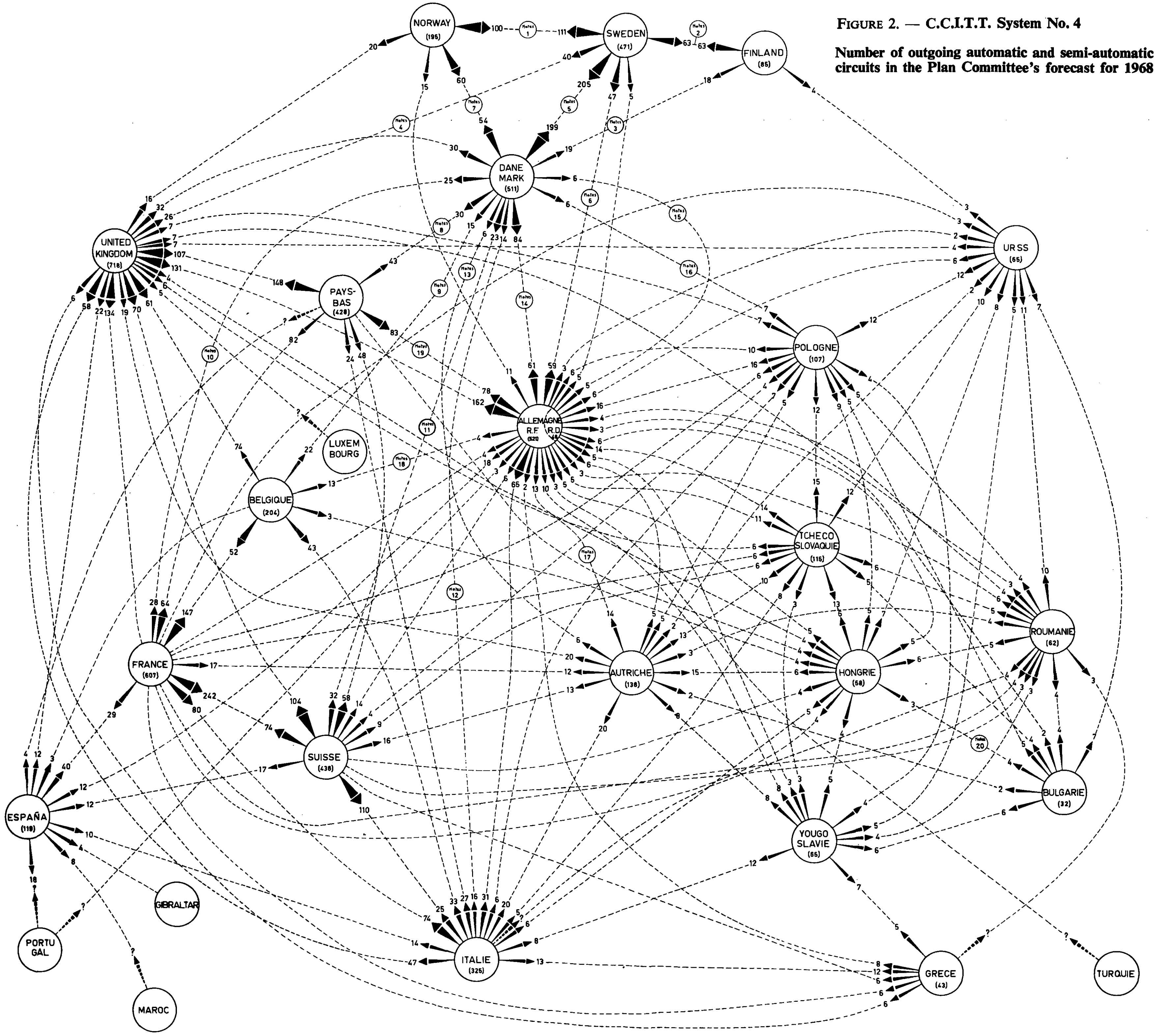


FIGURE 1. — C.C.I.T.T. system No. 3

Number of outgoing automatic and semi-automatic circuits in the Plan Committee's forecast for 1968

FIGURE 2. — C.C.I.T.T. System No. 4

Number of outgoing automatic and semi-automatic circuits in the Plan Committee's forecast for 1968



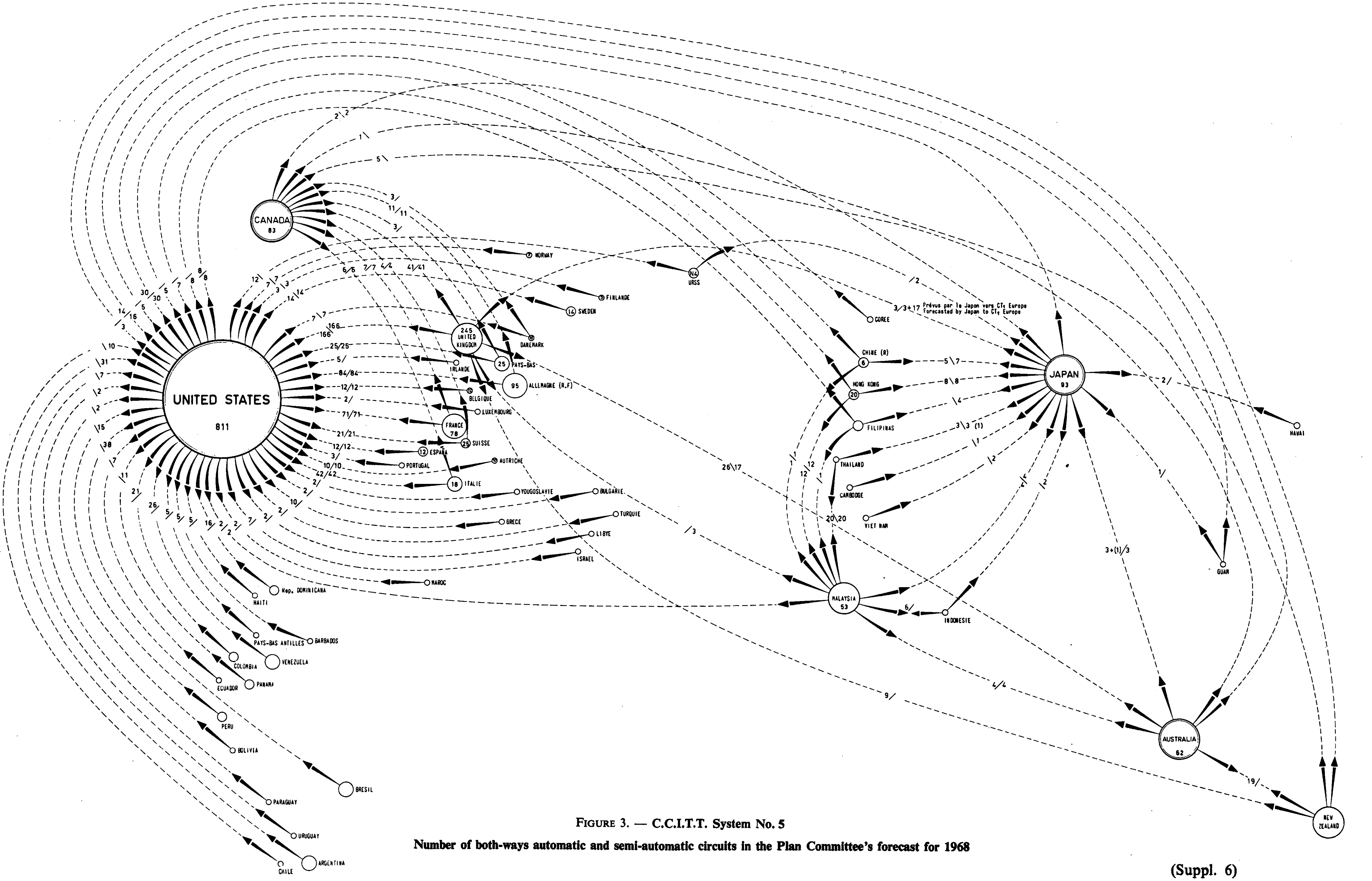


FIGURE 3. — C.C.I.T.T. System No. 5

Number of both-ways automatic and semi-automatic circuits in the Plan Committee's forecast for 1968

SUPPLEMENT No. 7

DESCRIPTION OF THE NORTH-AMERICAN SIGNALLING SYSTEM

(Text supplied by the A.T. & T. Co.—Contribution COM XI—No. 160)

Introduction

As noted in Recommendation Q.7, throughout the North-American continent a signalling system is used for international automatic and semi-automatic working. This system was not studied by the C.C.I.T.T. and is therefore not designated by a standard C.C.I.T.T. serial number. A description of this system is published for the sake of information in this Supplement.

