THE INTERNATIONAL TELEGRAPH AND TELEPHONE CONSULTATIVE COMMITTEE

(C.C.I.T.T.)

FIFTH PLENARY ASSEMBLY

GENEVA, 4-15 DECEMBER 1972

GREEN BOOK

VOLUME VI - 2

Telephone signalling and switching

COMMON CLAUSES TO THE STANDARDIZED SYSTEMS

SPECIFICATIONS OF SYSTEMS No. 3, No. 4, No. 5 and No. 5bis (Recommendations Q.101 to Q.232)

Published by
THE INTERNATIONAL TELECOMMUNICATION UNION
1973

THE INTERNATIONAL TELEGRAPH AND TELEPHONE CONSULTATIVE COMMITTEE

(C.C.I.T.T.)

FIFTH PLENARY ASSEMBLY

GENEVA, 4-15 DECEMBER 1972

GREEN BOOK

VOLUME VI - 2

Telephone signalling and switching

COMMON CLAUSES TO THE STANDARDIZED SYSTEMS

SPECIFICATIONS OF SYSTEMS No. 3, No. 4, No. 5 and No. 5bis (Recommendations Q.101 to Q.232)

Published by
THE INTERNATIONAL TELECOMMUNICATION UNION
1973

SPECIFICATIONS
FOR STANDARDIZED INTERNATIONAL SIGNALLING AND SWITCHING EQUIPMENT

INTRODUCTION

The strict observance of the clauses of these specifications is of 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.

PART VII

CLAUSES APPLICABLE TO C.C.I.T.T. STANDARD SYSTEMS

CHAPTER I

General. — Clauses applicable to all C.C.I.T.T. standard systems

Recommendation Q.101

1.1 FACILITIES PROVIDED IN INTERNATIONAL SEMI-AUTOMATIC WORKING

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

a) *outgoing* operators;

b) *incoming* operators;

c) *delay* operators;

d) *assistance* operators;

e) information or special service operators.

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

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

a) subscribers;

b) incoming operators at the incoming international exchange;

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

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

e) information or special service operators.

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

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

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

— any of the operators of this category;

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

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

1.1.5 *Notes on incoming and delay operators:*

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

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

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

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

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

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

---

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

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

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. Assistance operators may not be available on intraregional circuits.

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

Recommendation Q.102

1.2 FACILITIES PROVIDED IN INTERNATIONAL AUTOMATIC WORKING

In international automatic working, the calling subscriber can obtain only such subscriber numbers as are made up of the numerical digits appearing on his dial or push-button set. Hence, he cannot obtain operators reached by code-11 or code-12 signal, or an assistance operator reached by a forward-transfer signal. In principle, he should not obtain access to incoming, delay or information operators [1] reached by special numbers.

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

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

— enables the equipment in the outgoing international exchange to make a distinction between semi-automatic and automatic calls as is required when drawing up international accounts, as described in section 2 of Recommendation Q.51;

— enables, therefore, incoming equipment to serve both automatic and semi-automatic service;

— in systems No. 4, No. 5 *bis* and No. 6, informs the equipment in the international incoming exchange that it has not to rely on an end-of-pulsing signal (see Recommendation Q.106);

— enables the equipment in the incoming international exchange to prevent automatic calls from having access to certain destinations (special services, for example).

---

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

Recommendation Q.103

1.3 NUMBERING USED

1.3.1 *International prefix*

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

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

1.3.2 *Country code* [1]

Information about country codes will be found under 7.2 in Recommendation Q.11. In the international outgoing exchange, the country code is used:

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

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

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

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

Recommendation Q.104

1.4 LANGUAGE DIGIT OR DISCRIMINATING DIGIT

1.4.1 *Language digit* (or language information)

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

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

1 = French
2 = English
3 = German
4 = Russian
5 = Spanish
6, 7, 8 = available to Administrations for selecting a particular language provided by mutual agreement (in systems No. 5 and No. 5 *bis*, however, digit 7 is used on calls requiring access to test equipment)
9 = reserve (see 1.4.2.2)

[1] The country code may not be used on some intraregional calls.

1.4.1.3 The language digit (or information) is either:

— sent by the operator to the outgoing equipment; in this case the operator must send it immediately before the national (significant) number [1] of the called subscriber;

or

— sent automatically by the outgoing equipment.

1.4.2 *Discriminating digit* (or discriminating information)

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

1.4.2.2 The digit 9 (or its equivalent) in the list of language digits (or calling party's categories) has been kept in reserve for use as extra discriminating information if required. Such use should be for a call with special characteristics, but the digit 9 (or the equivalent information) must not be used merely to take the place of the digit 0 (or its equivalent) in an automatic call [2].

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

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

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

Recommendation Q.105

1.5 NATIONAL (SIGNIFICANT) NUMBER

1.5.1 In automatic working, the subscriber sends the called subscriber's national (significant) number [3] by means of a dial, push-button set, or automatic dialling divice.

1.5.2 In semi-automatic working, the operator sends the national (significant) number [3] of the called subscriber by means of a keyset for example.

1.5.3 The outgoing equipment must be designed to cater for a sufficient number of digits in the national (significant) number [3] as specified in Recommendation E.161/Q.11, paragraphs 2.2 and 3.

---

[1] See definition in Recommendation E.160/Q.10.

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

a) automatic calls and

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

Such a distinction might be necessary because:

— in international accounts, calls mentioned in b are 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.

[3] See the definitions in Recommendation E.160/Q.10.

Recommendation Q.106

1.6 THE SENDING-FINISHED SIGNAL

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

Note. — In semi-automatic working, local sending of the sending-finished signal will cause an " end-of-pulsing " signal to be sent on the international circuit [1] or signalling channel. This has the same function and shows the incoming equipment that there are no more digits to be received. In some cases also in automatic working, when the outgoing equipment decides that there are no more digits to follow, an end-of-pulsing signal is sent on the international circuit or signalling channel, for example in the ST condition of system No. 5 (see Recommendation Q.152).

Recommendation Q.107

1.7 SENDING SEQUENCE OF NUMERICAL (OR ADDRESS) SIGNALS

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

Notes to Table 1:

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

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

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

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

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

[6] For a call to a subscriber connected to a manual exchange obtained by automatic switching via the incoming international exchange, the national (significant) number consists of:

— the code of the required manual exchange in the national numbering plan;

— possibly the called subscriber's number if, in the incoming country, this number is required for routing the call to the manual exchange.

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

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

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

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

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

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

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

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

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

---

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

TABLE 1

SEQUENCE OF NUMERICAL (ADDRESS) SIGNALS

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

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

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

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

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

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

The following abbreviations are used throughout the table:

L = Language digit or information.
D = Discriminating digit or information.
Nat. No. = National (significant) number.
CP category ind. = Calling party's category indicator.
Routing inf. = Routing information in system No. 6 (terminal or transit indicator, nature of circuit indicator and echo-suppressor indicator).

Recommendation Q.108

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

1.8.1 *One-way operation*

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

1.8.2 *Both-way operation*

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

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

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

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

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

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

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

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

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

Recommendation Q.109

1.9 TRANSMISSION OF THE ANSWER SIGNAL IN INTERNATIONAL EXCHANGES

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

— the conversion of the national answer signal into the international answer signal and vice versa; and

— the transmission of the international answer signal over the international part of the connection,

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

CHAPTER II

Transmission clauses for signalling

A. Signalling on PCM links

Recommendation Q.110

2.0 GENERAL ASPECTS OF THE UTILIZATION OF STANDARDIZED C.C.I.T.T. SIGNALLING SYSTEMS ON PCM LINKS

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

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

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

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

2.0.2 *Signalling system No. 6*

Signalling system No. 6, as specified in Recommendations Q.251 to Q.295 may be used without modification by replacing the analogue voice-frequency channels of the data link by PCM voice-frequency channels. In this case, the connection of the modem to the PCM transmission channels should be made on a four-wire basis to the analogue input and the analogue output. Whilst this method is satisfactory, a digital version of system No. 6 is under study. The following proposals have so far been considered:

— asynchronous operation via a 64 kbit/s input port. With this mode of operation a 2400 bit/s data link is derived by sampling the 2400 bit/s data stream asynchronously at 64 kHz;

— synchronous operation at 2000 bit/s;

— synchronous operation at 4000 bit/s.

Synchronous operation at 2000 bit/s may be used without restriction. Synchronous operation at 4000 bit/s may be used over terrestrial PCM transmission systems by bilateral agreement. In the synchronous mode of operation, the digital data signals are applied via an appropriate signalling interface to a 2 or 4 kbit/s port of a PCM transmission system.

2.0.3 *Signalling system R1*

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

An alternative method of transmitting the line signals via a PCM system as specified in Recommendation G.733/Q.47 has been developed as the digital version of System R1. Details are given in Recommendations Q.310 to Q.332. The multifrequency interregister signals are applied in-band via the analogue input of the speech circuit.

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

2.0.4 *Signalling system R2*

The line signals of system R2 cannot be transmitted via an analogue input of a PCM transmission system since these signals are sent out-band using a 3825 Hz signalling channel. A digital version of the R2 line signalling system has been developed for use with a PCM system as specified in Recommendation Q.46 (G.732). Details are given in Recommendations Q.357-Q.359. The multifrequency interregister signals are applied in-band via the analogue input of the speech circuit.

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

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

Recommendation Q.112

2.1 SIGNAL LEVELS AND SIGNAL RECEIVER SENSITIVITY

2.1.1 *Standardized transmitted power*

The values of the standardized transmitted power for the different line and interregister signals are defined in the relevant parts of the specifications for the C.C.I.T.T. systems No. 4, No. 5, No. 5 *bis*, R.1 and R.2. They correspond with the " maximum permissible power " for the signalling frequencies (see Recommendation Q.16).

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

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

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

[1] For signalling system No. 6, see Part XIV of this Volume.

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

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

2.1.3 *Maximum sensitivity of the signal receiver*

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

Recommendation Q.113

2.2 CONNECTION OF SIGNAL RECEIVERS IN THE CIRCUIT

2.2.1 The line signal receivers are permanently connected to the four-wire side of the circuit. The register signal receivers in system No. 5 are connected to the four-wire side of the circuit when the register is associated with the circuit for the setting up of the call; the same is valid for the register signal receivers in system No. 5 *bis* and (in the international exchanges) for the register signal receivers in systems R.1 and R.2.

2.2.2 An in-band 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, for example:

$-18 + n$ dBm in the case of system No. 4 (see Recommendation Q.123, 3.2.1),
$-16 + n$ dBm in the case of system No. 5 (see Recommendation Q.144, 2.4.1);

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

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

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

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

2.2.4 The recommendations of Volume III of the *Green 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 in-band 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 impedance of the signal receiver, should meet the following condition throughout the 300 to 3400 Hz frequency band:

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

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

2.3.3 *Attenuation*

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

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

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

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

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

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

2.3.4 *Attenuation distortion*

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

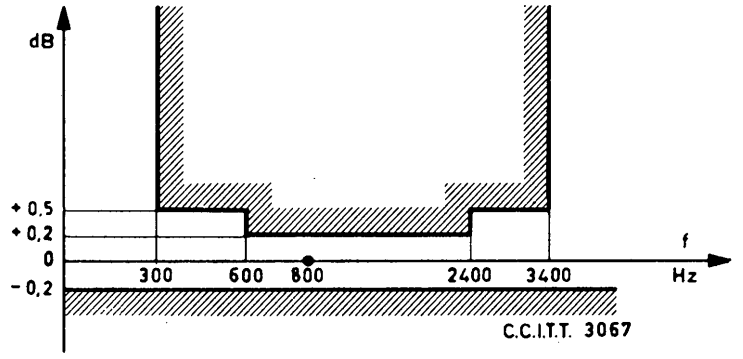


FIGURE 1/Q.114. — **Attenuation distortion of the signal receiver.**

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

2.3.5 *Non-linear distortion*

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

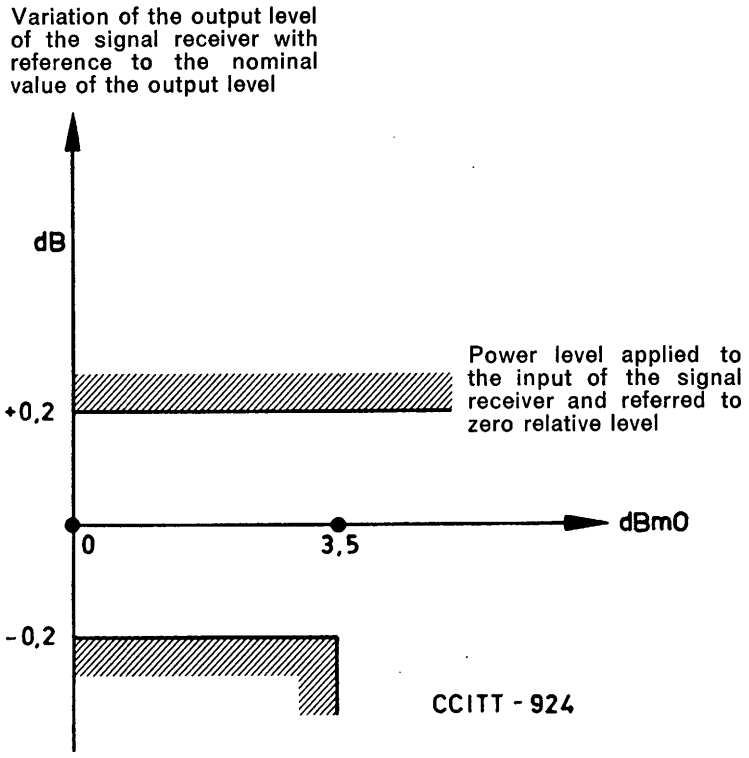


FIGURE 2/Q.114. — **Limits for non-linear distortion due to the insertion of the signal receiver.**

2.3.6 *Balance*

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

The same clause should apply to the signal sender.

2.3.7 *Crosstalk between adjacent signal receivers*

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

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

CHAPTER III

Control of echo suppressors

Recommendation Q.115

3. CONTROL OF ECHO SUPPRESSORS

3.1 *General*

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

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

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

3.2 *Compatibility of echo suppressors and signalling equipment*

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

i) Locating the echo suppressors on the switching side of the signalling equipment;

ii) Inhibiting the action of echo suppressors located on the line side of the signalling equipment by means of an appropriate condition extended from the signalling equipment to the echo suppressor while signalling is in progress.

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

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

3.3 *Terminology*

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

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

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

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

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

Systems Nos. 4, 5 *bis* and R2: Incoming half-echo suppressor required

System No. 6: Outgoing half-echo suppressor included

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

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

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

3.4 *Operation without signals*

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

3.5 *Analysis of information at an outgoing international exchange*

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

i) country code of destination and possibly some additional address digits;
ii) information about the actual routing of the call;
iii) nature of outgoing international circuit at A (e.g. satellite circuit);
iv) nature of incoming national circuit at A;
v) signals received over the incoming national circuit at A.

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

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

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

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

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

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

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

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

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

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

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

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

" Short " circuits equipped with C.C.I.T.T. systems Nos. 5, R1 and 4 (unless bilateral agreements are reached), provide no signals at the incoming CT for selective use of echo suppressors. As a result, in the

absence of separate circuit groups on the same route or other alternatives, the economic choice is to omit echo suppressors. In the case of a call that has passed through a transit exchange en route to the incoming exchange, the requirement for an incoming echo suppressor should then be met at the preceding CT as covered in para. 3.7 b above.

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

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

3.9 *Other considerations*

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

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

CHAPTER IV

Abnormal conditions

Recommendation Q.116

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

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

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

Recommendation Q.117

4.2 ALARMS FOR TECHNICAL STAFF AND ARRANGEMENTS IN CASE OF FAULTS

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

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

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

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

Recommendation Q.118

4.3 SPECIAL RELEASE ARRANGEMENTS

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

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

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

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

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

4.3.3 *Clear-forward signal not received by the incoming exchange after sending a clear-back signal* [2]

The incoming circuits at the incoming international exchange should include an arrangement for releasing the national part of the connection if, after sending a clear-back signal, a clear-forward signal is not received within 2 to 3 minutes (provided that a similar arrangement is not already made in the national network of the incoming country). This arrangement avoids indefinite blocking of the national circuits of the country of destination or of the subscriber's line in the case of interruptions of the line or equipment faults.

Recommendation Q.118 *bis*

4.4 INDICATION OF CONGESTION CONDITIONS AT TRANSIT EXCHANGES

In the case of congestion at a transit exchange, the following conditions apply:

4.4.1 The busy flash signal or an equivalent signal shall be returned to indicate that there is equipment congestion in the exchange or that no free outgoing circuit is available. This signal shall be returned within the periods specified.

In semi-automatic and in automatic working, the receipt of this signal by the outgoing exchange will cause the clear-forward signal to be sent so as to release the international connection and will give a suitable indication to the calling subscriber or operator, unless an automatic repeat attempt is made.

4.4.2 In addition, in a transit exchange, when reached by a circuit with system No. 4, connection should be made to a recorded announcement to advise the outgoing operator of the place where the congestion occurred.

In this case the busy-flash signal and the recorded announcement will be used at the outgoing exchange in the manner judged most suitable by the Administration of the country concerned.

---

[1] In the North American network the corresponding time-out is 13 to 32 seconds.

[2] These release arrangements may not be used within some regional networks.

PAGE INTENTIONALLY LEFT BLANK

PAGE LAISSEE EN BLANC INTENTIONNELLEMENT

PART VIII

C.C.I.T.T. SIGNALLING SYSTEM No. 3

Recommendation Q.119

SIGNALLING 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 workin g 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 Hz for transmitting line and register signals and provides for one-way circuits only.

The specification of signalling system No. 3 is described in Part 5 of Volume VI of the *Red Book* (New Delhi, 1960). The clauses which relate specifically to this system (Recommendations Q.76 to Q.79) appear in Chapter V (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 Hz be at least 10 dB less than that a 1000 Hz. "

PAGE INTENTIONALLY LEFT BLANK

PAGE LAISSEE EN BLANC INTENTIONNELLEMENT

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 [1] (or the discriminating digit) [1] plus the national (significant) number [1];

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) [1] necessary for routing the call through the international transit exchange towards the incoming international exchange or to another international transit exchange.

---

[1] For definitions, see Recommendations Q.10/E.160 and Q.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 [1] have been received [2]:

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 [1] 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

ii) by analyzing 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 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, retrans-

[1] See definition in Recommendation Q.10/E.160.

[2] See Recommendations Q.180 for interworking between systems No. 4 and No. 5, Q.232 for interworking between systems No. 4 and No. 5 *bis*, Q.261 for interworking between systems No. 4 and No. 6, Q.381 for interworking between systems No. 4 and R2, Q.382 for interworking between systems No. 5 and R2, Q.383 for interworking between system No. 5 *bis* and R2 and Q.388 for interworking between systems No. 6 and R2.

mission 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 [1].

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 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] 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.

1.8.2 *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 paragraph 4.3.1 and 4.3.2 in Recommendation Q.118 and Recommendation Q.131.

In semi-automatic working there may be forced release in the case of paragraph 4.3.1 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 [1] 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 to Part IX. Tables of Annex 2 to Part IX give a description of the operations corresponding to the various normal and abnormal conditions which may arise in setting up a call.

---

[1] 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 record 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.

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.

TABLE 1

CODE FOR SIGNALLING SYSTEM No. 4

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.

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*	Binary code (see Table 2)
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**
	Proceed-to-send / *Invitation à transmettre*: 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 [a]—*Blocage*	**PX**
—	(Unblocking) (*Déblocage*) = use of signal 10 of the list	**PYY**

[a] 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 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.

(The durations of the signal elements P, X and Y, X X and YYare multiples of 50 ms with a tolerance of $\pm$ 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 [1] 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 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.

The symbols used in Table 2 and in Figure 2/Q.121 have the following significance:

x short element of the single frequency *x*
y short element of the single frequency *y*.

[1] See definition of recognition time in paragraph 2.5 hereafter.

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
Incoming half-echo suppressor required [a]	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.

[a] Signal code 14 is available for use upon multi-lateral or bilateral agreement for echo suppressor control (see Recommendations Q.107 and Q.115).

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* [1] *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*;
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.

[1] See definition of recognition time in paragraph 2.5 d hereafter.

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/Q.121 and 2/Q.121 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.

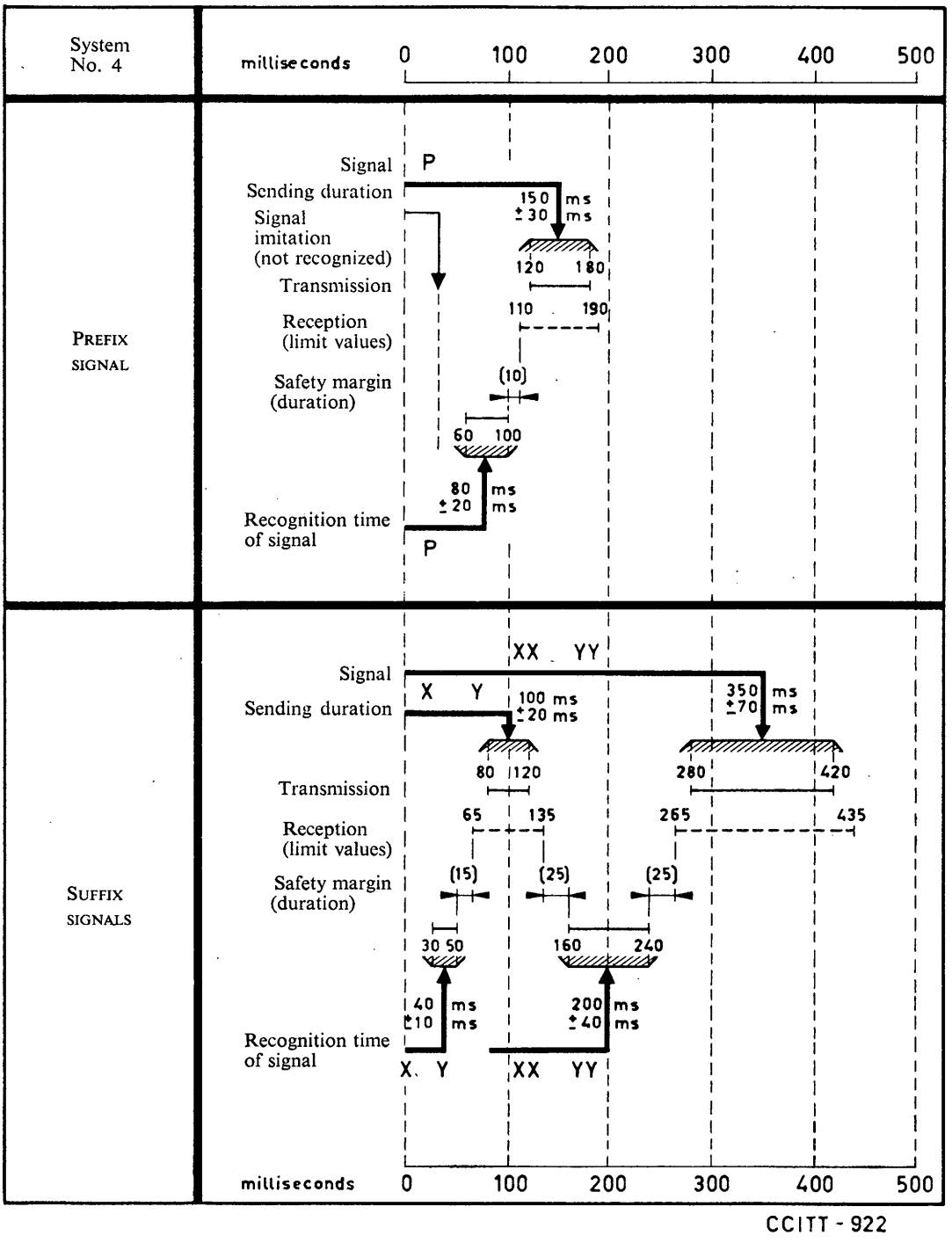


FIGURE 1/Q.121. — **Duration of line signal elements.**

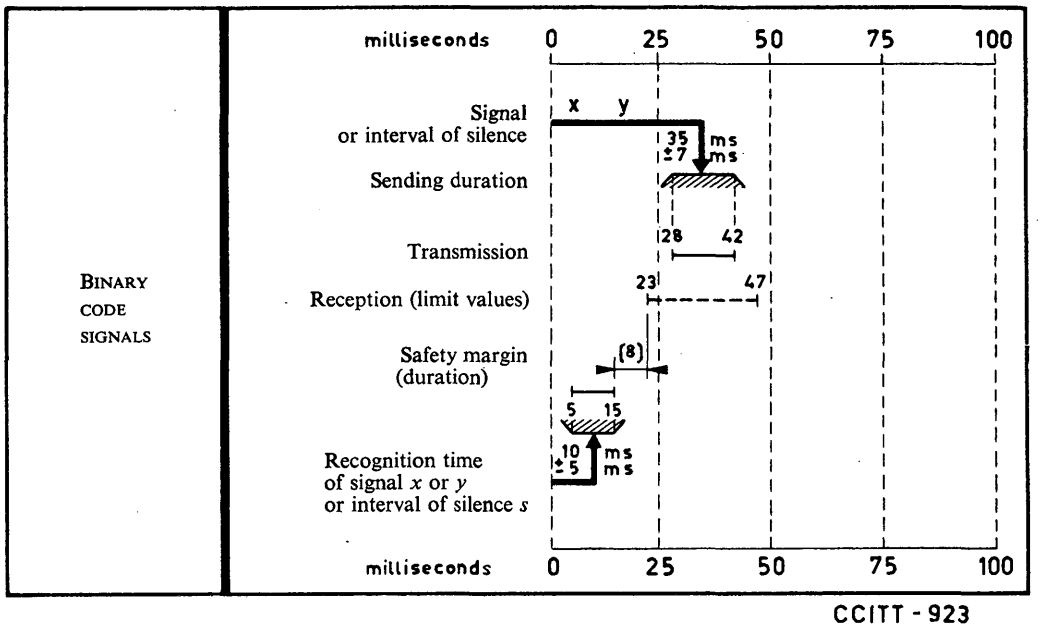


FIGURE 2/Q.121. — **Numerical signal elements.**

Legend to Figures 1 and 2/Q.121

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):

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

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

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

— 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.

CHAPTER III

Signal sender and signal receiver

Recommendation Q.122

3.1 SIGNAL SENDER [1]

3.1.1 *Signalling frequencies*

The signalling frequencies shall be:

2040 ± 6 Hz (" x " frequency); and
2400 ± 6 Hz (" 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 with a tolerance of ± 1 dB.

These levels also apply to each signal frequency in a signal element made up of a combination of the two frequencies (compound signal element) but the two signalling frequencies making up such a signal must not differ in level by more than 0.5 dB.

Note 1. — The noise as measured at the output of the line signal sender shall be as low as practicable, but in any event, at least 40 dB below signal level. This noise includes all extraneous power in the frequency band between 300 Hz and 3400 Hz including power resulting from non-linear distortion of the signal.

Note 2. — 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 below signal level per frequency.

Recommendation Q.123

3.2 SIGNAL RECEIVER [1]

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 Hz
" y " frequency: 2400 ± 15 Hz.

b) The absolute power level N of each unmodulated received signal frequency shall be within the limits:

$$-18 + n \leqslant N \leqslant n \text{ dBm};$$

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

[1] See also Recommendation Q.112.

These limits give a margin [1] of ± 9 dB on the nominal absolute level of each received signal at the input to the signal receiver.

c) The absolute level of the two unmodulated signal frequencies may differ from each other, but the received level of the 2400 Hz signal shall not be more than 3 dB above, nor more than 6 dB below the received level of the 204 0Hz 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 Hz from the nominal value of 2040 Hz or of 2400 Hz.

b) *Maximum sensitivity of the receiver*

The signal receiver shall not operate to a signal of 2040 ± 15 Hz or 2400 ± 15 Hz whose absolute power level at the point of connection of the receiver is $(-26 - 9 + n)$ dBm, n being the relative power level at this point.

This limit is 26 decibels 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 Hz be at least 10 dB less than that at 1000 Hz.

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

a) during 10 hours of speech, normal speech currents should not, on the average, cause more than one simultaneous operation of the receiver relays for each of the two signalling frequencies lasting more than 55 ms (the minimum recognition time of a compound signal element is 60 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.

[1] See 2.1.2 of Recommendation Q.112.

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 (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 the 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 and uniform spectrum energy over the frequency range 300 to 3400 Hz.

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 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 2.3.1, 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 2.3.4 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 [1], 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.

[1] 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 [1]

Sending line split

4.1.1 According to Recommendation Q.25, section 2, 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 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 Recommendation Q.123, 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.

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.

---

[1] See Recommendation Q.25.

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 [1] 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 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 paragraph 4.3.5 and in the Annex to this Recommendation.

The transit exchange ensures that the transit register does not request the signal code 15, e.g. by evaluating the signals code 11 or code 12.

[1] See Recommendation Q.11/E.161, paragraph 1.2.

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:

$I_1\ Z\ N_1\ N_2\ N_3$
$I_1\ I_2\ Z\ N_1\ N_2$
$I_1\ I_2\ I_3\ Z\ N_1\ N_2$

where I_1, I_2, I_3 = digits of the country code

Z = characteristic digit, i.e. discriminating digit (D) or language digit (L), 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 analyzed 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 analyzed 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

Note. — 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) [1] Semi-automatic calls to code 11 or code 12 operators.

Examples: $\underbrace{I_1\ I_2\ L\ N_1}_{\text{analyzed}}\ C_{11}$ or $\underbrace{I_1\ I_2\ L\ N_1}_{\text{analyzed}}\ C_{12}$

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. [1] 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: $\underbrace{L\ N_1}_{\text{analyzed}}\ C_{11}\ C_{15}$ or $\underbrace{L\ N_1}_{\text{analyzed}}\ C_{12}\ X\ X\ C_{15}$

[1] 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.