1. General

The general specification and design requirements for the signalling system described herein are generally being followed in the North-American continent where they are being applied to national as well as international circuits. Line signalling employs a single frequency in each direction on the four-wire transmission path, the presence or absence of which indicates a specific signal dependent upon when it occurs in the signalling sequence. Telephone addresses or numerical signals may be transmitted as decimal coded signals by pulsing the single-line frequency or by a separate multifrequency signalling arrangement using a two-out-of-six frequency code. The latter arrangement is the preferred method of operation on both national and international circuits.

The basic features of the system are:

a) Semi-automatic or automatic operation,

b) both-way operation,

c) link-by-link in-band line and inter-register signalling,

d) continuous type line signalling.

2. Line signal transmitter

2.1 *Signal frequency*

2600 ± 5 c/s (*f*1).

2.2 *Transmitted signal level*

a) -8 ± 1.5 dbm0 for initial 300-550 ms of signal,

b) steady state -20 ± 1 dbm0.

2.3 *Signal frequency leak*

The level of the leak current transmitted to the line should not exceed -50 dbm0.

3. Line signal receiver

The line signal receivers operate, release and non-operate requirements are dependent upon:

1) receiver sensitivity,
2) receiver selectivity,
3) receiver guard circuit efficiency.

To ensure correct signalling operation, the latter two receiver characteristics are controlled as a function of the signalling state being transmitted and received in the following manner:

Signalling state transmitted tone	Signalling state received tone	Receiver band selectivity	Guard circuit efficiency
on	on	broad	low
on	off	narrow	medium
off	on	broad	low
off	off	narrow	high

The decrease in selectivity and guard circuit efficiency introduced on receiver response to incoming tone must be delayed by 150 to 220 ms in order to minimize false signal imitation by speech. The degree of selectivity and guard circuit efficiency established for a given signalling state must be in accord with the signalling requirement established herein.

3.1 *Operate and release limits*

The line signal receiver shall operate on received signals that meet the following conditions:

a) $f1$: 2600 ± 15 c/s,

b) the absolute power level N of each signal shall be within the limits: $(-26 + n \leqslant N \leqslant -14 + n)$ dbm, where n is the relative power level at the signal receiver input.

These limits give a margin of ± 6 db on the steady-state nominal absolute level of the received signal at the input to the signal receiver.

To ensure proper receiver operation in the presence of noise the initial portion of each signal shall be augmented by 12 db (see section 2.2). With augmentation the effective margin is increased from 6 db to 18 db. All short-duration pulse signals such as ring-forward (forward-transfer) * and digital signals are augmented for their entire duration.

c) By decreasing signal receiver selectivity and guard circuit efficiency, a signal receiver having once operated for 150 to 220 ms shall remain operated on an input signal meeting the conditions specified in *a)* and *b)* in the presence of maximum expected noise or speech interference. The signal receiver shall, however, release when the signal is removed in the presence of noise, as specified in section 3.4 *a)*.

---

* In the description of the North-American signalling system, the North-American designations for signals are used. The designation of the signal in system No. 5 which most nearly resembles a particular North-American signal is shown in parenthesis. There is not always exact correspondence in function—e.g., ring forward is used only on manual calls.

The tolerances given in *a), b)* and *c)* are to allow for variations at the sending end and for variations in line transmission.

3.2 *Non-operate conditions of line signal receiver*

a) Selectivity

The signal receiver shall not operate on a signal having an absolute power level at the receiving end within the limits specified in section 3.1 when the frequency is outside 2600 ± 100 c/s.

b) Maximum sensitivity of line signal receiver

The signal receiver shall not operate on a signal of 2600 ± 15 c/s whose absolute power level at the point of connection of the receiver is $(-10 - 20 + n)$ db, n being the relative power level at this point. This limit is 10 db below the steady-state nominal absolute power level of the signal at the input to the signal receiver.

3.3 *Efficiency of the guard circuit*

The signal receiver must be protected by a guard circuit against false operation due to speech currents.

The purpose of the guard circuit is to prevent:

a) signal imitation by speech,

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) normal speech currents should not, on the average, cause more than one false operation of the signal receiver lasting more than 140 ms in each 5000 charged calls or in each 1000 free calls. (In the free call condition answer supervision is not returned to the originating end.)

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

3.4 *Guard circuit limits*

a) Steady noise

Considering:

1) 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 or cause its false release;

2) that unweighted noise of a level –35 dbm0 and uniform spectral energy may arise:

it is recommended that for a signalling current within the limits specified in section 3.1, the signal receiver should satisfy the conditions indicated in section 3.5 for the distortion of signals in the presence of noise of a level of –35 dbm0 and uniform spectral energy over the frequency range 300 to 3400 c/s.

b) Surges

A guard circuit with excessive hangover time may cause difficulties in receiving a signal, for example, when it has been immediately preceded by a surge. 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 $(0 + n)$ dbm, at the relative level point n where the receiver is connected, ceases within 5 ms of the application of a signal satisfying the limits defined in section 3.1, the lengths of the received signals must remain within the limits specified in section 3.5. Guard circuit hangover must, therefore, be short. However, as noted in section 3, the changing of guard circuit efficiency, predicated on recognition of an incoming tone signal, should be delayed by 150 to 220 ms.

3.5 *Distortion of received signals*

a) Since all supervisory signals are continuous signals except the ring forward (forward-transfer) signal, distortion as such is not applicable. In order to minimize delays in signalling, the operate and release time of the signal receiver should be held to a minimum consistent with signal simulation requirements, and pulse correction requirements.

b) Ring forward (forward-transfer) signals within the frequency and augmented level limits specified in section 3.1 and within 70 to 130 ms in duration at the input of the receiver in the presence of noise defined in section 3.4 shall at the output of the receiver be within 60 to 130 ms in duration.

c) Dial pulse signals, made up of a series of short tone pulses separated by short silent intervals, within the speed and PER CENT BREAK limits shown and within the frequency and augmented level limits specified in section 3.1 at the input of the signal receiver, shall at the output of the receiver be within the limits indicated in the presence of noise defined in section 3.4:

A.C. input pulses		D.C. output pulses	
Speed (pps)	PER CENT BREAK RANGE	Speed (pps)	PER CENT BREAK RANGE
8	33-83	8	36-73.5
10	42-79	10	39-73
12	50-75	12	44-72

PER CENT BREAK is equal to ratio of tone-on time to tone-off plus tone-on time multiplied by 100:

$$\text{PER CENT BREAK} = \frac{(\text{ms tone-on})}{(\text{ms tone-on}) + (\text{ms tone-off})} \times 100$$

To counter the effects of noise-induced distortion and to meet the above requirement, it is necessary to incorporate pulse correction in the signalling receiver design. The pulse correcting circuit should lengthen short pulses, shorten long pulses and maintain a suitable interval between pulses.

d) Considering signal simulation and pulse correction requirements, it is necessary to bridge a 40-ms transient interruption of continuous tone signals.

4. Splitting arrangements

4.1 *Receiving-line split*

To prevent the line signals of the signalling system from causing disturbances to subsequent signalling systems, the circuit should be split at the outgoing and incoming exchanges when the signal frequency is received to ensure that no portion of the signal exceeding 15 ms duration may pass out of the circuit. The initial portion of the split may be a complete split, but subsequent to signal receiver operation the complete split must cease and a signalling frequency band-stop filter inserted. The use of a band-stop filter for splitting is necessary since in case of non-charged calls a continuous signalling tone persists in the return path direction during conversation. The level of leak signal current transmitted to the subsequent circuit from the splitting device in the split condition should be at least 35 db below the received signal level.

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

The split must be maintained for the duration of the signals, but should cease within 20 ms after the signal receiver has released. The splitting of the line must not give rise to surges which might cause interference with signalling.

4.2 *Transmitting-line split*

To prevent incorrect operation of the signal receiver due to surges caused by the opening or closing of d.c. circuits connected to the line at the transmitted signal end, the following arrangements should be made for the transmission of the signals:

a) On transmittal of a tone signal, the transmitting path on the exchange side of the circuit shall be disconnected within 5 ms of the start of the signal. The split must persist for at least 300 ms but should not extend beyond 750 ms.

b) On initiation of a no-tone signal, the transmitting path on the exchange side of the circuit shall be disconnected within 5 ms of the start of the signal. The split must be ceased within 75 to 160 ms.

c) A signalling unit receiving and sending tones simultaneously shall maintain the split discussed under *a)* above until, as in *b)*, the transmitted tone ceases or the incoming tone ceases. In this latter event, the transmitting path must be restored within 750 ms of the termination of the incoming tone. This requirement establishes a transmitting path split at both ends of the circuit during the idle and dial pulsing condition.

5. Transmission requirements—line signalling

The receiving transmission path shall include a buffer amplifier to ensure that voice currents or noise from the near end of the circuit shall not interfere with proper operation of the signal receiver.

Refer to Recommendation Q.114 as an example for other detailed transmission requirements.

6. Signal code for line (supervisory) signalling

6.1 *Line signal code*

The coding arrangement is based on the application and removal of one frequency *f*1 (2600 c/s) as shown in Table 1.

By taking advantage of the fixed order of occurrence of specific signals, both tone-on and tone-off signals are used to indicate more than one signal condition. For example, in the backward direction *f*1 is used to indicate start dialling (proceed-to-send), and terminating end hang-up (clear-back) signals without conflict. The signalling equipment or associated trunk circuit equipment must operate in a sequential manner retaining memory of the preceding signalling states and the direction of signals in order to differentiate between like signals.

6.2 *Sending duration of line signals*

All signals are continuous signals that persist until the d.c. signal to be transmitted changes. As such, the ring forward (forward-transfer) signal consists of a 100 ± 30 ms *f*1 tone signal. Dial pulse signal lengths have been previously defined in section 3.5.

6.3 *Recognition times of line signals*

Recognition time is defined as the length of time a d.c. signal, at the output of the signal receiver, must persist before the signal is recognized as a valid condition by the switching equipment. Only two signals, the ring forward (forward-transfer) and originating end disconnect (clear-forward) signals, have an associated recognition time as defined above. All other signals are acted upon as soon as possible on a d.c. output indication from the signalling receiver.

The recognition time of the ring forward (forward-transfer) signal is approximately 50 ms. The recognition time of the originating end disconnect (clear-forward) signal must be in excess of 140 ms to permit positive discrimination between it and the ring forward (forward-transfer) signal.

Line signal code

TABLE 1

Signal *	Direction (1 and 2)	Transmitted duration (3)	Originating end	Terminating end
			Tone on or off	
Idle	← →	Continuous	on	on
Connect (seizing)	→	Continuous	off	on
Delay dialling (7)	←	Continuous	off	off
Start dialling (proceed-to-send)	←	Continuous	off	on
Dial pulses	→	Short tone pulses with short silent intervals	on-off	on
Answer or off-hook (answer)	←	Continuous	off	off
Hang-up or on-hook (clear-back)	←	Continuous	off	on
Disconnect (6) (clear-forward)	→	Continuous	on	on
Ring forward (forward-transfer) (4)	→	100 ± 30 ms	on	off
No circuit, Busy, Reorder (5)			off	on

* In some applications other signals are used such as WINK START PULSING and STOP and GO signals. For an explanation of these signals refer to the A.T. & T. Co. publication "*Notes on distance dialing*".

Notes on Table 1:

(1) → indicates forward signal.

(2) ← indicates backward signal.

(3) Transmitted duration of signals is directly proportional to the length of d.c. input signal and as such continues until the d.c. input signal changes.

(4) Ring forward (forward-transfer) signals, used on manual calls only, may be sent toward an end that is in either the answer or hang-up condition.

(5) No circuit, busy and reorder conditions are audible tone (600 c/s modulated by 120 c/s) interrupted at 30, 60, 120 interruptions per minute respectively.

(6) Access to the outgoing trunk shall be maintained busy for approximately 750 ms after initiation of the originating end disconnect (clear-forward) signal to ensure sufficient time for the release of the equipment at the incoming end.

(7) A signal sent by the incoming exchange to delay the transmission of multifrequency or dial pulses until the incoming office is in a condition to accept the pulses.

General notes (Dial pulsing systems)

(8) The time from the sending of the connect (seizing) signal to the return of the delay dialling signal should not exceed 300 ms. The sender should be prevented from looking for a start dialling (proceed-to-send) signal for a minimum of 300 ms. (See "*Notes on distance dialing*" for permissible variations of this procedure.)

(9) The interval between sender detection of the start dialling (proceed-to-send) signal and outpulsing shall be a minimum of 70 ms.

7. Dual seizure on both-way operation

7.1 *Unguarded interval*

In general, the unguarded interval relative to dual seizure is fairly short since it is primarily only a function of propagation time and signal receiver response time. As a result the probability of dual seizure is usually fairly small.

7.2 *Detection of dual seizure*

In the event of dual seizure the incoming connect (seizing) signal at each end is recognized as a delay dialling signal. If a start dialling (proceed-to-send) signal is not received in 30 to 40 seconds, appropriate steps shall be taken by the registers to release the connection and route the call to reorder.

8. Multifrequency register signalling

8.1 *General*

Either automatic or direct operator access may be used for outgoing traffic. With automatic access the incoming digital signals are stored in a register until sufficient digital information is received to route the call properly, at which time a free trunk may be selected and a connect (seizing) signal sent. (In some switching systems all the digital information must be received before the switching process is started.) Subsequent to the receipt of a delay dialling signal and a start dialling (proceed-to-send) signal a KP signal followed by the numerical information and an end-of-pulsing ST signal are transmitted. The KP signal, which is normally 100 ms long, serves as a gate opener for the MF receiver associated with the distant incoming register. The transmission of the KP signal should be delayed by a minimum of 220 ms after receipt of the start dialling signal. When an operator has direct access to the network the ST signal is initiated by the operator, while in automatic access the ST signal is initiated by the register.

Register signalling is in a forward direction only and shall be a two-out-of-six multifrequency code as shown in Table 2. Three of the 15 possible codes are unused in normal service.

Register signal code

TABLE 2

Signals	Frequencies (compounded) c/s
KP	1100/1700
1	700/900
2	700/1100
3	900/1100
4	700/1300
5	900/1300
6	1100/1300
7	700/1500
8	900/1500
9	1100/1500
0	1300/1500
ST	1500/1700

8.2 *Transmitted (sending end) signal limits*

8.2.1 *Signalling frequencies*

700, 900, 1100, 1300, 1500 and 1700 c/s. A signal shall consist of a combination of any two of these six frequencies. The frequency variation shall not exceed ± 1.5% of each nominal frequency.

8.2.2 *Transmitted signal level*

−6 ± 1 dbm0 per frequency.

8.2.3 *Signal frequency leak*

The level of the leak current transmitted to the line should be at least:

a) 50 db below the single-frequency level when a multifrequency signal is not being transmitted;

b) 30 db below the transmitted-signal level of either of the two frequencies when a multifrequency signal is being transmitted.

8.2.4 *Signal durations*

KP signal: 100 ms ± 10 ms
All other signals: 68 ± 7 ms
Interval between all signals: 68 ± 7 ms.

8.2.5 *Compound signal tolerance*

The interval of time between the moments when the two frequencies comprising a signal are sent must not exceed 1 ms. The interval of time between the moments when the two frequencies cease must not exceed 1 ms.

8.3 *Multifrequency signal receiver*

8.3.1 *Operate limits*

The signal receiver must operate satisfactorily to any combination of two of the frequencies received as a single pulse, or to a train of pulses, which satisfy the following conditions:

a) Duration of received signals:

1. Digits and ST, 27 ms or greater.

2. KP, 55 ms or greater.

3. Silent interval of 20 ms or greater.

4. The digit pulsing rate: not to exceed 10 digits per second. (Some registers have pulsing speed limitations which necessitate limiting the maximum speed to 8.5 digits per second. Overseas registers used in C.C.I.T.T. system No. 5 accept 10 digits per second.)

b) Transmission limits of received signals:

1. Frequencies: ± 1.5% ± 10 c/s of the nominal frequency.

2. Maximum absolute power per received frequency at the input of the receiver: 0 dbm.

3. Minimum absolute power per received frequency at the input of the receiver: −22 dbm.

4. Maximum frequency attenuation distortion: 6.5 db between any two frequencies comprising a signal.

5. Maximum delay distortion between 700 and 1700 c/s: 6 ms providing both frequencies comprising a signal persist simultaneously for a minimum of 25 ms.

6. Maximum noise: −35 dbm0 noise of uniform spectral energy over the frequency range 300 to 3400 c/s.

7. Minimum receiver recognition time includes the "two and only two frequency" check.

Notes

1. The limits given in *a)* and *b)* allow for variations at the sending end and for variations in line transmission.

2. The wide input level range of −22 to 0 dbm permits multifrequency application on trunks having low or high transmission loss.

8.3.2 *Non-operate conditions*

a) Maximum sensitivity

The signal receiver shall not operate on a signal whose absolute power level at the point of connection of the receiver is −30 dbm.

b) Transient response

The operation of the signal receiver shall be delayed for a minimum period necessary to guard against false operation due to spurious signals generated within the receiver on the reception of any signal.

c) Short signal response

The signal receiver should not operate on a pulse signal of 10 ms or less. This signal may be of a single frequency or two frequencies received simultaneously.

8.3.3 *Input impedance*

The value of the input impedance should be such that the return loss over a frequency range 300 to 3400 c/s against a 600-ohm non-inductive resistor in series with a two-microfarad capacitor is greater than 20 db.