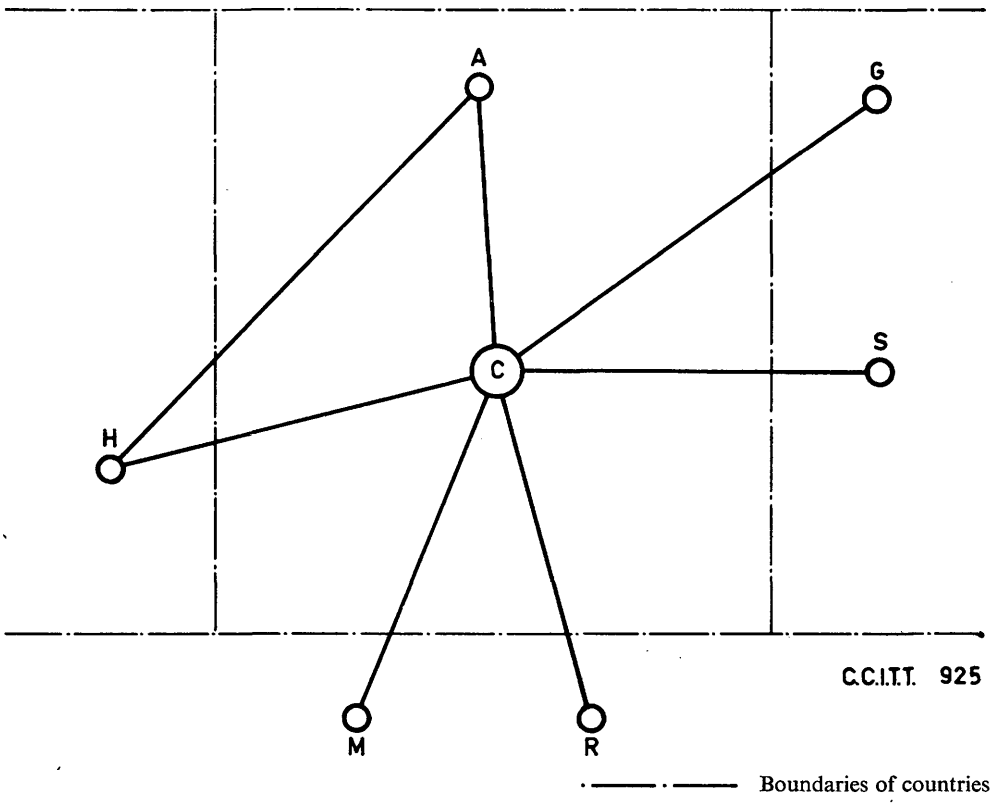


FIGURE 3/Q.126. — **Examples of digit transfer control by a transit exchange.**

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).[1]

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:

1. With semi-automatic operation if, after a delay of 10 to 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.

[1] See definition of " re-routing " in Recommendation E.170 (Q.12).

2. With automatic operation if, after a delay of 15 to 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 Recommendations Q.116 and Q.118).

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

b) 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, Recommendation Q.112, 2.1.2., for the maximum number of circuits switched in tandem).

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 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.

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.

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.[1]

2. The outgoing circuit should be blocked and an alarm given [1] 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.[1]

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.

[1] The alarm may be immediate or delayed depending upon the desire of the Administration concerned.

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) of Recommendation Q.127.

CHAPTER V

Testing arrangements [1]

Recommendation Q.133

5.1 NUMBERING FOR ACCESS TO AUTOMATIC MEASURING AND TESTING DEVICES

5.1.1 Automatic measuring and testing devices situated in the I.T.M.C.s and the I.S.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 measuring or testing equipment. Combination 51 to combination 59 are allocated to automatic transmission measuring devices standardized by the C.C.I.T.T. for A.T.M.E. No. 1. Combination 00 is used for access to the automatic testing device specified in Recommendation Q.137. Combination 61 to 63 are allocated to the automatic transmission measuring and signalling testing equipment No. 2.[1]

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.129).

[1] See A.T.M.E. No. 2 specification in Recommendation Q.49 (0.22).

5.2.3 Testing of the circuit and signalling equipment should include a check that the specifications of system No. 4 are met in regard to the following:

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 line signal elements;
Recognition time of line signal elements;
Sending duration of numerical signal elements;
Recognition time of numerical signal elements;
Time-out and alarm features.

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 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 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 $\pm$ 1 dB.

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 $\pm$ 4 dB 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 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 Hz 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.

If, due to the non-reception of a clear-forward signal, the test signal is transmitted for a period of 1 to 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 4.3.3.

(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 Hz ± 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.

(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 $\pm 1\,\%$ of the nominal value of the sent signal.

Frequency:

The sent frequency shall not differ by more than ± 5 Hz 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 thees specifications.

Tolerances on the reading of the level of the sent signalling frequencies to be ± 0.2 dB.

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 $\pm 1\,\%$ 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 Hz.

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.

Recommendation Q.139

5.7 MANUAL TESTING

5.7.1 *Functional testing of signalling arrangements*

Functional tests from one end of the circuit to the other 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, that a clear-forward signal is followed by the return of a release-guard signal and that the circuit is clear.

b) The second method consists of verification of satisfactory signal transmission by initiating a test call:

1) to 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 will consist 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) complete terminal and transit calls. [1]

5.7.2 *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;

b) Initiate a clear-forward signal and verify the receipt and recognition of the release-guard signal from the distant end.

2. In the event of a failure appropriate steps should be taken to locate and correct the trouble.

3. The above tests are short, simple, and should be performed at least monthly from each end of the circuit as appropriate. This minimum periodicity should be increased to as often as daily if the incidence of trouble encountered is unsatisfactory.

5.7.3 *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).

---

[1] Transit test calls are not intended to check the performance or the quality of the circuit beyond the transit exchange, this being entirely the responsibility of the Administration concerned. However, it is important that in principle the transit operations can be checked.

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 tests should be made monthly when the manual testing methods prescribed in paragraph 5.7.3.1 are used.

They may be made daily when semi-automatic test arrangements are available.

5.7.4 *Third method: comprehensive tests; terminal and transit 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 section 5.2.3 should have been completed at both terminals.

2. *Terminal calls*

Initiate a call to the distant end test centre. Coordinate this test with the distant end so that appropriate test equipment is connected prior to establishing the call. The tests shall proceed as follows:

a) at the originating end, check that a terminal seizing signal is followed by the receipt of a terminal proceed-to-send signal from the distant end;

b) at the distant end check that the individual signal elements are correctly received and that each digit is acknowledged correctly;

c) at the originating end check that the number received signal is received;

d) check that the audible ringing tone is heard at the originating end;

e) at the distant end initiate an answer signal;

f) at the originating end check that the answer signal is received and recognized;

g) at the distant end initiate a clear-back signal;

h) at the originating end check that the clear-back signal is received and recognized;

i) at the originating end initiate a forward-transfer signal;

j) at the distant end check the receipt of the forward-transfer signal;

k) 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;

l) 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 transmission of the fast switch-hook flashes the equipment indicates the final position of the switch-hook;

m) at the originating end initiate the release of the circuit;

n) at the distant end check that the clear-forward signal is received and recognized and that the circuit releases;

o) at the originating end check that the release-guard signal is received and recognized and that the circuit releases;

p) at the originating end set up a call to a busy line or to a test call device which provokes the return of a busy-flash signal and check that the busy-flash signal is received and recognized;

q) at the originating end, after receipt of the busy-flash signal, initiate a release of the connection and check that the equipment releases correctly;

r) at the distant end, after sending the busy-flash signal, check that the clear-forward signal releases the equipment;

s) at the distant end initiate the transmission of a blocking signal;

t) at the originating end check that the blocking signal busies the circuit;

u) at the distant end initiate the transmission of an unblocking signal;

v) at the originating end check that the unblocking signal restores the circuit to normal;

w) at the distant end connect in turn a continuous x tone, a continuous y tone, a continuous x + y tone, with the circuit in the idle state in each case;

x) at the originating end, check that the receipt of a continuous x tone, or a continuous y tone, or a continuous x + y tone busies the circuit;

y) 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;

z) at the originating end, check the presence of a transmission test loop with the circuit in an idle condition and then check that within 35 ms of receipt of a seizure signal, the loop is removed.

3. *Transit calls* (system No. 4 to system No. 4)

After securing the cooperation of a third international centre to act as a terminal centre, initiate a transit call to this centre through the international centre, covered in 2 above, which thus becomes the transit centre. Check the following sequence:

a) at the originating end check that a transit seizure signal is followed by the receipt of a transit proceed-to-send signal from the transit centre;

b) at the transit centre check that the necessary routing digits are received and acknowledged correctly and that a circuit to the terminal centre is selected;

c) at the originating centre check that a terminal proceed-to-send signal is received and that the correct digital information is sent to the terminal centre;

d) with the assistance of technical personnel at the terminal centre, check that the number received, answer, clear-back, forward-transfer, busy-flash, clear-forward and release-guard are correctly interpreted.

PAGE INTENTIONALLY LEFT BLANK

PAGE LAISSEE EN BLANC INTENTIONNELLEMENT

ANNEXES TO SIGNALLING SYSTEM No. 4 SPECIFICATIONS

ANNEX 1

Signalling sequences

Table 1. — Signalling sequences in terminal traffic

Table 2. — Signalling sequences in transit traffic

In these tables the arrows have the following meanings:

——► transmission of a signalling frequency (permanent or pulse emission).

— — ► end of transmission of the signalling frequency in the case of its permanent transmission.

· · · ► transmission of an audible tone.

ANNEX 2

Descriptions 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

(to the specifications of system No. 4)

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 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.	x = acknowledgement of the reception of a digit ← ← P	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. 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.
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.

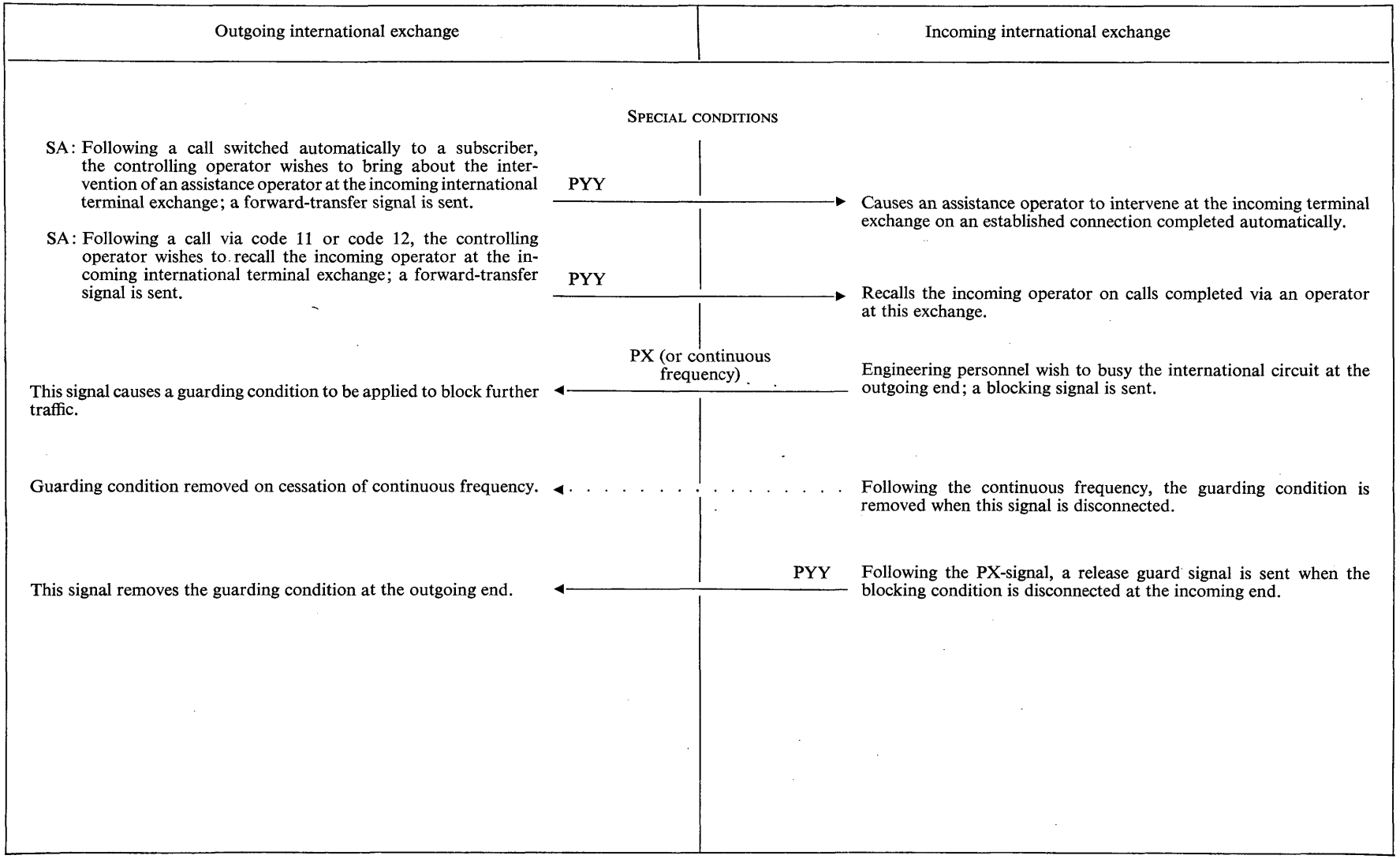
Outgoing international exchange		Incoming international exchange
	PY ◄——	Called party re-answers; answer signal is returned.
SA: An answer supervisory signal is given to the controlling operator. A: The measuring of the delay of 1-2 min. will be ceased.		
SA: Controlling operator clears down the connection. A: The calling subscriber clears: Clear-forward signal is sent.	PXX ——►	
	PYY ◄——	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.		

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.

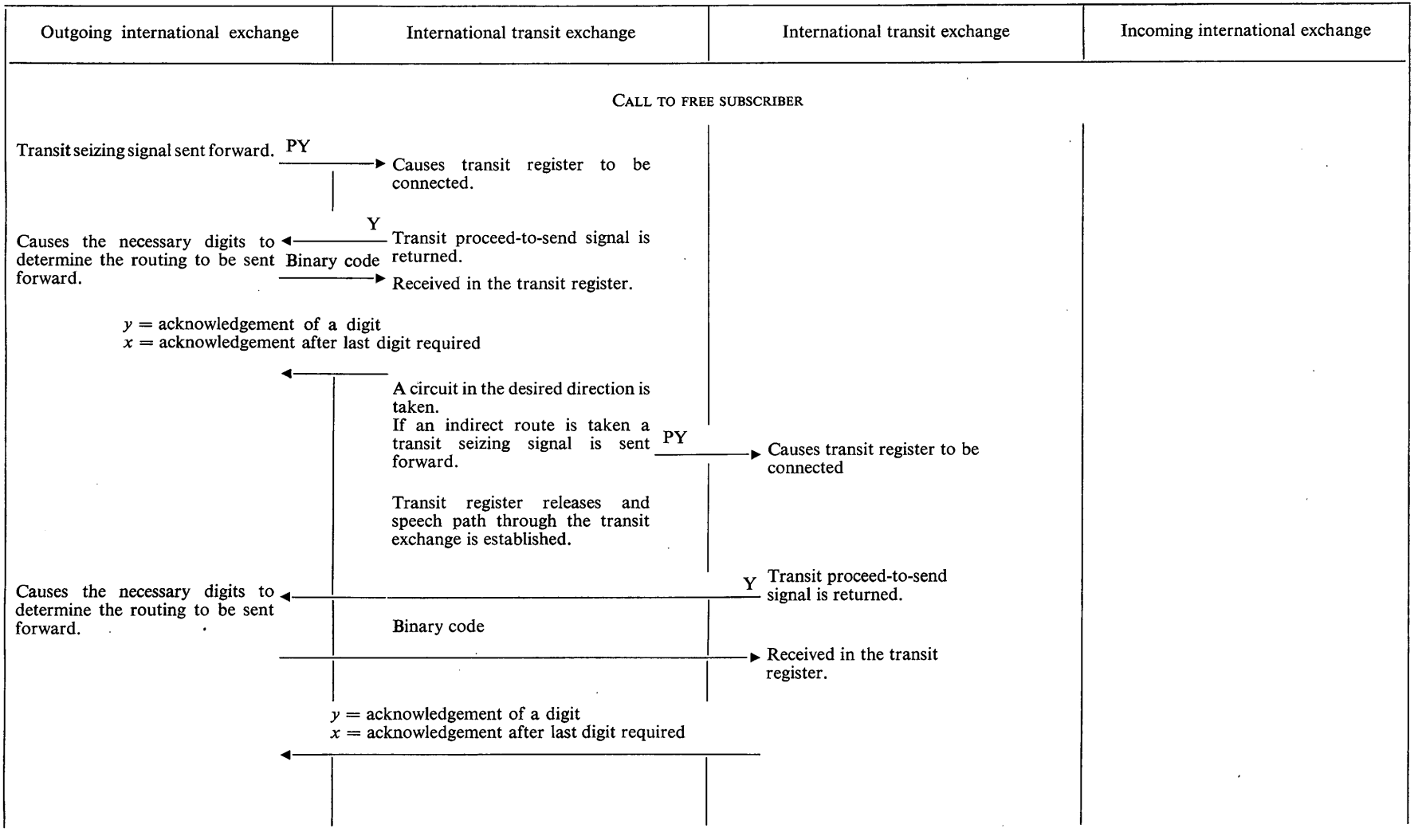
	P ◄——	Transmission of the number-received signal and establishment of speech conditions at the incoming end.
SA: An indication can be given to the outgoing operator that the international selection operations have been completed.		*1st case.* — The national network of the incoming country can give the 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).	◄	The busy tone of the incoming country if present is sent back.
A: The international connection will be released automatically. The calling subscriber hears the busy tone from the (national or international) outgoing exchange.		
		2nd case. — The national network of the incoming country cannot give the busy-flash signal.
The operator and/or the calling subscriber hears the busy tone, and and releases the connection (see above).	◄	The busy tone of the incoming country is sent back.

ANNEX 1. — TABLE 1 *(concluded)*



ANNEX 1

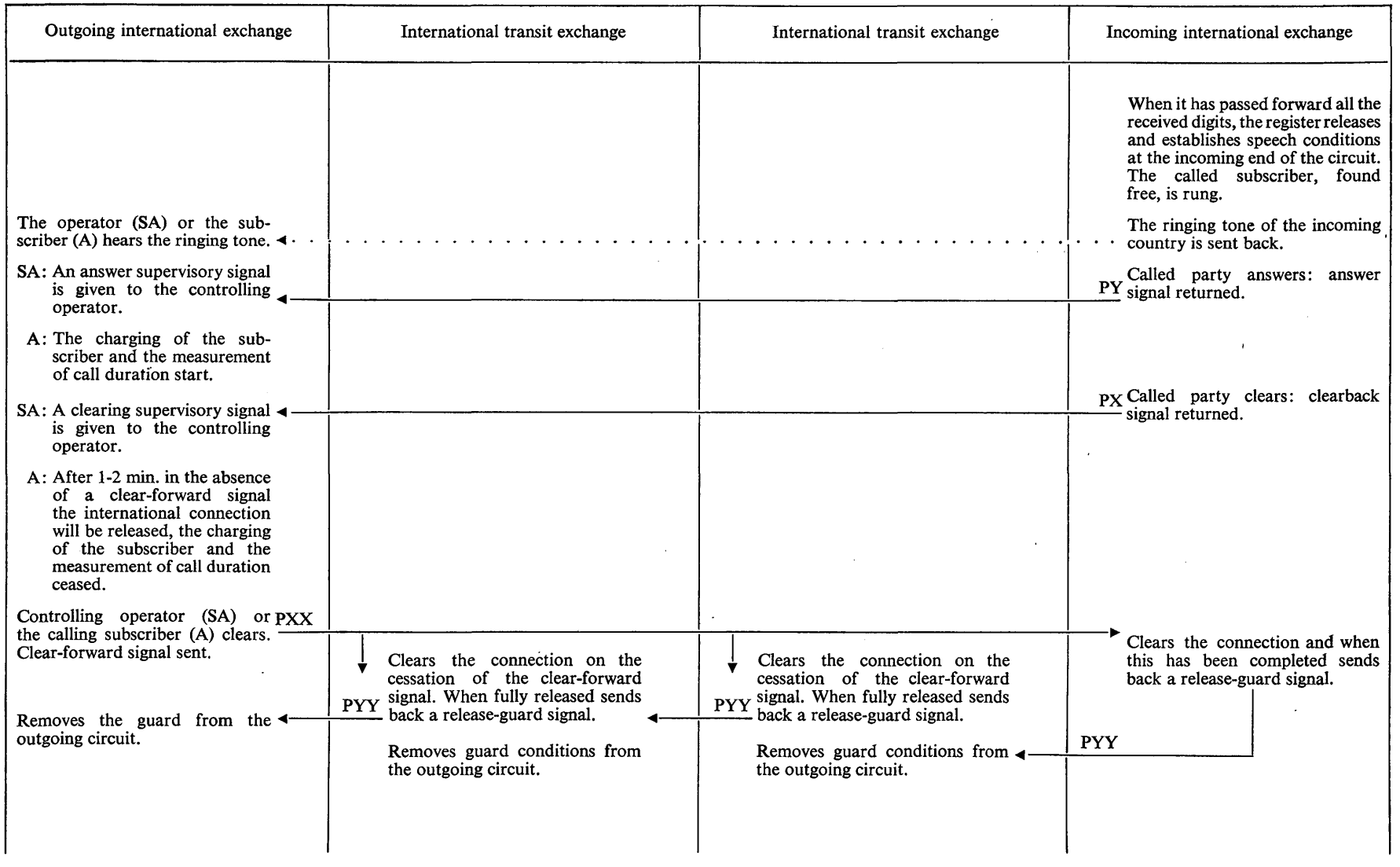
TABLE 2. — SEMI-AUTOMATIC (SA) AND AUTOMATIC (A) TRANSIT TRAFFIC



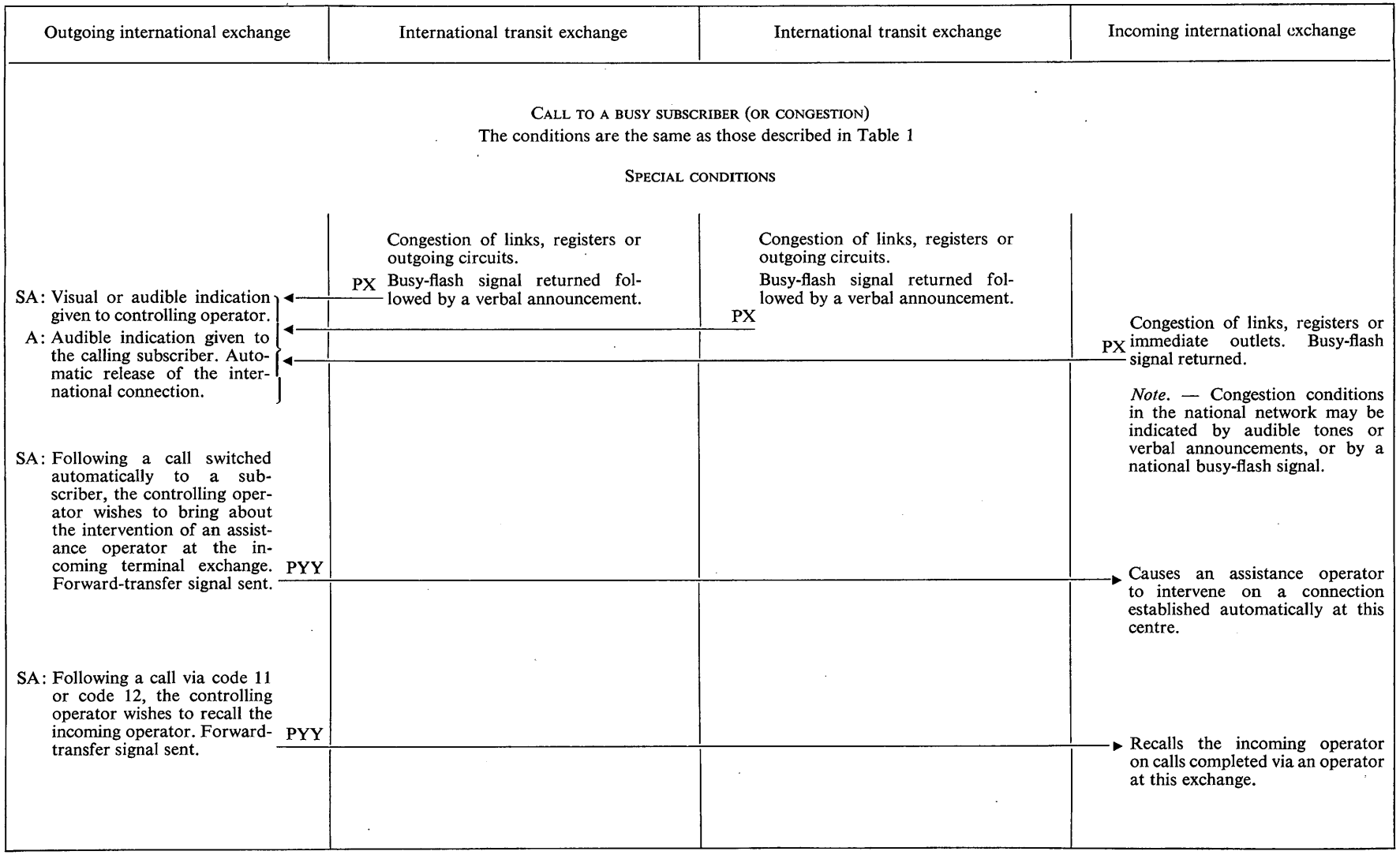
ANNEX 1. — TABLE 2 *(continued)*

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:			← X Terminal proceed-to-send signal is returned.
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		→ Received in the incoming register.
		x = acknowledgement of a digit	
SA: The register then releases and establishes the speech path.			← 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)*



ANNEX 1. — TABLE 2 *(concluded)*



ANNEX 2

TABLE 1. — OUTGOING EXCHANGE—ABNORMAL CONDITIONS

Conditions		Subscriber free	Subscriber busy or national congestion		Congestion outgoing from the incoming exchange	Congestion of common equipment at the exchange			Congestion outgoing from the transit exchange [a]
			The busy-flash signal			Incoming exchange		1st transit exchange	
			is not provided	is provided		Terminal traffic	Transit traffic		
Operations effected	Release of register	SA - after sending code 15			SA - after sending code 15 or after reception of busy-flash signal	After reception of busy-flash signal		After reception of busy-flash signal [b]	
		A - after reception of number-received signal		A - after reception of number-received or busy-flash signal					
	Speech position	After release of register		SA - after release of register					
	Action on the international circuit			A - Release of the circuit after reception of busy-flash signal				Possibly automatic re-routing	
	SA - Local signals given to the operator [c]	End of international selection operations		End of selections, then busy	Busy			Busy or re-routing	
	A - Transmission of an appropriate indication to the calling subscriber			Busy tone				Busy tone (possibly [b])	
Information received from the international circuit	Signals received	Number received		Busy-flash preceded or not by number-received	Terminal proceed-to-send, then:		Transit proceed-to-send, then:		Transit proceed-to-send, then:
					Busy-flash signal				
	Audible indication received	Ringing tone	Busy tone					Name of transit exchange	
References		1.5 4.4.1 (1)		1.6 4.4.1 (1)				Q.12, Q.119; 1.6 4.4.1 (1)	

SA — Semi-automatic service
A — Automatic service
} When there is no specific indication, the clause is applicable to both services.

[a] — Similarly for congestion of the common equipment of a 2nd or subsequent transit exchange.

[b] — Not applicable if automatic re-routing is provided.

[c] — 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

Conditions		The outgoing register receives no more digits	Registration of unused numerical information	Non-receipt of a backward signal after sending the seizing signal	Non-receipt of an acknowledgement signal after sending a digit	The outgoing register not having detected an abnormality, the incoming register receives		Non-receipt of a backward signal after sending the routing-digits to a transit exchange	Receipt of too many transit proceed-to-send signals
						an incomplete number followed by code 15 (SA)	a non-existing national number (SA and A)		
Operations effected	Release of register	SA 10-20 seconds, A 15-30 seconds after seizure or the receipt of the last digit	Immediately the anomaly is recognized	10-30 seconds after sending the seizing signal	5-10 seconds after sending the digit	After sending code 15 (SA) or after receipt of the number-received signal A)		15-30 seconds after sending the required digits	After receipt of the third signal
	Speech position					After release of the register			
	Action on the international circuit	A-Release (if a circuit has been seized)		Possible blocking of the circuit				Possible blocking of the circuit	
	SA-Local signals given to the operator [a]	Faulty call	Wrong number	Fault	Fault	End of international selection operations		Fault	Busy
	A - Indication given to the subscriber	Appropriate audible indication							
Information received from the international circuit	Signals received					Number received			
	Tone received					If possible, national number-unobtainable tone, or verbal announcement			
References		4.4.1 (2) a	4.4.1 (2) b	4.7.1 4.4.1 (2) c	4.4.1 (2) d	4.4.3 (2) c		4.7.1 4.4.1 (2) c	4.4.1 (2) e

[a] 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

Operations effected	Conditions				
	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 1.6b	1.5 1.6b	1.6b 4.2.4, 4.4.3 (1)	4.2.4

ANNEX 2

TABLE 4. — INCOMING EXCHANGE—ABNORMAL CONDITIONS

Operations effected	Conditions			
	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)	1.6a 4.2.4, 4.4.2 (1), Q.118	1.6.a 4.2.4, Q.118

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 [1] and non-TASI-equipped circuits and may be applied for automatic and semi-auotmatic 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 Hz and 2600 Hz, 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 Hz) be different from that of the seizing signal (2400 Hz). The detection is achieved when one end transmits the outgoing seizing signal (2400 Hz) and at the same time receives the seizing signal (2400 Hz) from the other end and not the 2600 Hz 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 the continuous compelled [2] 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

---

[1] See Supplement No. 2 in this Volume.

[2] See for this term Recommendation Q.141, section 2.1.6.

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 [1] type. For reasons of fast speed, the answer signal is overlap-compelled [1] 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 (m.f.) in-band en bloc [2] 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 Hz... 1700 Hz) 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 [2] 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 m.f. signals.

En bloc overlap register signalling [2] 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 m.f. pulses, system No. 5 functions correctly in the presence of compandors.

---

[1] See for these terms Recommendation Q.141, section 2.1.7.

[2] See for these terms the footnote to Recommendation Q.151, section 3.1.1.

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.[1]

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.

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;

[1] 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.

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 4.3.1 and 4.3.2 for automatic working and 4.3.1 for 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 [1] 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 to Part X.

A description of the various operations corresponding to the various normal and abnormal conditions which may arise in setting up a call are given in the tables of Annex 2 to Part X.

---

[1] 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 Hz) and $f2$ (2600 Hz) 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 signalling*

2.1.3.1 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 $\pm$ 200 ms to permit 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) *Time-out and alarm procedures*

i) Should the transmission of any seize, busy-flash, answer, clear-back or clear-forward signal persist beyond a maximum of 10 to 20 seconds, the signal shall be terminated.

Note. — 10 to 20 seconds time-out for the seizing signal allows reasonable time for association of a register in a distant centre.

ii) Should the transmission of any proceed-to-send, release-guard or other acknowledgement signal persist beyond a maximum of 4 to 9 seconds, the signal shall be terminated.