9. Release of registers

9.1 *Normal release conditions*

An outgoing or incoming register shall release when it has completed out-pulsing or when released by a common control unit after a switching operation not requiring out-pulsing is completed.

9.2 *Abnormal release condition*

a) An outgoing register shall release when directed by an appropriate common control unit in any of the following situations:

1. on failure to receive a start dialling (proceed-to-send) signal within 30 seconds of circuit seizure;
2. on receipt of an unexpected delay dialling signal subsequent to receipt of a start dialling (proceed-to-send) signal;
3. on exceeding over-all register timing of 240 seconds.

b) An incoming register shall release when directed by an appropriate common control unit in any of the following situations:

1. on failure to receive the first digit within 10 seconds of register seizure;
2. on failure to receive the second and third digits within 10 seconds of registration of the first digit;
3. on failure to receive the remaining digits within 30 seconds;
4. on error detection such as receipt of more than two frequencies;
5. on failure to gain access to associated switching equipment within appropriate intervals of time.

The timing intervals indicated in *a)* and *b)* are representative values but do not necessarily apply to all types of switching systems.

Abnormal releases normally result in the return of a reorder tone toward the originating end (600 c/s modulated by 120 c/s interrupted 120 times a minute).

SUPPLEMENTS CONCERNING THE WORK OF STUDY GROUP XIII

Supplement No. 8. — Table of the Erlang loss formula (Erlang No. 1 formula, also called Erlang B formula).

Supplement No. 9. — Curves showing the relation between the traffic offered and the number of circuits required according to Recommendations Q.81, Q.82 and Q.84.

Supplement No. 10. — Reply to the question on the grade of service studied in 1961-1964.

Supplement No. 11. — Reply to part 1 of Question 3/XIII studied in 1961-1964.

Supplement No. 12. — Reply to part 2 of Question 3/XIII studied in 1961-1964.

Supplement No. 13. — Recording of traffic values supplied by the Swedish Administration.

Supplement No. 14. — Traffic statistics recorded by the French Administration.

SUPPLEMENT No. 8

TABLE OF THE ERLANG LOSS FORMULA

(Erlang No. 1 formula, also called Erlang B formula)

Loss probabilities: 1%, 3%, 5%, 7%.

Formula :

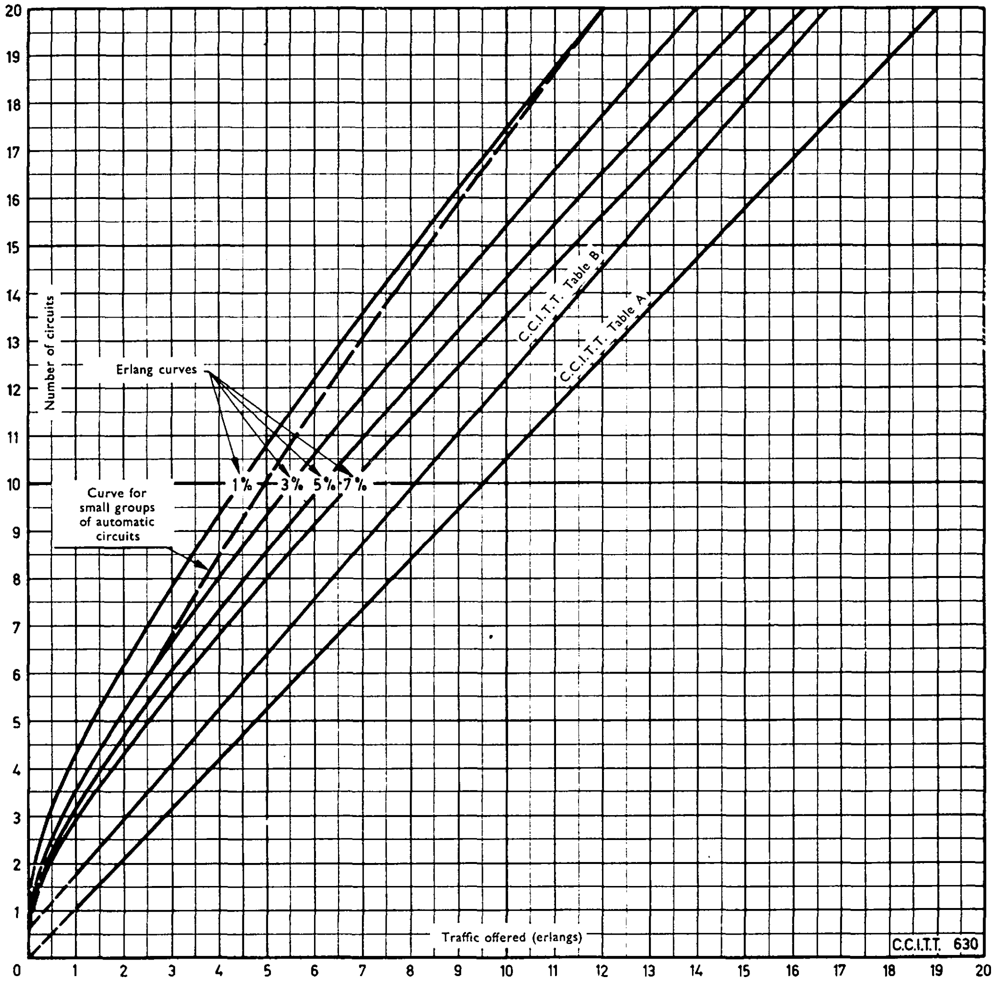
let p = the loss probability
y = the traffic offered (in erlangs)
n = the number of circuits

$$E_{1,n}(y) = p = \frac{\dfrac{y^n}{n!}}{1+\dfrac{y}{1}+\dfrac{y^2}{2!}+\cdots+\dfrac{y^n}{n!}}$$

n	$p = 1\%$	$p = 3\%$	$p = 5\%$	$p = 7\%$	n	$p = 1\%$	$p = 3\%$	$p = 5\%$	$p = 7\%$
1	0.01	0.03	0.05	0.08	51	38.80	42.89	45.53	47.72
2	0.15	0.28	0.38	0.47	52	39.70	43.85	46.53	48.76
3	0.46	0.72	0.90	1.06	53	40.60	44.81	47.53	49.79
4	0.87	1.26	1.53	1.75	54	41.50	45.78	48.54	50.83
5	1.36	1.88	2.22	2.50	55	42.41	46.74	49.54	51.86
6	1.91	2.54	2.96	3.30	56	43.31	47.70	50.54	52.90
7	2.50	3.25	3.74	4.14	57	44.22	48.67	51.55	53.94
8	3.13	3.99	4.54	5.00	58	45.13	49.63	52.55	54.98
9	3.78	4.75	5.37	5.88	59	46.04	50.60	53.56	56.02
10	4.46	5.53	6.22	6.78	60	46.95	51.57	54.57	57.06
11	5.16	6.33	7.08	7.69	61	47.86	52.54	55.57	58.10
12	5.88	7.14	7.95	8.61	62	48.77	53.51	56.58	59.14
13	6.61	7.97	8.84	9.54	63	49.69	54.48	57.59	60.18
14	7.35	8.80	9.73	10.48	64	50.60	55.45	58.60	61.22
15	8.11	9.65	10.63	11.43	65	51.52	56.42	59.61	62.27
16	8.88	10.51	11.54	12.39	66	52.44	57.39	60.62	63.31
17	9.65	11.37	12.46	13.35	67	53.35	58.37	61.63	64.35
18	10.44	12.24	13.39	14.32	68	54.27	59.34	62.64	65.40
19	11.23	13.11	14.31	15.29	69	55.19	60.32	63.65	66.44
20	12.03	14.00	15.25	16.27	70	56.11	61.29	64.67	67.49
21	12.84	14.89	16.19	17.25	71	57.03	62.27	65.68	68.53
22	13.65	15.78	17.13	18.24	72	57.96	63.24	66.69	69.58
23	14.47	16.68	18.08	19.23	73	58.88	64.22	67.71	70.62
24	15.29	17.58	19.03	20.22	74	59.80	65.20	68.72	71.67
25	16.13	18.48	19.99	21.21	75	60.73	66.18	69.74	72.72
26	16.96	19.39	20.94	22.21	76	61.65	67.16	70.75	73.77
27	17.80	20.31	21.90	23.21	77	62.58	68.14	71.77	74.81
28	18.64	21.22	22.87	24.22	78	63.51	69.12	72.79	75.86
29	19.49	22.14	23.83	25.22	79	64.43	70.10	73.80	76.91
30	20.34	23.06	24.80	26.23	80	65.36	71.08	74.82	77.96
31	21.19	23.99	25.77	27.24	81	66.29	72.06	75.84	79.01
32	22.05	24.91	26.75	28.25	82	67.22	73.04	76.86	80.06
33	22.91	25.84	27.72	29.26	83	68.15	74.02	77.87	81.11
34	23.77	26.78	28.70	30.28	84	69.08	75.01	78.89	82.16
35	24.64	27.71	29.68	31.29	85	70.02	75.99	79.91	83.21
36	25.51	28.65	30.66	32.31	86	70.95	76.97	80.93	84.26
37	26.38	29.59	31.64	33.33	87	71.88	77.96	81.95	85.31
38	27.25	30.53	32.62	34.35	88	72.81	78.94	82.97	86.36
39	28.13	31.47	33.61	35.37	89	73.75	79.93	83.99	87.41
40	29.01	32.41	34.60	36.40	90	74.68	80.91	85.01	88.46
41	29.89	33.36	35.58	37.42	91	75.62	81.90	86.04	89.52
42	30.77	34.30	36.57	38.45	92	76.56	82.89	87.06	90.57
43	31.66	35.25	37.57	39.47	93	77.49	83.87	88.08	91.62
44	32.54	36.20	38.56	40.50	94	78.43	84.86	89.10	92.67
45	33.43	37.16	39.55	41.53	95	79.37	85.85	90.12	93.73
46	34.32	38.11	40.54	42.56	96	80.31	86.84	91.15	94.78
47	35.22	39.06	41.54	43.59	97	81.24	87.83	92.17	95.83
48	36.11	40.02	42.54	44.62	98	82.18	88.82	93.19	96.89
49	37.00	40.98	43.53	45.65	99	83.12	89.80	94.22	97.94
50	37.90	41.93	44.53	46.69	100	84.06	90.79	95.24	98.99