Note. — The shorter time-out periods for secondary signals enable, under many conditions, detection of a fault at both ends of a circuit on a single call.

iii) Upon the occurrence of a time-out under the above two conditions, the attention of the maintenance personnel should be drawn to the fact that time-out has occurred. [1]

iv) Upon the occurrence of a time-out, the circuit should automatically be removed from service. However, time-out of a seize signal may be excluded from this provision if time-out of that signal is followed by a clear-forward attempt.[1]

v) As a test procedure, Administrations may make repeated signalling attempts and restore the circuit to service if it is found to perform in a normal manner.

vi) Each Administration shall make appropriate arrangements to ensure that a single fault will not cause removal from service of more than one circuit or of more than one register.

[1] An Administration may decide that on the time-out of an acknowledgement signal at the incoming end of the connection, when an automatic repeat attempt is provided, no indication is given to the maintenance personnel, neither is the circuit taken out of service.

2.1.3.2 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 I

LINE SIGNAL CODE

Signal	Direction (1)	Frequency (2)	Sending duration	Recognition time
Seizing—*Prise*	——►	$f1$	continuous	40±10 ms
Proceed-to-send—*Invitation à transmettre*	◄——	$f2$	continuous	40±10 ms
Busy-flash—*Occupation*	◄——	$f2$	continuous	125±25 ms
Acknowledgement—*Accusé de réception*	——►	$f1$	continuous	125±25 ms
Answer—*Réponse*	◄——	$f1$	continuous	125±25 ms
Acknowledgement—*Accusé de réception*	——►	$f1$	continuous	125±25 ms
Clear-back—*Raccrochage du demandé*	◄——	$f2$	continuous	125±25 ms
Acknowledgement—*Accusé de réception*	——►	$f1$	continuous	125±25 ms
Forward-transfer—*Signal d'intervention*	——►	$f2$	850±200 ms	125±25 ms
Clear-forward—*Signal de fin*	——►	$f1+f2$ (compound)	continuous	125±25 ms
Release-guard—*Libération de garde*	◄——	$f1+f2$ (compound)	continuous	125±25 ms

Notes to Table 1

(1) ——► forward signals
◄—— backward signals

(2) $f1 = 2400$ Hz $f2 = 2600$ Hz

2.1.6 *Further specification clauses relative to the 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.[1]

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.[1]

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.[1]

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 $\pm$ 25 ms) of the primary signal has elapsed. The primary signal shall not be ceased until the signal recognition time (125 $\pm$ 25 ms) of the acknowledgement signal has elapsed [1] (see section 2.1.7 with respect to the transmission of the answer signal at a transit point).

d) The busy-flash 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 (125 $\pm$ 25):

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;

— 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.

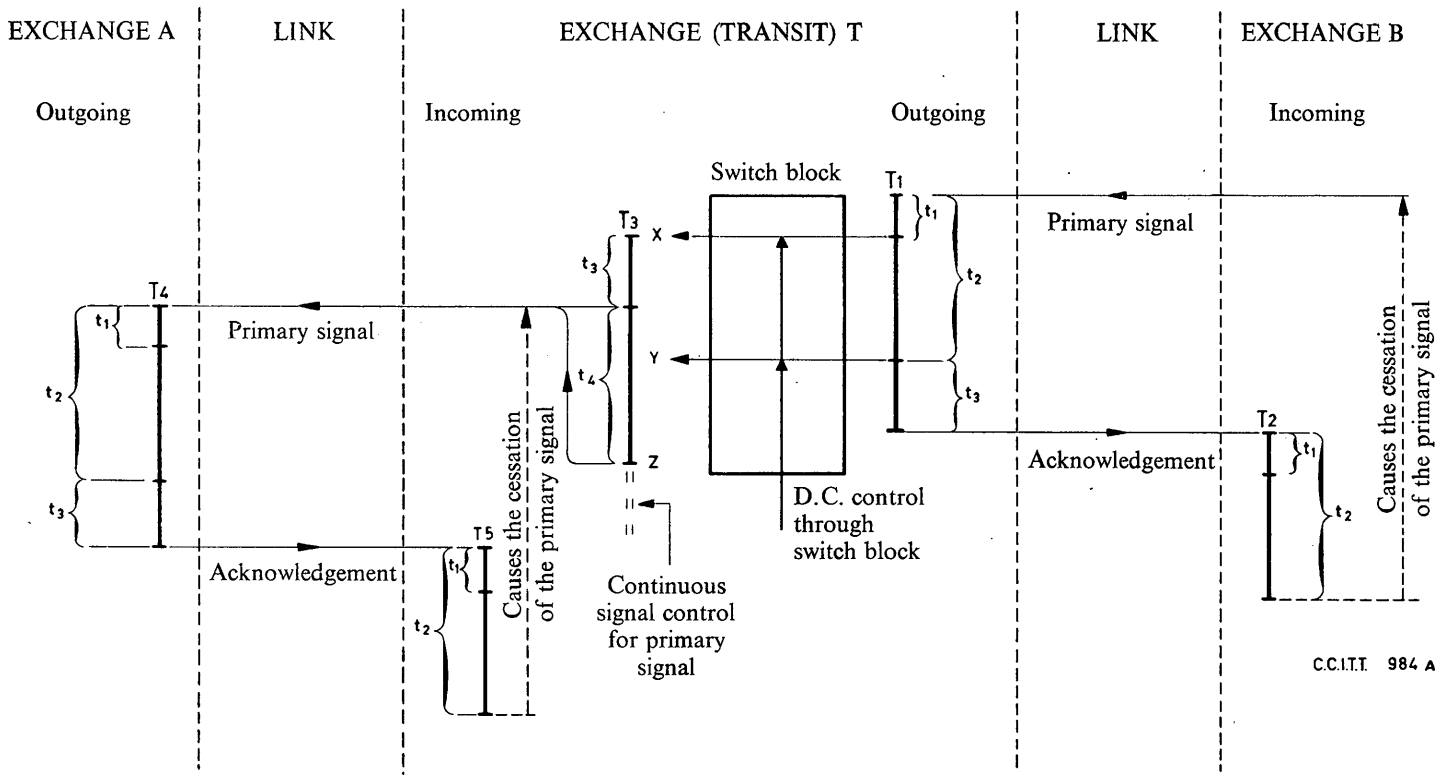
f) Receipt of busy-flash at a transit exchange will cause after signal recognition time:

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.

[1] This type of signalling is called " *continuous compelled* ".



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/Q.141. — **Typical arrangement to illustrate the principle of overlap compelled signalling for the answer signal at transit points.**

2.1.7 *Backward signals on multilink connections*

(consider 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 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/Q.141 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 " tsart to send " control condition X through the switch block at the transit point) as soon as the signal receiver response on thepri mary 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_1) 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 elasped, 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 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 [1]

2.3.1 *Signalling frequencies*

2400 ± 6 Hz ($f1$) and 2600 ± 6 Hz ($f2$).

These frequencies are applied separately or in combination.

2.3.2 *Transmitted signal level*

-9 ± 1 dBm0 per frequency.

For compound signals the difference in transmitted level between $f1$ and $f2$ shall not exceed 1 dB.

Note 1. — The noise as measured at the output of the line signal sender shall be as low as practicable but in any event, at least 40 dB below signal level. This noise includes all extraneous power in the frequency band between 300 Hz and 3400 Hz including power resulting from non-linear distortion of the signal.

Note 2. — The level of the leak current transmitted to line should be at least 50 dB below signal level per frequency.

Recommendation Q.144

2.4 LINE SIGNAL RECEIVER [1]

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 Hz; $f2$: 2600 ± 15 Hz.

b) The absolute power level N of each unmodulated signal received shall be within the limits:

$(-16 + n) \leqslant N \leqslant (-2 + n)$ dBm

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

These limits give a margin of ± 7 dB on the nominal absolute level of each received signal at the input to the signal receiver.

c) The absolute level of the two unmodulated signal frequencies in a compound signal may differ from each other by not more than 5 dB.

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:

$2400 \begin{smallmatrix}+100\\-150\end{smallmatrix}$ Hz for the $f1$ signal circuit or

$2600 \begin{smallmatrix}+150\\-100\end{smallmatrix}$ Hz for the $f2$ signal circuit.

[1] See also Recommendation Q.112.

b) *Maximum sensitivity of line signal receiver*

The signal receiver shall not operate on a signal of 2400 ± 15 Hz or 2600 ± 15 Hz whose absolute power level at the point of connection of the receiver is $(-17 \ -9 + n)$ dBm, n being the relative power level at this point. This limit is 17 dB below the nominal absolute level of the signal current at the input to the signal receiver.

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 Hz be at least 10 dB less than that at 1000 Hz.

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 $f1$ or the $f2$ 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 (100 000 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 and uniform spectrum energy over the frequency range 300 to 3400 Hz.

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 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 miminum 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 [1]. 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 2, 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.

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.

---

[1] See Recommendation Q.141, section 2.1.6., explaining the term " continuous compelled ".

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 below the received signal level. Exceptionally, the level of the leak current may be 25 dB 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 analyzed.

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.

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 [1]. En bloc non-overlap [1] applies at the outgoing international register. En bloc overlap [1] 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 to call to another international exchange.

4) The register signalling is a 2-out-of-6 multifrequency code, forward signalling only, as shown in Table 2.

---

[1] *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*.

TABLE 2

REGISTER SIGNAL CODE OF SYSTEM No. 5

Signal	*Frequencies (compound)* Hz	*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 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 Hz.

A signal shall consist of a combination of any two of these six frequencies. The frequency variation shall not exceed ± 6 Hz of each nominal frequency.

3.3.2 *Transmitted signal level*

— 7 ± 1 dBm0 per frequency.

The difference in transmitted level between the two frequencies comprising a signal shall not exceed 1 dB.

Note. — The level of the leak current transmitted to 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.

3.3.3 *Signal duration*

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 Hz 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 where n is the relative power level at the signal receiver input. These limits give a margin of ± 7 dB 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;

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.

Note 1. — The tolerances given in a, b, and c are to allow for variations at the sending end and in line transmission.

Note 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, n being the relative power level at this point.

This limit is 17 dB 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 (100 000 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 and uniform spectrum energy over the frequency range 300 to 3400 Hz.

3.4.4 *Input impedance*

The input impedance should be such that the return loss over a frequency range 300 to 3400 Hz against a 600 ohm non-inductive resistor is greater than 20 dB.

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 [1] 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 analyzed in an international transit exchange*

1) The *maximum* number of digits [1] which has to be analyzed 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_2 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 1b and 3).

(2) Accordingly the maximum number of digits that have to be analyzed at an international transit exchange is six, which number includes the language or the discriminating digit.

[1] See Recommendation E.161 (Q.11), paragraph 1.2.

3.5.3 *Digital analysis for routing at the outgoing international exchange*

The *maximum* number of digits which have to be analyzed 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.

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):

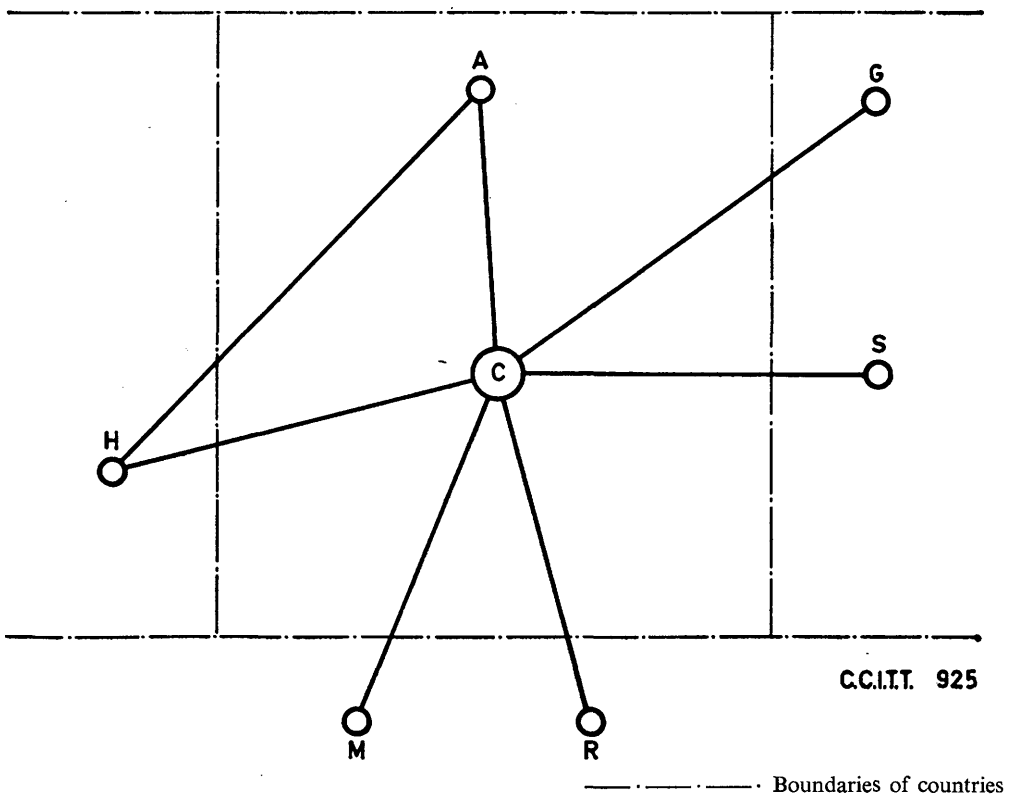


FIGURE 2/Q.155. — **Example of the digit analysis in a transit exchange.**

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: $\underbrace{I_1\ I_2\ Z\ N_1\ N_2}_{\text{Analyzed}}$ ----

b) [1] Semi-automatic calls to code 11 or code 12 operators.

Examples: $\underbrace{I_1\ I_2\ L\ N_1\ C_{11}}_{\text{Analyzed}}$ or $\underbrace{I_1\ I_2\ L\ N_1\ C_{12}}_{\text{Analyzed}}$

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: $\underbrace{I_1\ I_2\ D}_{\text{Analyzed}}$ --- or $\underbrace{I_1\ I_2\ L}_{\text{Analyzed}}$ ---

3. [1] 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: $\underbrace{L\ N_1\ C_{11}}_{\text{Analyzed}}\ C_{15}$ or $\underbrace{L\ N_1\ C_{12}}_{\text{Analyzed}}\ X\ X\ C_{15}$

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.

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.

---

[1] 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.

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. Proced-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 section 3.6.1 of Recommendation Q.156).

CHAPTER IV

Manual testing arrangements for signalling system No. 5

Recommendation Q.161

4.1 GENERAL ARRANGEMENTS FOR MANUAL TESTING [1]

4.1.1 The guiding principles for the maintenance of the international automatic service, as covered by Recommendations Q.70 to Q.74, and the organization of routine maintenance tests and measurements of signalling and switching, as covered by Recommendations Q.76 to Q.79, are applicable to manual testing arrangements for system No. 5 with the following remarks:

a) Functional tests from the I.T.M.C. and the I.S.M.C. may require cooperation of personnel at the distant end.

b) These manual testing arrangements do not fully provide for the circuit limit tests specified in Recommendation Q.73.

c) The distant I.S.C.C. (see Recommendation Q.72) 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.

d) 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 (see 4.2.2 c of Recommendation Q.162 below).

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 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.

---

[1] See Recommendation Q.49/O.22: " Specifications for the C.C.I.T.T. automatic transmission measuring and isgnalling testing equipment ATME No. 2. "

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.

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 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, 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:

1. to 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 [1] 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/4-9 seconds (see Recommendation Q.141, paragraph 2.1.3.1 e).

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 performed at least monthly from each end of the circuit as appropriate. This minimum periodicity should be increased to as often as daily if the incidence of trouble encountered is unsatisfactory.

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:
   i) the audible ringing tone should be heard;
   ii) 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.

[1] See the note to paragraph 4.3.4.3.

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 monthly 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. Coordinate 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.

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 [1]

a) After securing the cooperation 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:

[1] 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 Hz 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.

3. Signal duration 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 Hz of the nominal signalling frequency or frequencies and shall not vary during the time required for testing.

2. Signals levels should be variable between the limits given in the specification and be able to be set within ± 0.2 dB.

3. Signal durations and intervals between signals shall be within the limits given in the specification in Recommendation Q.153, paragraph 3.3.3, for normal operate values and in Recommendation Q.154, paragraph 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 Hz.

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.

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 $\pm 1\,\%$ 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 and of 4 to 9 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 Hz.

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.

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 recorded 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*

Local 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.

PAGE INTENTIONALLY LEFT BLANK

PAGE LAISSEE EN BLANC INTENTIONNELLEMENT

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 the arrows have the following meanings:

——► transmission of a signalling frequency (permanent or pulse emission).

– – ► end of transmission of the signalling frequency in the case of its permanent transmission.

· · · ► transmission of an audible tone.

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

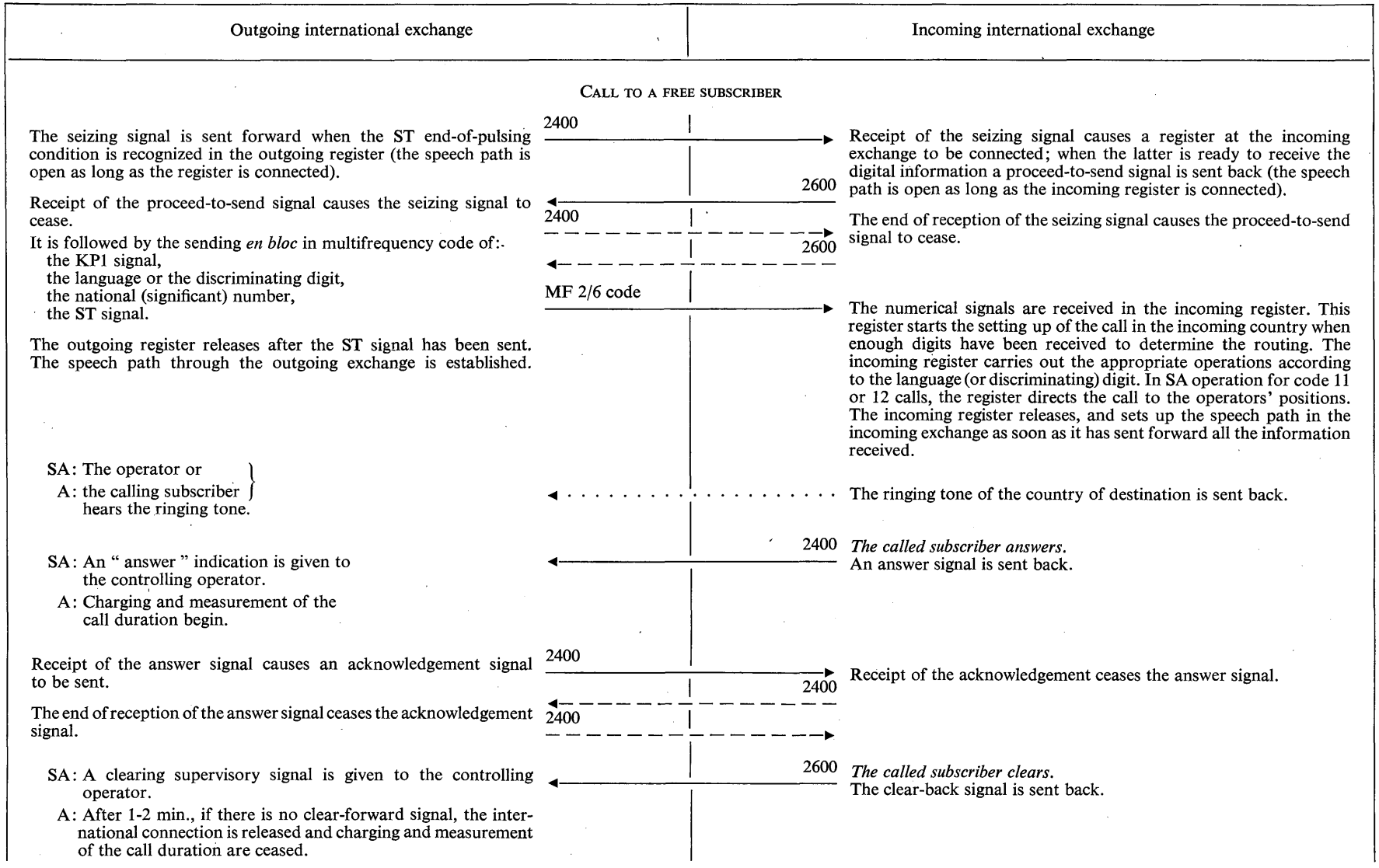
Table 4: Incoming exchange—Abnormal conditions

Table 5: Transit exchange—Normal conditions

Table 6: Transit exchange—Abnormal conditions

ANNEX 1

TABLE 1. — SEMI-AUTOMATIC (SA) AND AUTOMATIC (A) TERMINAL TRAFFIC



ANNEX 1. — TABLE 1 *(continued)*

Outgoing international exchange		Incoming international exchange
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 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 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 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 causes the acknowledgement signal to be sent.	← 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.
		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.

ANNEX 1. — TABLE 1 *(concluded)*

Outgoing international exchange		Incoming international exchange
	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 or an 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.
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

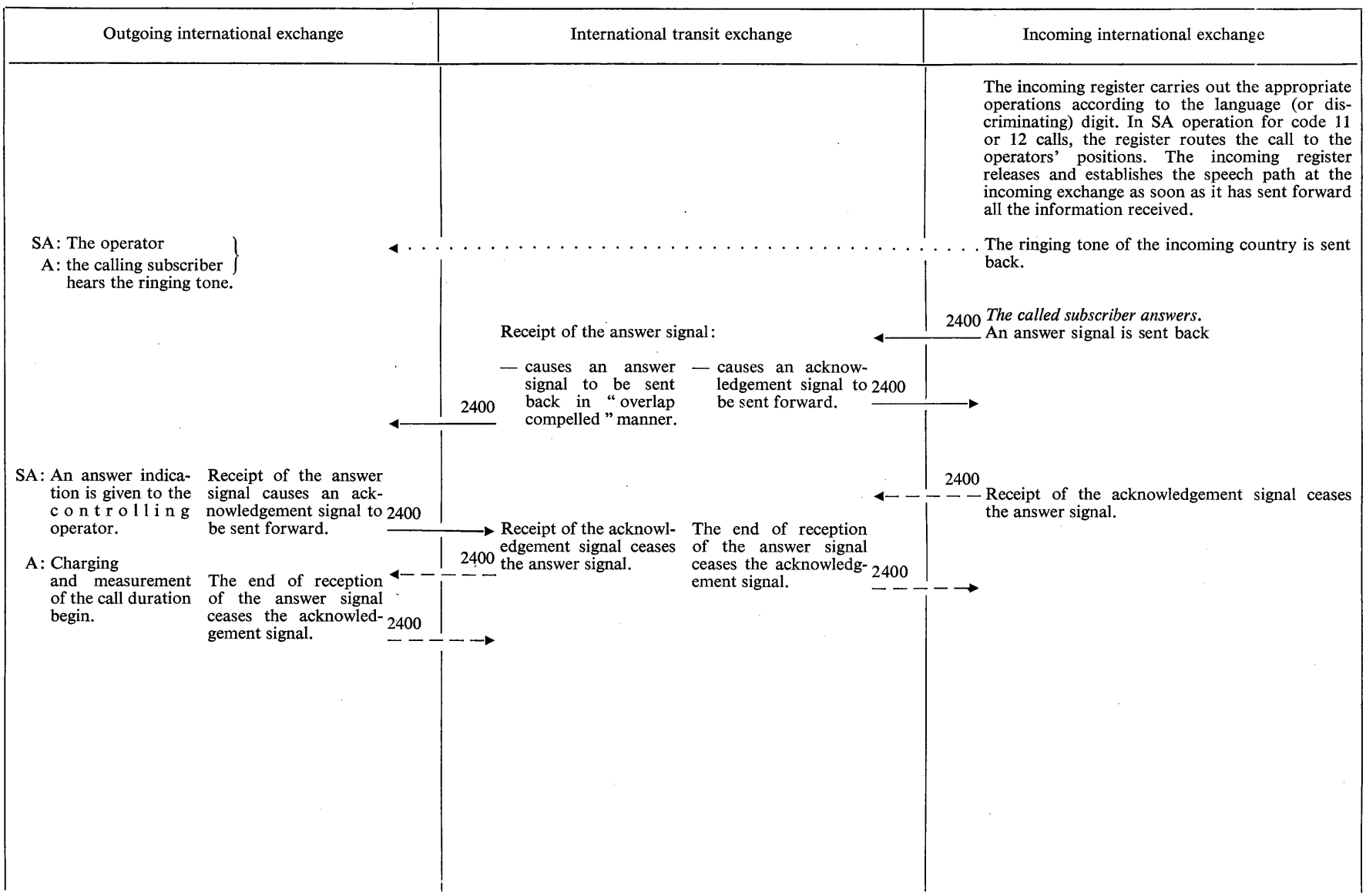
b) { SA: a re-order indication is given to the operator;
   { A: a busy tone is sent to the subscriber.

ANNEX 1

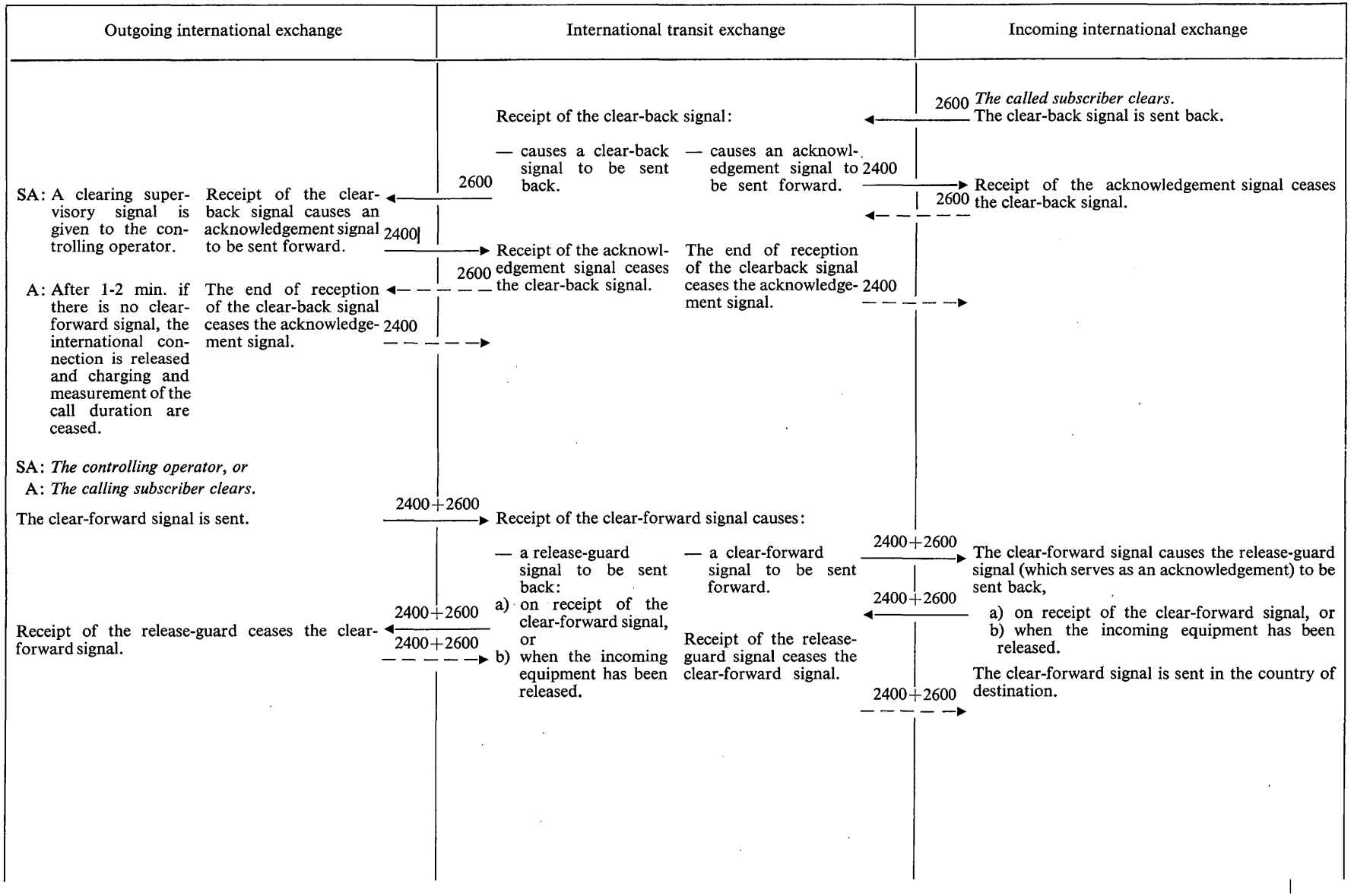
TABLE 2. — SEMI-AUTOMATIC AND AUTOMATIC TRANSIT TRAFFIC

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 the 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. — 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).
	Receipt of the proceed-to-send signal ceases the seizing signal. ← 2600	
	It is followed by the sending *en bloc* overlap in multifrequency code of: — 2400 →	The end of reception of the seizing signal ceases the proceed-to-send signal.
	— the KP1 signal — the language or the discriminating digit — the national (significant) number — the ST signal. — 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 transit register releases after the ST signal has been sent. The speech path through the transit exchange is established.	

ANNEX 1. — TABLE 2 *(continued)*



ANNEX 1. — TABLE 2 *(continued)*



ANNEX 1. — TABLE 2 *(continued)*

Outgoing international exchange	International transit exchange	Incoming international exchange
The end of the release-guard signal terminates the guard condition at the outgoing end. ← 2400+2600	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 outgoing access of the incoming end is maintained busy for 200 to 300 ms after the cessation of the release-guard signal.	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 conditions 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.

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

		Receipt of the busy-flash signal: — causes the busy-flash signal to be sent back. — causes the acknowledgement signal to be sent forward.	2600 *1st Case:* The national incoming network gives the busy-flash signal. The busy-flash signal is sent back.
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 ←		2400 → Receipt of the acknowledgement signal ceases the busy-flash signal. 2600 ←
	2400 →	Receipt of the acknowledgement signal ceases the busy-flash signal.	
	The end of reception of the busy-flash signal ceases the acknowledgement signal. 2600 ←		The end of reception of the busy-flash signal ceases the acknowledgement signal. 2400 →
	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

Conditions		Subscriber free	Subscriber busy or national congestion		Congestion at a transit or an incoming exchange or on circuits immediately outgoing from that exchange (after register association)
			The busy-flash signal:		
			is not provided	is provided	
Operations effected	Release of register	After sending the ST signal			
	Speech position	After release of register			
	Action on the international circuit			Release of the circuit after reception of a busy-flash signal	
	SA - Local signals given to the operator			Busy	
	A - Transmission of an appropriate indication to the calling subscriber			Busy tone	
Information received from the international circuit	Signals received			Busy-flash signal	
	Audible indication received	Ringing tone	Busy tone		
References		3.6.1	3.7	3.6.1, 3.7, 1.6	

SA = Semi-automatic service
A = Automatic service
} When there is no specific indication the clause is applicable to both services.