SUPPLEMENT No. 9

CURVES SHOWING THE RELATION BETWEEN THE TRAFFIC OFFERED AND THE NUMBER OF CIRCUITS REQUIRED ACCORDING TO RECOMMENDATIONS Q.81, Q.82, AND Q.84



Relation between the traffic (in erlangs) offered and the number of circuits required in the case of:

- the C.C.I.T.T. Tables A and B (Recommendation Q.81)
- the Erlang formula ($p = 1\%$, 3%, 5% and 7%)
- the curve for small groups of automatic circuits (see Annex to Recommendation Q.84)

FIGURE 1. — **Number of circuits between 1 and 20**

Relation between the traffic (in erlangs) offered and the number of circuits required in the case of the Erlang formula for ($p = 1\%$, 3%, 5% and 7%)

FIGURE 2. — **Number of circuits between 1 and 100**

SUPPLEMENT No. 10

CONSIDERATION BY WORKING PARTY 5 OF THE "GRADE OF SERVICE" QUESTION IN MELBOURNE (OCTOBER 1963)

(Document COM XIII—No. 80, page 105)

Working Party 5 has noted the proposal in document COM XIII—No. 46 (page 11) in respect to the "Grade of service" for the mean busy hour, and for the days when the traffic flow is exceptionally high.

> "A loss probability of 0.01 is to be considered for large groups and 0.03 for smaller groups when these circuits are calculated for automatic operation (amendments to Recommendation E.95). This probability applies to final routes.
>
> "The traffic to be considered in the calculations is the mean busy hour traffic during the busy season (Recommendation E.1, paragraph 20) and not the busy-hour traffic of an exceptional day. *However, it should be verified that the loss probability in the case of a busy hour of an exceptional day does not exceed 0.07 to 0.08*".

It is appreciated that the recommended procedure for sampling the mean busy-hour traffic provides a practical basis for estimating the growth of the mean busy-hour traffic, and also for "defining" the grade of service within certain confidence limits, but there is considerable doubt whether such measurements of "carried traffic" would provide an acceptable basis for determining whether a projected number of circuits would be adequate for the proposed grade of service for exceptional days.

On such days the number of attempts to establish a connection which find no free circuit will be much larger than on days when the traffic does not exceed the mean busy-hour value. In consequence the number of subsequent attempts will be greatly increased and may be expected to constitute a large percentage of all the call attempts which find no free circuit.

The recommended procedure for measuring the traffic carried by a group of circuits provides virtually no information about subscribers' behaviour in respect to subsequent attempts. The anticipated growth in subscriber-dialling and pushbutton-calling may be expected to result in reduced intervals between subsequent attempts.

The Working Party has considerable doubts whether the procedures which might be necessary to determine the extent and frequency of subsequent attempts would be found acceptable to Administrations. As a consequence it wonders whether there may not be better methods of establishing the grade of service standards to cater for exceptional days.

SUPPLEMENT No. 11

REPLY TO PART 1 OF QUESTION 3/XIII BY WORKING PARTY 5 IN MELBOURNE (OCTOBER 1963)

(Document COM XIII—No. 80, page 109)

PART 1 OF QUESTION 3/XIII

How should the grade of service for the international circuits be defined to take into account the service for the busiest hours and during the mean busy hour?

REPLY PROPOSED BY WORKING PARTY 5

1. Possible bases for grade of service standards

1.1 The following alternative methods have been considered as a partial basis for the definition of the grade of service standard:

(1) the amount of traffic experiencing congestion,

(2) the call congestion,

(3) the duration of congestion, or

(4) an "improvement function".

These different definitions will not necessarily lead to identical results regarding the number of circuits to be provided on a particular route, but nevertheless the different grade of service requirements will be satisfied provided the traffic information is reliable enough.

1.2 These definitions are not, however, in themselves sufficient since the different methods of specifying the grade of service must be related to a period which could be a complete year, the mean busy hour for a year, for a quarter, for the '*n*' busiest days or for some shorter period such as a selection of known busy days. The choice of the specified period must relate to the measurement arrangement and the specific probability traffic tables which are used. Thus the following alternatives were considered by the Working Party:

I. Methods leading to estimates of traffic carried and, therefrom, offered traffic

1. *a)* Take a 10-day sample after the manner now defined in the *Red Book* (Recommendation E.1, paragraph 20).

1. *b)* Take a 10-day sample from the results of measurements made over a much longer period, for example, 13 weeks.

2. *a)* Use a first parameter such as the average of the time-consistent busy-hour traffic of the '*n*' highest days of the year (not necessarily consecutive days) as a basis of a forecasting and dimensioning process.

2. *b)* Use also a second parameter such as the average of the time-consistent busy-hour traffic of the 'n_2' highest days of the year (not necessarily consecutive days) as a supplementary basis of a forecasting and dimensioning process.

(*Note.*—n is greater than n_2. Typical values: $n = 30$, $n_2 = 5$)

3. Measure over a comparatively long period of time (e.g., 13 weeks to complete year), rank the individual daily busy-hour traffics (now time-consistent busy hours) in order of descending magnitude and adopt the traffic during the nth busiest hour as the basis.

4. Establish a histogram for the traffic flow in the mean busy hour (Recommendation E.1, paragraph 20) for the whole year.

II. Methods leading directly to circuit estimates

Since it may be possible to determine the required number of circuits in other ways, the Working Party also considered:

1) the amount of traffic experiencing congestion,
2) the call congestion,
3) the duration of congestion, or
4) an "improvement function".

2. General comments of grade of service tolerances

Various combinations of the above criteria and methods lead to procedural errors and, before proceeding further, it seems appropriate to comment on grade-of-service tolerances in general. The Working Party believes that the certainty with which the number of circuits to be estimated satisfies the specified value of the grade of service depends on the tolerance acceptable. The less the tolerance permitted, the greater will be the need for accuracy, and hence the smaller will be the margin permissible for procedural errors. In other words, it may be stated that if a simple sampling procedure is to be employed a rather wide tolerance must be permitted in the grade-of-service requirements.

To illustrate with a 10-day sample this condition becomes more critical in the case of the exceptionally busy days because the 10-day sample will provide only meagre information about such busy days.

The Working Party appreciates that there are objections to admitting wide tolerances to the specified grade of service, and it has therefore studied other possibilities.

3. Specific comments on methods for traffic estimation (refers to paragraph 1.2.I)

3.1 *Method recommended in Recommendation E.1, paragraph 20 (see 1.2.I.a)*

Studies have been carried out to determine what error is likely to result if the traffic-flow measurement is made strictly in accordance with the method defined in the *Red Book* (Recommendation E.1, paragraph 20). Such studies indicate that the provision of circuits might be underestimated by as much as 15% to 20%. This error would be mainly due to the specified procedure and not to any error in measurement.

The basic source of this "procedural error" is the fact that the 10-day sample measured is not a true representation of the busy season. It is evident that it is not a constant error but that it depends on several factors, such as variation in the busy season from year to year, and on the ability to select the correct sample period from background information, etc.