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 [a] after seizure or receipt of last digit. A - 15-30 seconds [a] after seizure of 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 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

[a] 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	4-9 seconds after the start of sending the proceed-to-send signal	Immediately the error is recognized	20-40 seconds [a] 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	2.1.3.1 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

[a] 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

Operations effected	Conditions				
	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[a] 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	2.1.3.1 e 2.1.6 d	2.1.6 d	2.1.6 d 3.6.2 c	2.1.6 d	2.1.3.1 e 2.1.6 d 3.6.2 c

[a] Typical value.

PAGE INTENTIONALLY LEFT BLANK

PAGE LAISSEE EN BLANC INTENTIONNELLEMENT

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.

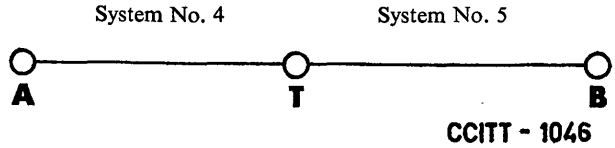
In general, the interworking of the two systems merely requires that a signal received in the code of one of the systems be converted into the corresponding signal of the code used by the other system. Nevertheless, in a transit exchange where there is interworking of systems No. 4 and No. 5, special 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.

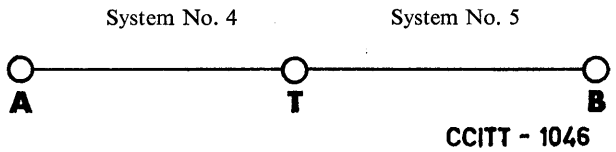
3. On receipt of an end-of-pulsing signal from A, the incoming part of system No. 4 at transit exchange T sends to A an acknowledgement of the end-of-pulsing signal and then sends to A a number-received signal.

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 [1] 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 [1] 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.

In this situation the system No. 5 register signalling at T will be *en bloc* non-overlap [2]. (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 [3] 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 [3] of system No. 5 at T is then released.

---

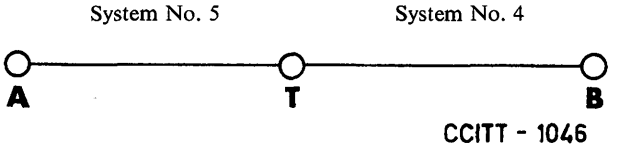
[1] These register functions may be combined in a single register.

[2] See for this term the footnote to Recommendation Q.151.

[3] These register functions may be combined in a single register.

3. *Calls from system No. 5 to system No. 4*

3.1 *Semi-automatic calls from system No. 5 to system No. 4*



1. In semi-automatic operation at transit exchange T the incoming register[1] 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[1] of system No. 4 is released when the end-of-pulsing signal is sent.

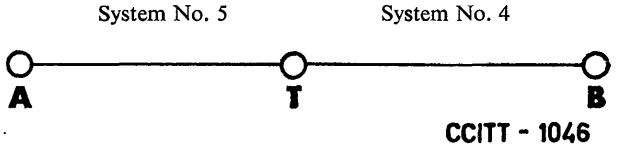
6. At B, the incoming register of system No. 4 is released as soon as the number-received signal is sent backward to T on system No. 4 and all the numerical information necessary for setting up the call in the incoming country has been sent forward.

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*



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:

[1] These register functions may be combined in a single register.

a) an end-of-pulsing signal has been received, or

b) it has recognized that all the digits have been received.

In this case of interworking, condition a 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/Q.180) or for a call from an outgoing exchange K (Figure 2/Q.180) and arriving via a group of circuits in system No. 4 at 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.

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.

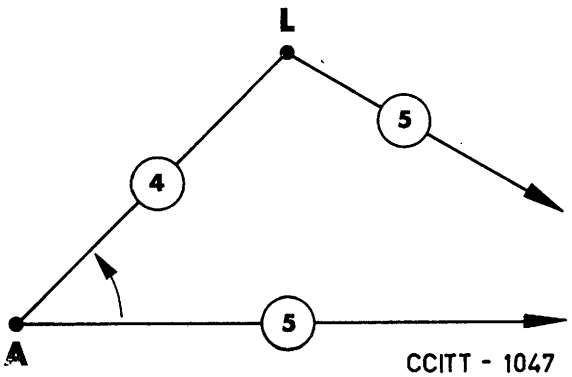


FIGURE 1/Q.180.

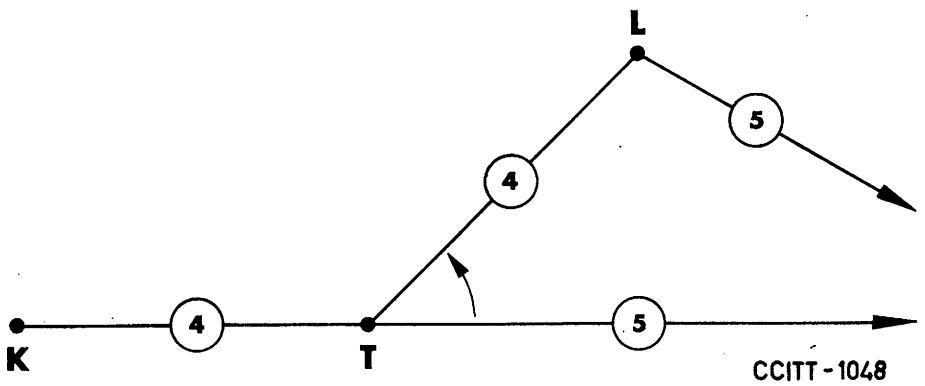


FIGURE 2/Q.180.

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/Q.180 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/Q.180, 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. It should be noted 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.

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 this tables the arrows have the following meanings:

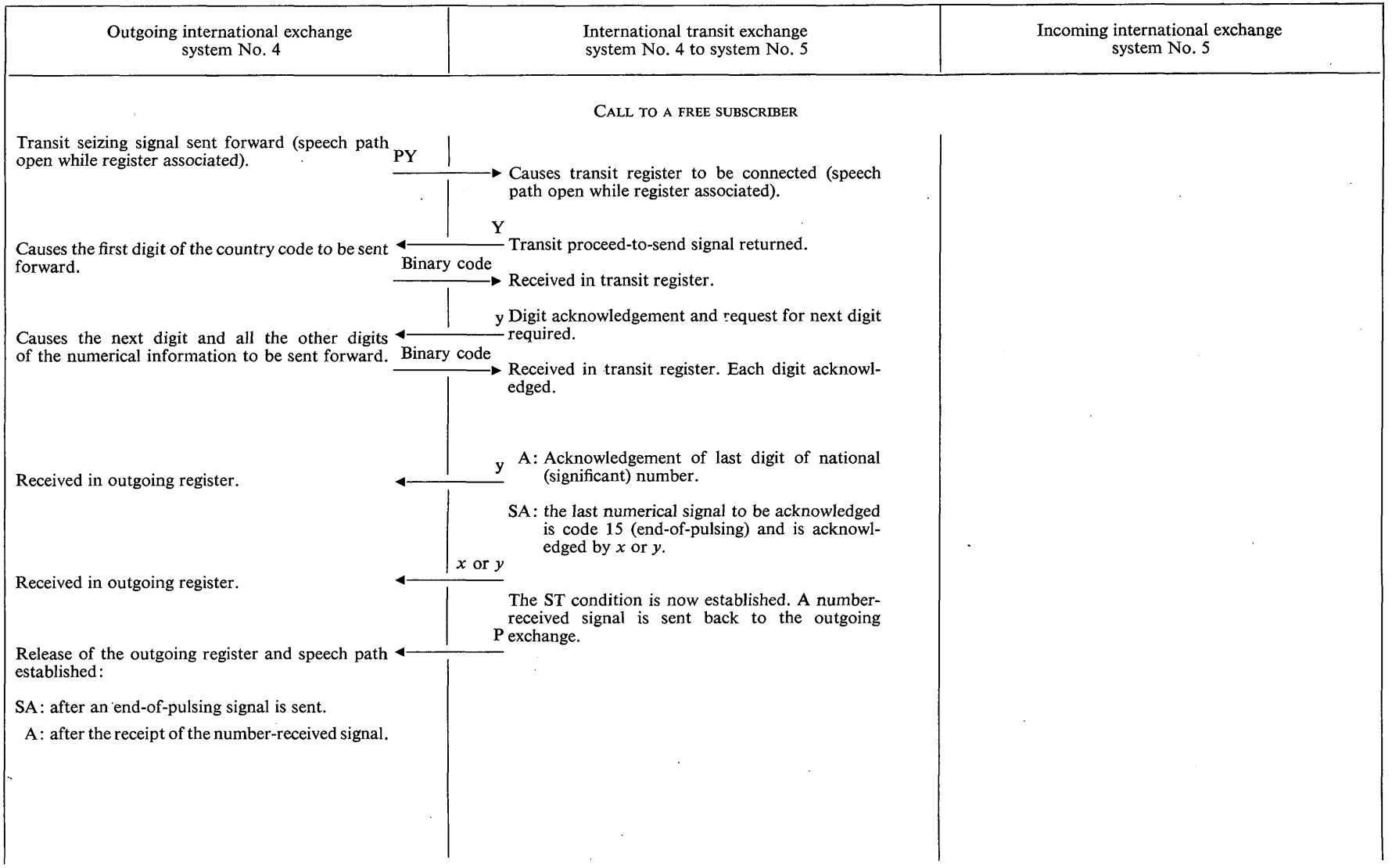
——► transmission of a signalling frequency (permanent or pulse emission).

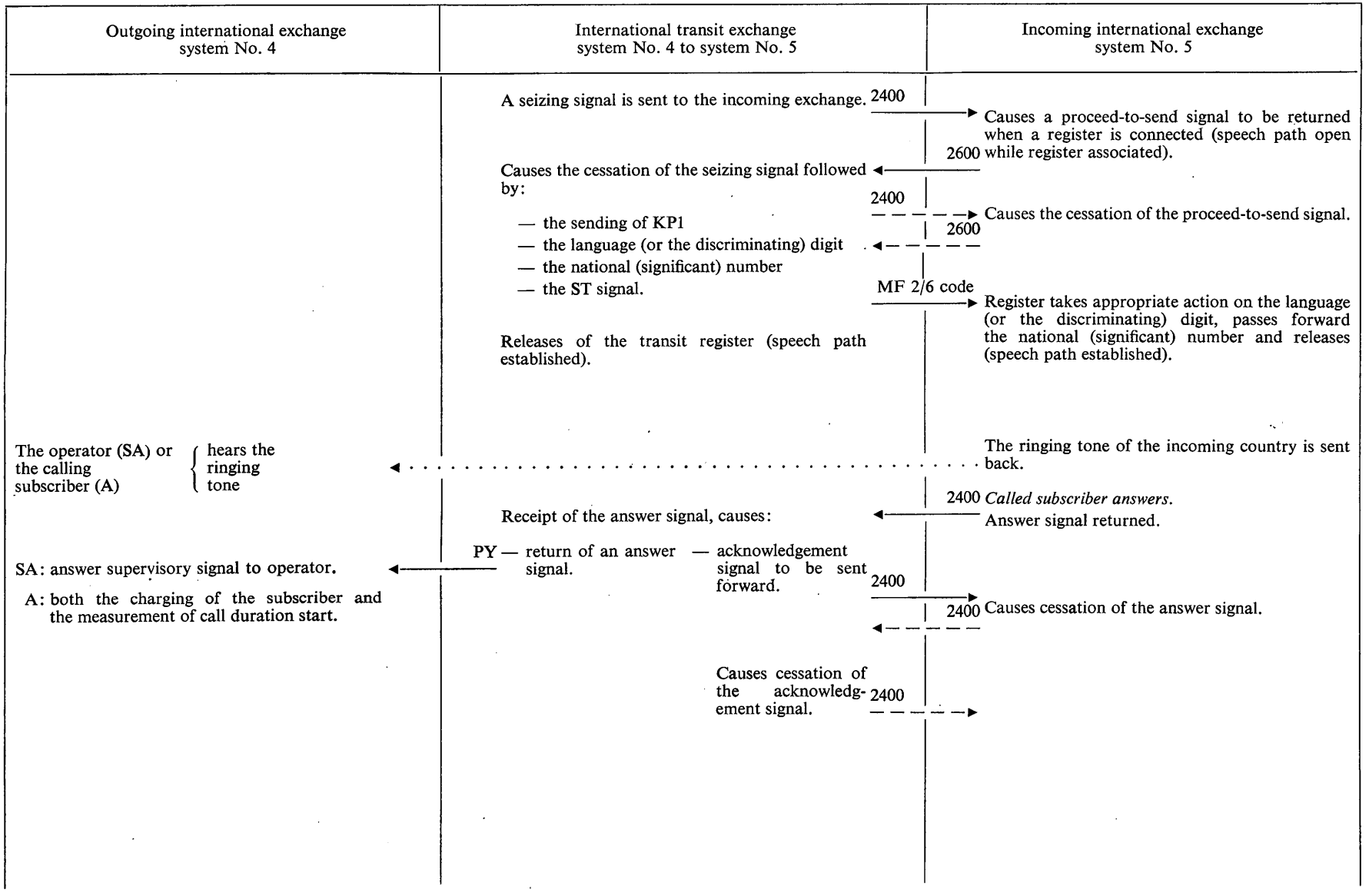
– – ► end of transmission of the signalling frequency in the case of its permanent transmission.

· · · ► transmission of an audible tone.