3.2 *10-day sub-sample from larger population (see 1.2.I.1.b)*

The 10-day sample procedure (as defined in Recommendation E.1, paragraph 20) is characterized by measuring the traffic carried during the mean busy hour and using a set of curves (or tables) for converting a traffic flow value into a number of circuits. A change to other curves (or tables) based on a different theory cannot obviate inaccuracy due to a procedural error in the choice of the sample. This error could be reduced by measuring the traffic flow during the mean busy hour for 13 weeks or even longer.

3.3 *Method based on larger sample and two traffic parameters (see 1.2.I.2. a and b)*

The measurement of the traffic flow during the mean busy hour (Recommendation E.1, paragraph 20) for 12 months could be used to provide a basis for defining the grade of service with fair accuracy. The first parameter could be based on the mean of, say, the 30 busiest days, while a second parameter could be based on the mean of, say, the five busiest days. The relationship between these two means can be used to determine the requirements of exceptionally busy days, and to indicate any likelihood that the offered traffic has been restricted by the existing number of circuits. The methods described in 3.2 and 3.3 can provide a "running mean of the traffic flow" calculated monthly or less frequently. Such values would be independent of seasonal and daily variations. They also have the advantage that an unwieldy accumulation of statistics can be avoided. There is no need to choose measurement days which are unaffected by public holidays in terminal and transit countries. The procedure would permit traffic statistics to be measured without difficulty outside the mean busy hour if such information is needed by another Administration for the study of the anticipated traffic for some other network busy hour. A further feature of this method is the ability to observe growth for the different months of the year.

3.4 *Use of "reference hour"*

Studies have been carried out based on the 10th busiest hour (e.g., the carried traffic flow value for the day on which the mean busy hour traffic is tenth in order of descending magnitude). It would appear that the use of such criteria based on measurements during the busiest quarter of the year would give a procedural error of only about 4% in the number of circuits to be provided. This result is good enough to suggest that the reference hour would be a fair basis for comparison of the various sampling methods. It seems possible in this way, from traffic observations made for a period such as a whole year, to compare the results obtained from the various methods of sampling with the traffic value of the reference hour. It is in such a way that the error described in the first paragraph of 3.1 can be evaluated for several groups.

However, statistical information about the reference hour is, as yet, very limited. Thus it is desirable to study further which particular hour should be chosen for the reference hour. With the use of a reference hour there are several methods by which the number of circuits can be determined. For example, the Erlang or Poisson loss curves (E or P curves), or perhaps a single improvement curve (F curve) could be used.

4. Comments on methods leading directly to circuit estimates (refers to paragraph 1.2.II)

The first two methods using new criteria assume that the grade of service requirement would be specified on the basis of the amount of traffic or the number of calls experiencing congestion. The third method would be similar but based on the duration of congestion. A direct method would be to establish a histogram for observed values of the congestion, either as call congestion, traffic congestion or as time congestion. This would give a direct basis for the evaluation of existing traffic-handling conditions during the period of measurement. The fourth method, using an improvement function, would need the grade of service requirement to be specified by some fixed amount which the improvement total must not exceed; these four methods need further study.

5. Conclusions regarding methods

While it is highly desirable that an accurate traffic base be obtained, it must not be overlooked that economic conditions and world events may and sometimes will overshadow the accuracy obtained by a precise measurement.

SUPPLEMENT No. 12

REPLY TO PART 2 OF QUESTION 3/XIII BY WORKING PARTY 5 IN MELBOURNE (OCTOBER 1963)

(Document COM XIII—No. 80, page 125)

PART 2 OF QUESTION 3/XIII

What is the minimum amount of traffic data necessary to plan for any specified grade of service?

REPLY PROPOSED BY WORKING PARTY 5

Any of the following measured parameters could form a basis for planning for any specified grade of service:

1. Carried traffic flow
2. Total number of call attempts (including repeated attempts)
3. Period during which all circuits are occupied
4. Number of calls experiencing congestion

(See Volume VI of the *Red Book*, page 198, section 1.2.)

The minimum amount of traffic data which would be necessary to plan for any specified grade of service would be either:

a) parameter 1 alone, but preferably

b) parameters 1, 2 and 3, or

c) parameters 1, 2 and 4.

The measurement of parameter 4 might involve difficulties on both-way circuits and therefore parameters 1, 2 and 3 are preferred.

Notes. — 1. Where alternate routing facilities are available, a distinction should be made between high-usage routes and final route.

2. For traffic relations involving partial or complete transit switching, the minimum amount of data would be the number of call attempts supplemented, when possible, by measurements to derive the mean holding time. In some cases the traffic is mixed with traffic of other relations.

It would be advantageous to be able to collect (perhaps on one relation at a time) the number of call attempts experiencing congestion and the point of congestion.

Such information would presumably be valuable for maintenance also.

It is suggested that signalling facilities that provide such data should be classified "desirable".

SUPPLEMENT No. 13

RECORDING OF TRAFFIC VALUES PRESENTED BY THE SWEDISH ADMINISTRATION

The traffic values recorded by the Swedish Administration are a continuation of those published in Volume VI of the *Red Book*, on page 202, for the period from 1 June 1959 to 1 July 1960.

These values have been recorded to examine the possibility of recording traffic by automatic equipment, as indicated in the Annex to Recommendation Q.85.

The tables published on the following three pages are for the period from 1 August 1960 to 1 July 1963. For each month of the period, the traffic flow values for the 30 highest days during the preceding 12 months are listed in order of magnitude, with the day and the month concerned shown beside them. The entries in brackets indicate the highest traffic values for the preceding month. 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.

For each month, there is shown at the foot of the column:

- the number of new highest values recorded,
- the average of the 5 highest values,
- and the average of the 30 highest values.

Recording of traffic values

	1.8.60	1.9.60	1.10.60	1.11.60	1.12.60	1.1.61	1.2.61	1.3.61	1.4.61	1.5.61	1.6.61	1.7.61
1	23/6 94	23/6 94	23/6 94	23/6 94	23/6 94	(19/12 96)	19/12 96	19/12 96	(24/3 98)	(17/4 102)	(15/5 103)	15/5 103
2	20/6 93	20/6 93	20/6 93	20/6 93	20/6 93	23/6 94	23/6 94	23/6 94	(13/3 97)	(10/4 101)	17/4 102	17/4 102
3	31/5 92	31/5 92	31/5 92	31/5 92	31/5 92	(8/12 94)	8/12 94	8/12 94	19/12 96	(24/4 101)	10/4 101	10/4 101
4	13/6 92	13/6 92	13/6 92	13/6 92	13/6 92	20/6 93	20/6 93	20/6 93	(27/3 95)	24/3 98	24/4 101	24/4 101
5	24/5 89	(22/8 90)	22/8 90	(17/10 91)	17/10 91	31/5 92	(31/1 92)	31/1 92	23/6 94	13/3 97	(23/5 98)	23/5 98
6	7/6 89	24/5 89	24/5 89	(24/10 90)	24/10 90	13/6 92	31/5 92	31/5 92	(14/3 94)	19/12 96	24/3 98	24/3 98
7	8/6 88	7/6 89	7/6 89	22/8 90	(8/11 90)	17/10 91	13/6 92	13/6 92	8/12 94	27/3 95	(16/5 97)	16/5 97
8	3/6 88	8/6 88	8/6 88	24/5 89	22/8 90	(13/12 91)	(9/1 92)	9/1 92	(6/3 94)	23/6 94	(29/5 97)	29/5 97
9	22/6 88	3/6 88	3/6 88	7/6 89	24/5 89	(6/12 90)	17/10 91	(14/2 91)	20/6 93	14/3 94	(10/5 97)	10/5 97
10	23/5 86	22/6 88	22/6 88	8/6 88	7/6 89	24/10 90	13/12 91	17/10 91	(22/3 93)	(13/4 94)	(24/5 97)	24/5 97
11	10/6 85	(15/8 87)	15/8 87	(11/10 88)	(9/11 89)	8/11 90	6/12 90	13/12 91	31/1 92	8/12 94	13/3 97	13/3 97
12	30/5 85	(29/8 86)	29/8 86	3/6 88	(21/11 88)	(12/12 90)	24/10 90	(6/2 91)	31/5 92	6/3 94	19/12 96	19/12 96
13	14/6 85	23/5 86	23/5 86	(3/10 88)	8/6 88	22/8 90	8/11 90	6/12 90	13/6 92	20/6 93	(18/5 96)	18/5 96
14	9/6 83	(30/8 86)	30/8 86	22/6 88	11/10 88	24/5 89	12/12 90	24/10 90	9/1 92	22/3 93	(19/5 95)	19/5 95
15	21/6 83	10/6 85	10/6 85	31/10 87	3/6 88	7/6 89	22/8 90	8/11 90	(21/3 91)	(25/4 92)	27/3 95	(1/6 95)
16	1/6 82	30/5 85	(28/9 85)	15/8 87	3/10 88	9/11 89	24/5 89	12/12 90	14/2 91	31/1 92	23/6 94	27/3 95
17	16/5 81	14/6 85	30/5 85	29/8 86	22/6 88	21/11 88	7/6 89	22/8 90	17/10 91	31/5 92	(8/5 94)	(19/6 95)
18	25/5 81	9/6 83	14/6 85	23/5 86	(29/11 88)	8/6 88	9/11 89	24/5 89	13/12 91	13/6 92	14/3 94	8/5 94
19	15/6 81	21/6 83	(29/9 85)	30/8 86	31/10 87	11/10 88	21/11 88	7/6 89	6/2 91	9/1 92	13/4 94	14/3 94
20	17/6 80	(24/8 83)	(23/9 84)	10/6 85	15/8 87	3/6 88	8/6 88	9/11 89	6/12 90	21/3 91	8/12 94	(5/6 94)
21	17/5 79	1/6 82	(5/9 84)	28/9 85	(3/11 86)	3/10 88	11/10 88	21/11 88	(3/3 90)	14/2 91	6/3 94	13/4 94
22	2/6 79	16/5 81	9/6 83	30/5 85	(30/11 86)	22/6 88	3/6 88	8/6 88	24/10 90	17/10 91	20/6 93	8/12 94
23	17/3 79	25/5 81	21/6 83	14/6 85	29/8 86	(14/12 88)	3/10 88	11/10 88	8/11 90	13/12 91	22/3 93	6/3 94
24	29/6 78	(31/8 81)	24/8 83	29/9 85	23/5 86	29/11 88	22/6 88	(7/2 88)	12/12 90	6/2 91	25/4 92	22/3 93
25	11/5 78	(23/8 81)	(21/9 83)	(10/10 85)	30/8 86	(5/12 88)	14/12 88	3/6 88	22/8 90	6/12 90	(3/5 92)	(6/6 93)
26	18/5 78	15/6 81	(26/9 83)	23/9 84	10/6 85	31/10 87	(18/1 88)	3/10 88	(20/3 89)	3/3 90	31/1 92	(7/6 92)
27	16/12 78	17/6 80	1/6 82	(4/10 84)	28/9 85	15/8 87	29/11 88	22/6 88	24/5 89	24/10 90	13/6 92	25/4 92
28	(1/7 77)	(17/8 79)	(20/9 82)	(27/10 84)	(28/11 85)	(9/12 87)	5/12 88	14/12 88	7/6 89	8/11 90	9/1 92	3/5 92
29	9/5 77	17/5 79	25/5 81	5/9 84	30/5 85	(15/12 87)	(3/1 87)	18/11 88	(29/3 89)	12/12 90	21/3 91	31/1 92
30	28/6 77	2/6 79	31/8 81	21/6 83	14/6 85	3/11 86	31/10 87	29/11 88	(9/3 89)	28/8 90	14/2 91	9/1 92
Number of new highest values												
	1	8	7	8	7	9	4	3	11	5	10	5
Average of the 5 highest values												
	92.0	92.2	92.2	92.4	92.4	93.8	93.8	93.8	96.0	99.8	101.0	101.0
Average of the 30 highest values												
	83.5	85.2	86.1	87.4	88.1	89.5	89.9	90.2	91.9	93.4	95.4	95.7

	1.8.61	1.9.61	1.10.61	1.11.61	1.12.61	1.1.62	1.2.62	1.3.62	1.4.62	1.5.62	1.6.62	1.7.62
1	15/5 103	15/5 103	15/5 103	15/5 103	15/5 103	(11/12 107)	11/12 107	11/12 107	11/12 107	11/12 107	11/12 107	11/12 107
2	17/4 102	17/4 102	17/4 102	17/4 102	17/4 102	15/5 103	15/5 103	15/5 103	15/5 103	15/5 103	9/10 101	9/10 101
3	10/4 101	10/4 101	10/4 101	10/4 101	10/4 101	17/4 102	17/4 102	17/4 102	17/4 102	9/10 101	21/8 99	21/8 99
4	24/4 101	24/4 101	24/4 101	(9/10 101)	9/10 101	10/4 101	10/4 101	10/4 101	10/4 101	21/8 99	22/11 99	22/11 99
5	23/5 98	(21/8 99)	21/8 99	24/4 101	24/4 101	9/10 101	9/10 101	9/10 101	9/10 101	22/11 99	30/10 98	30/10 98
6	24/3 98	23/5 98	23/5 98	21/8 99	21/8 99	24/4 101	24/4 101	24/4 101	24/4 101	23/5 98	21/11 97	21/11 97
7	16/5 97	24/3 98	24/3 98	23/5 98	(22/11 99)	21/8 99	21/8 99	21/8 99	21/8 99	30/10 98	(2/5 97)	2/5 97
8	29/5 97	16/5 97	16/5 97	24/3 98	23/5 98	22/11 99	22/11 99	22/11 99	22/11 99	16/5 97	4/12 96	4/12 96
9	10/5 97	29/5 97	29/5 97	(30/10 98)	24/3 98	23/5 98	23/5 98	23/5 98	23/5 98	29/5 97	18/12 96	18/12 96
10	24/5 97	10/5 97	10/5 97	16/5 97	30/10 98	24/3 98	24/3 98	24/3 98	30/10 98	21/11 97	23/10 95	(4/6 96)
11	13/3 97	24/5 97	24/5 97	29/5 97	16/5 97	30/10 98	30/10 98	30/10 98	16/5 97	10/5 97	1/6 95	23/10 95
12	19/12 96	13/3 97	13/3 97	10/5 97	29/5 97	16/5 97	16/5 97	16/5 97	29/5 97	24/5 97	12/12 95	12/12 95
13	18/5 96	19/12 96	19/12 96	24/5 97	(21/11 97)	29/5 97	29/5 97	29/5 97	21/11 97	4/12 96	(16/5 95)	16/5 95
14	19/5 95	18/5 96	18/5 96	13/3 97	10/5 97	21/11 97	21/11 97	21/11 97	10/5 97	18/5 96	(28/5 95)	28/5 95
15	1/6 95	19/5 95	19/5 95	19/12 96	24/5 97	10/5 97	10/5 97	10/5 97	24/5 97	18/12 96	19/6 95	7/12 95
16	27/3 95	1/6 95	1/6 95	18/5 96	13/3 97	24/5 97	24/5 97	24/5 97	4/12 96	23/10 95	7/12 95	(19/6 94)
17	19/6 95	27/3 95	27/3 95	(23/10 95)	19/12 96	13/3 97	13/3 97	13/3 97	18/5 96	19/5 95	5/6 94	25/9 94
18	8/5 94	19/6 95	19/6 95	19/5 95	18/5 96	(4/12 96)	4/12 96	4/12 96	18/12 96	1/6 95	25/9 94	21/12 94
19	14/3 94	8/5 94	8/5 94	1/6 95	23/10 95	18/5 96	18/5 96	18/5 96	23/10 95	12/12 95	21/12 94	16/4 94
20	5/6 94	14/3 94	14/3 94	27/3 95	19/5 95	(18/12 96)	18/12 96	18/12 96	19/5 95	19/6 95	16/4 94	15/11 94
21	13/4 94	5/6 94	5/6 94	19/6 95	1/6 95	23/10 95	23/10 95	23/10 95	1/6 95	7/12 95	15/11 94	5/12 94
22	8/12 94	13/4 94	(25/9 94)	8/5 94	27/3 95	19/5 95	19/5 95	19/5 95	12/12 95	18/5 94	5/12 94	18/9 94
23	6/3 94	8/12 94	13/4 94	14/3 94	19/6 95	1/6 95	1/6 95	1/6 95	19/6 95	5/6 94	18/9 94	18/10 94
24	22/3 93	6/3 94	8/12 94	5/6 94	18/5 94	(12/12 95)	12/12 95	12/12 95	7/12 95	25/9 94	18/10 94	(14/6 93)
25	6/6 93	(7/8 93)	6/3 94	25/9 94	14/3 94	27/3 95	27/3 95	27/3 95	18/5 94	21/12 94	12/9 93	12/9 93
26	7/6 92	22/3 93	(18/9 94)	13/4 94	5/6 94	19/6 95	19/6 95	19/6 95	5/6 94	(16/4 94)	(21/5 93)	21/5 93
27	25/4 92	6/6 93	(12/9 93)	8/12 94	25/9 94	(7/12 95)	7/12 95	7/12 95	25/9 94	15/11 94	7/8 93	(18/6 93)
28	3/5 92	7/6 92	7/8 93	6/3 94	13/4 94	18/5 94	18/5 94	18/5 94	21/12 94	5/12 94	6/6 93	(12/6 93)
29	31/4 92	25/4 92	22/3 93	18/9 94	(15/11 94)	25/9 94	25/9 94	25/9 94	13/4 94	18/9 94	7/6 92	7/8 93
30	9/1 92	3/5 92	6/6 93	(18/10 94)	6/3 94	(21/12 94)	21/12 94	21/12 94	15/11 94	18/10 94	26/2 92	26/2 92
Number of new highest values												
	0	2	3	4	3	6	0	0	0	1	4	5
Average of the 5 highest values												
	101.0	101.2	101.2	101.6	101.6	102.8	102.8	102.8	102.8	101.8	100.8	100.8
Average of the 30 highest values												
	95.7	95.9	96.1	96.6	96.9	97.5	97.5	97.5	97.2	96.5	95.4	95.4

	1.8.62	1.9.62	1.10.62	1.11.62	1.12.62	1.1.63	1.2.63	1.3.63	1.4.63	1.5.63	1.6.63	1.7.63
1	11/12 107	11/12 107	11/12 107	(15/10 108)	(28/11 110)	(17/12 112)	17/12 112	17/12 112	17/12 112	17/12 112	(22/5 114)	22/5 114
2	9/10 101	9/10 101	(17/9 102)	11/12 107	15/10 108	10/10 110	10/12 110	10/12 110	10/12 110	(10/4 111)	17/12 112	17/12 112
3	21/8 99	22/11 99	9/10 101	(23/10 104)	(26/11 108)	28/11 110	28/11 110	28/11 110	28/11 110	10/12 110	(20/5 112)	20/5 112
4	22/11 99	30/10 98	(18/9 100)	(31/10 103)	11/12 107	15/10 108	15/10 108	(25/2 109)	25/2 109	28/11 110	10/4 111	(10/6 111)
5	30/10 98	21/11 97	(24/9 100)	(3/10 102)	(19/11 106)	26/11 108	26/11 108	15/10 108	15/10 108	25/2 109	10/12 110	10/4 111
6	21/11 97	2/5 97	(13/9 100)	(30/10 102)	(14/11 105)	19/11 106	(7/1 108)	26/11 108	26/11 108	16/10 108	28/11 110	10/12 110
7	2/5 97	(29/8 97)	22/11 99	(29/10 102)	(12/11 104)	(11/12 105)	19/11 106	7/1 108	(4/3 108)	26/11 108	(28/5 110)	28/11 110
8	4/12 96	4/12 96	(25/9 98)	17/9 102	23/10 104	14/11 105	11/12 105	19/11 106	7/1 108	(9/4 108)	(16/5 110)	28/5 110
9	18/12 96	18/12 96	30/10 98	(8/10 101)	(6/11 104)	12/11 104	14/11 105	11/12 105	(12/3 106)	(8/4 108)	(25/2 109	16/5 110
10	4/6 96	4/6 96	21/11 97	(22/10 101)	(27/11 104)	(3/12 104)	12/11 104	(26/2 105)	19/11 106	4/3 108	15/10 108	25/2 109
11	23/10 95	23/10 95	2/5 97	18/9 100	31/10 103	23/10 104	3/12 104	14/11 105	11/12 105	7/1 108	26/11 108	15/10 108
12	12/12 95	12/12 95	29/8 97	24/9 100	3/10 102	6/11 104	(21/1 104)	(4/2 105)	26/2 105	(22/4 106)	9/4 108	26/11 108
13	16/5 95	16/5 95	4/12 96	13/9 100	30/10 102	27/11 104	23/10 104	12/11 104	14/11 105	12/3 106	8/4 108	9/4 108
14	28/5 95	28/5 95	18/12 96	22/11 99	(30/11 102)	(18/12 104)	6/11 104	3/12 104	4/2 105	19/11 106	(13/5 108)	8/4 108
15	7/12 95	7/12 95	4/6 96	(4/10 99)	(20/11 102)	(12/12 103)	27/11 104	21/1 104	12/11 104	(5/4 105)	4/3 108	13/5 108
16	19/6 94	19/6 94	23/10 95	(25/10 99)	(29/11 102)	31/10 103	18/12 104	23/10 104	3/12 104	11/12 105	7/1 108	4/3 108
17	25/9 94	25/9 94	12/12 95	25/9 98	29/10 102	(7/12 103)	12/12 103	6/11 104	21/1 104	(23/4 105)	(21/5 106)	7/1 108
18	21/12 94	21/12 94	16/5 95	(26/10 98)	17/9 102	3/10 102	(14/1 103)	27/11 104	(18/3 104)	26/2 105	22/4 106	(13/6 107)
19	16/4 94	16/4 94	28/5 95	(1/10 97)	(2/11 101)	30/10 103	31/10 102	18/12 104	23/10 104	14/11 105	12/3 106	(5/6 106)
20	15/11 94	15/11 94	7/12 95	21/11 97	8/10 101	30/11 102	7/12 103	12/12 103	6/11 104	4/2 105	(29/5 106)	21/5 106
21	5/12 94	5/12 94	19/6 94	2/5 97	22/10 101	20/11 102	3/10 102	14/1 103	27/11 104	(1/4 105)	19/11 106	22/4 106
22	18/9 94	18/9 94	(11/9 94)	29/8 97	18/9 100	29/11 102	30/10 102	31/10 103	18/12 104	12/11 104	5/4 105	12/3 106
23	18/10 94	18/10 94	(19/9 94)	(9/10 96)	24/9 100	29/10 102	30/11 102	7/12 103	12/12 103	3/12 104	11/12 105	29/5 106
24	14/6 93	14/6 93	21/12 94	4/12 96	13/9 100	17/9 102	20/11 102	3/10 102	14/1 103	21/1 104	23/4 105	19/11 106
25	12/9 93	12/9 93	16/4 94	(16/10 96)	4/10 99	2/11 101	29/11 102	30/10 102	31/10 103	18/3 104	26/2 105	5/4 105
26	21/5 93	21/5 93	(12/9 94)	18/12 96	25/10 99	(19/12 101)	29/10 102	30/11 102	7/12 103	23/10 104	14/11 105	11/12 105
27	18/6 93	18/6 93	15/11 94	4/6 96	(13/11 98)	8/10 101	17/9 102	20/11 102	3/10 102	6/11 104	4/2 105	23/4 105
28	12/6 93	12/6 93	5/12 94	(18/10 95)	25/9 98	22/10 101	2/11 101	29/11 102	30/10 102	27/11 104	(2/5 105)	26/2 105
29	7/8 93	(21/8 93)	18/10 94	12/12 95	(16/11 98)	(6/12 100)	19/12 101	29/10 102	(11/3 102)	18/12 104	1/4 105	(4/6 105)
30	26/2 92	26/2 92	(10/9 93)	28/5 95	26/10 98	18/9 100	(24/1 101)	17/9 102	30/11 102	12/12 103	3/12 104	2/5 105
Number of new highest values												
	0	2	9	15	13	8	4	3	4	7	8	4
Average of the 5 highest values												
	100.8	100.4	102.0	104.8	107.8	109.6	109.6	109.8	109.8	110.4	111.8	112.0
Average of the 30 highest values												
	95.4	95.4	96.6	99.3	102.3	103.8	104.3	104.8	105.2	106.3	107.6	107.9

SUPPLEMENT No. 14

TRAFFIC STATISTICS RECORDED BY THE FRENCH ADMINISTRATION

(Contribution to the study of part 1 of Question 3/XIII * studied in 1961-1964)

		1961		1962		
	$n = 10$	Average for $n = 1$ to 30	Average for $n = 1$ to 5	$n = 10$	Average for $n = 1$ to 30	Average for $n = 1$ to 5
Example from page 202 of Volume VI of the *Red Book* (1959)	72	70	76			
MALMÖ–GOTHENBURG	98	97	103	104	104	110
PARIS–BRUSSELS	35	34	40	59	56	77
PARIS–ANTWERP	14	14	20	14	13	17
PARIS–BORDEAUX	64	63	70	71	71	82
PARIS–CHARLEVILLE	15	15	17	19	19	22
PARIS–MULHOUSE	16	15	17	24	25	34
PARIS–NANCY	40	39	53	50	49	68
PARIS–ORLEANS	33	34	46	46	48	64
PARIS–ROUEN	92	88	101	102	100	114
PARIS–VALENCIENNES	14	13	15	18	18	24

Value, in erlangs, for traffic during the 10th busiest hour of the busy hours of the year (1 busy hour daily).

Average traffic during the 30 and the 5 busiest hours.

Note 1. — The first two lines represent observation of traffic carried, and the following nine observation of traffic offered.

Note 2. — Where observation is limited, for example to the three busy months of the year and to two consecutive busy hours daily, the 10th busiest hour of the year given in the table then corresponds approximately to the 5th busiest hour of the limited observation period (homologous points of histograms).

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* The reply to part 1 of this Question constitutes Supplement No. 11 above.

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