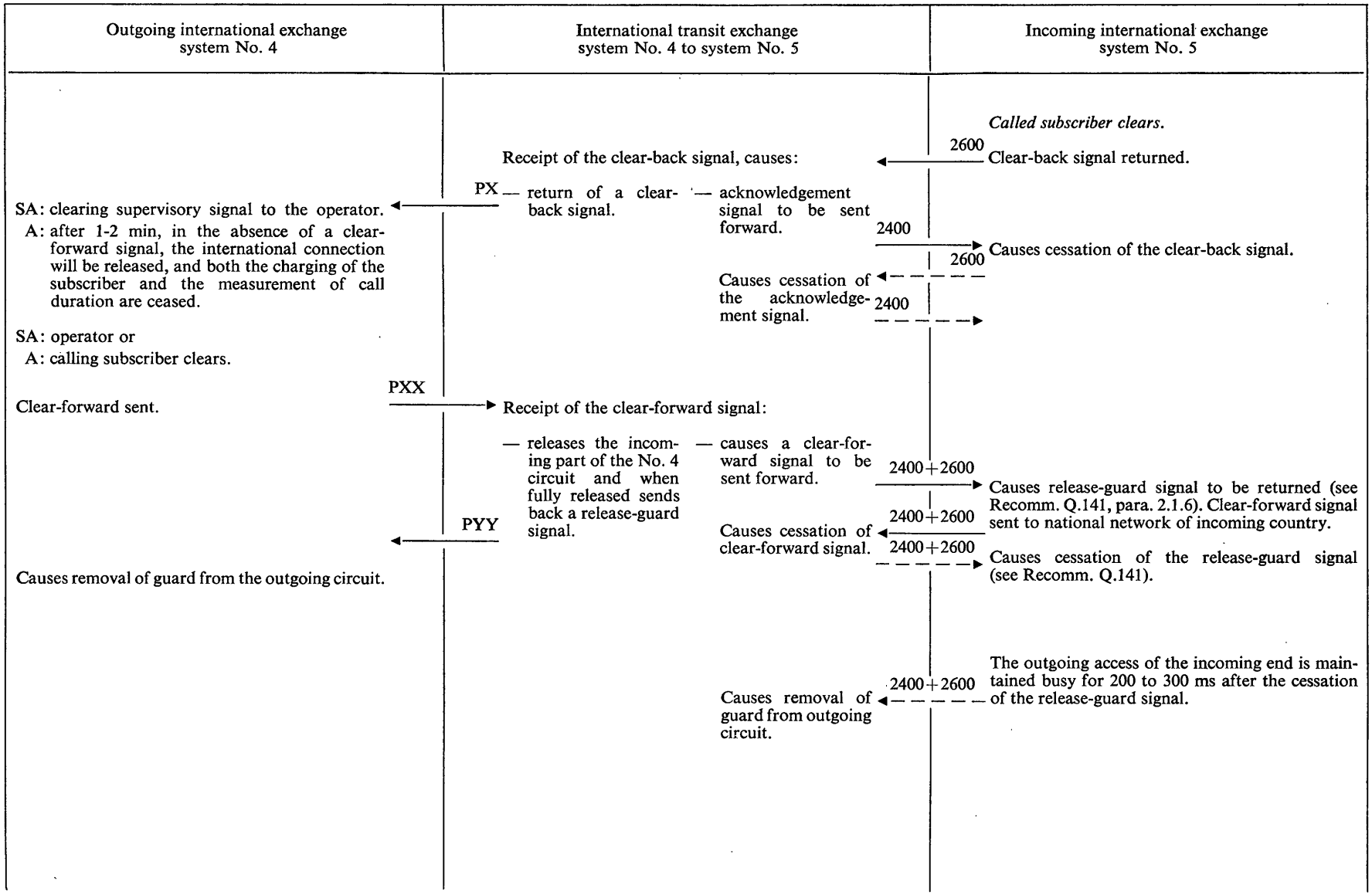
ANNEX 1

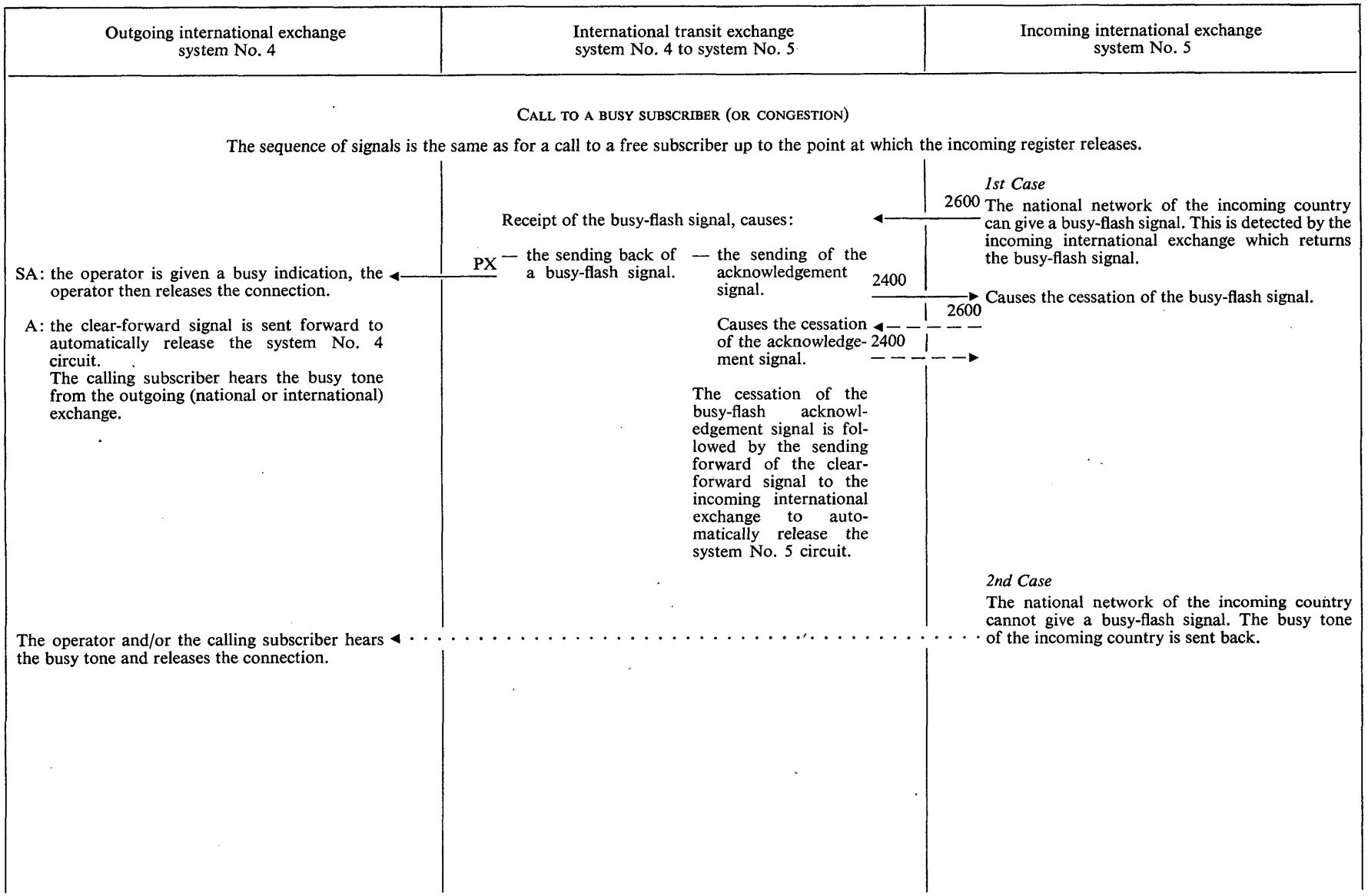
SIGNALLING SEQUENCES IN INTERWORKING FROM SYSTEM No. 4 TO SYSTEM No. 5




Outgoing international exchange system No. 4
International transit exchange system No. 4 to system No. 5
Incoming international exchange system No. 5
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).
2600
Causes the cessation of the seizing signal followed by:
2400
Causes the cessation of the proceed-to-send signal.
— the sending of KP1
— the language (or the discriminating) digit
— the national (significant) number
— the ST signal.
2600
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).
Releases 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.
2400
Called subscriber answers.
Receipt of the answer signal, causes:
Answer signal returned.
PY — return of an answer signal.
— acknowledgement signal to be sent forward.
SA: answer supervisory signal to operator.
2400
A: both the charging of the subscriber and the measurement of call duration start.
2400
Causes cessation of the answer signal.
Causes cessation of the acknowledgement signal.
2400

ANNEX 1 *(continued)*



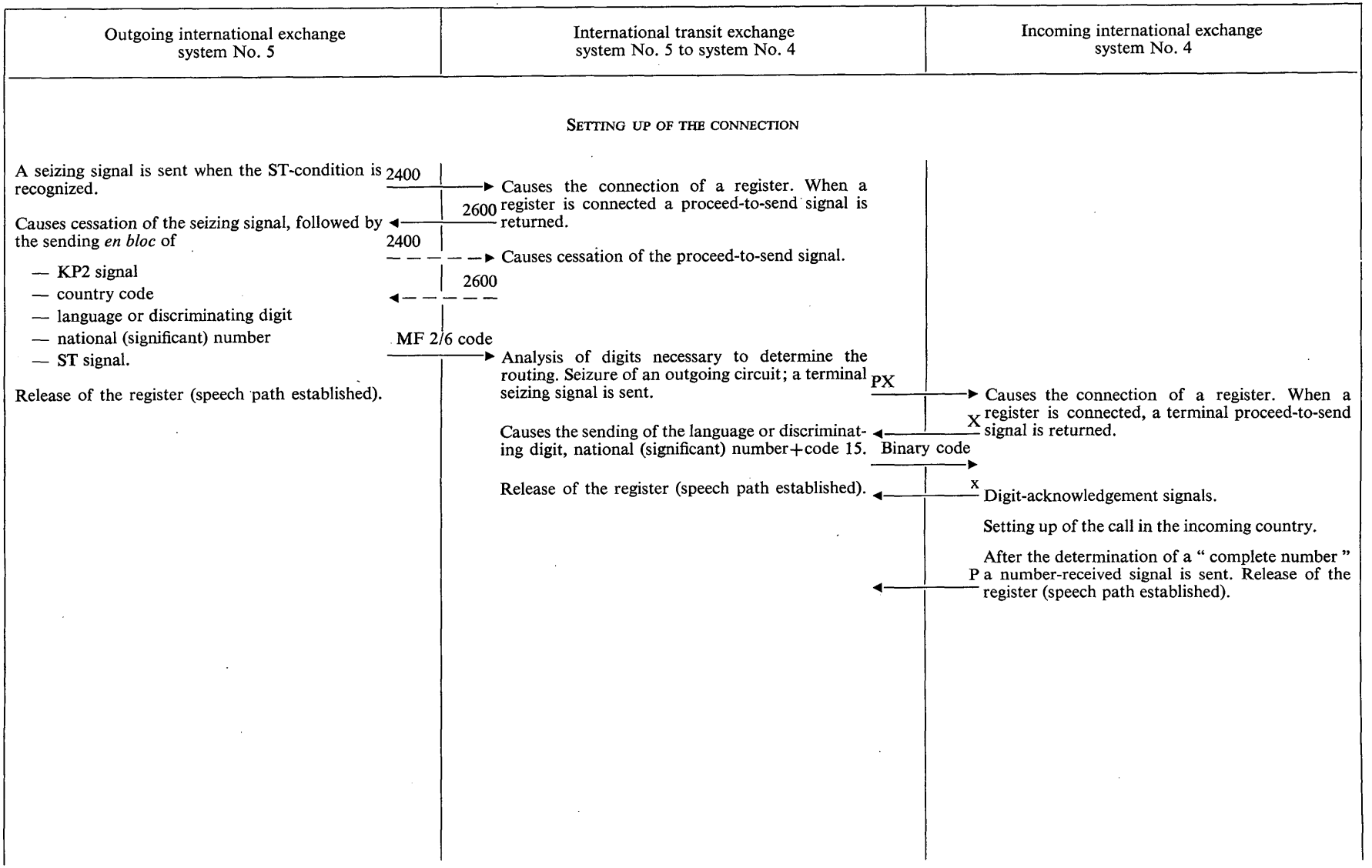

Outgoing international exchange system No. 4
International transit exchange system No. 4 to system No. 5
Incoming international exchange system No. 5
CALL TO A BUSY SUBSCRIBER (OR CONGESTION)
The sequence of signals is the same as for a call to a free subscriber up to the point at which the incoming register releases.
1st Case
2600
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.
Receipt of the busy-flash signal, causes:
PX — the sending back of a busy-flash signal.
— the sending of the acknowledgement signal.
2400
Causes the cessation of the busy-flash signal.
2600
Causes the cessation of the acknowledgement signal.
2400
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.
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.
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.

ANNEX 1 *(concluded)*

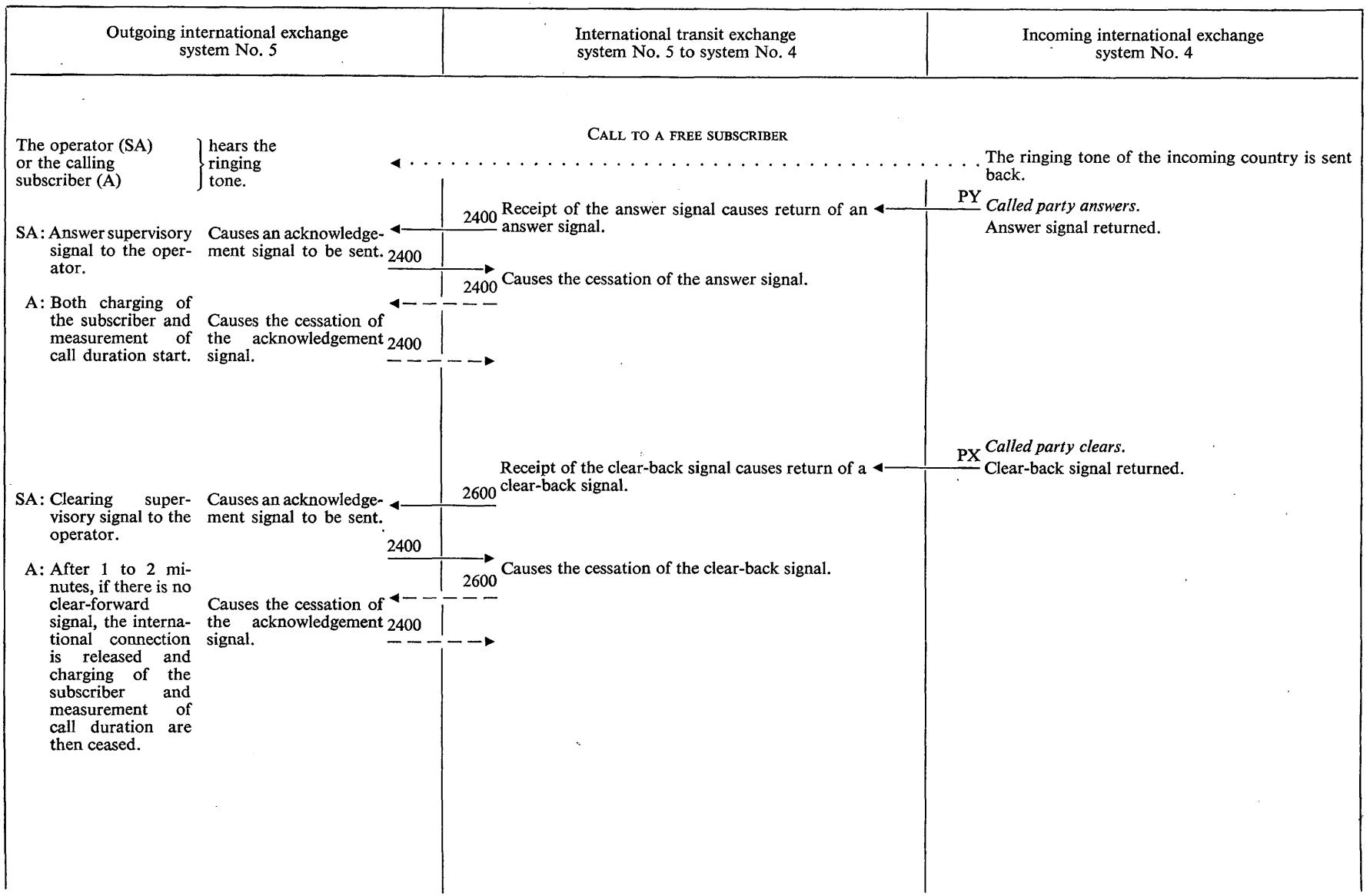
Outgoing international exchange system No. 4	International transit exchange system No. 4 to system No. 5	Incoming international exchange system No. 5
SPECIAL CONDITIONS		
1st Case SA: Following a call switched automatically to a subscriber, or following a call established via a special number incoming 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.

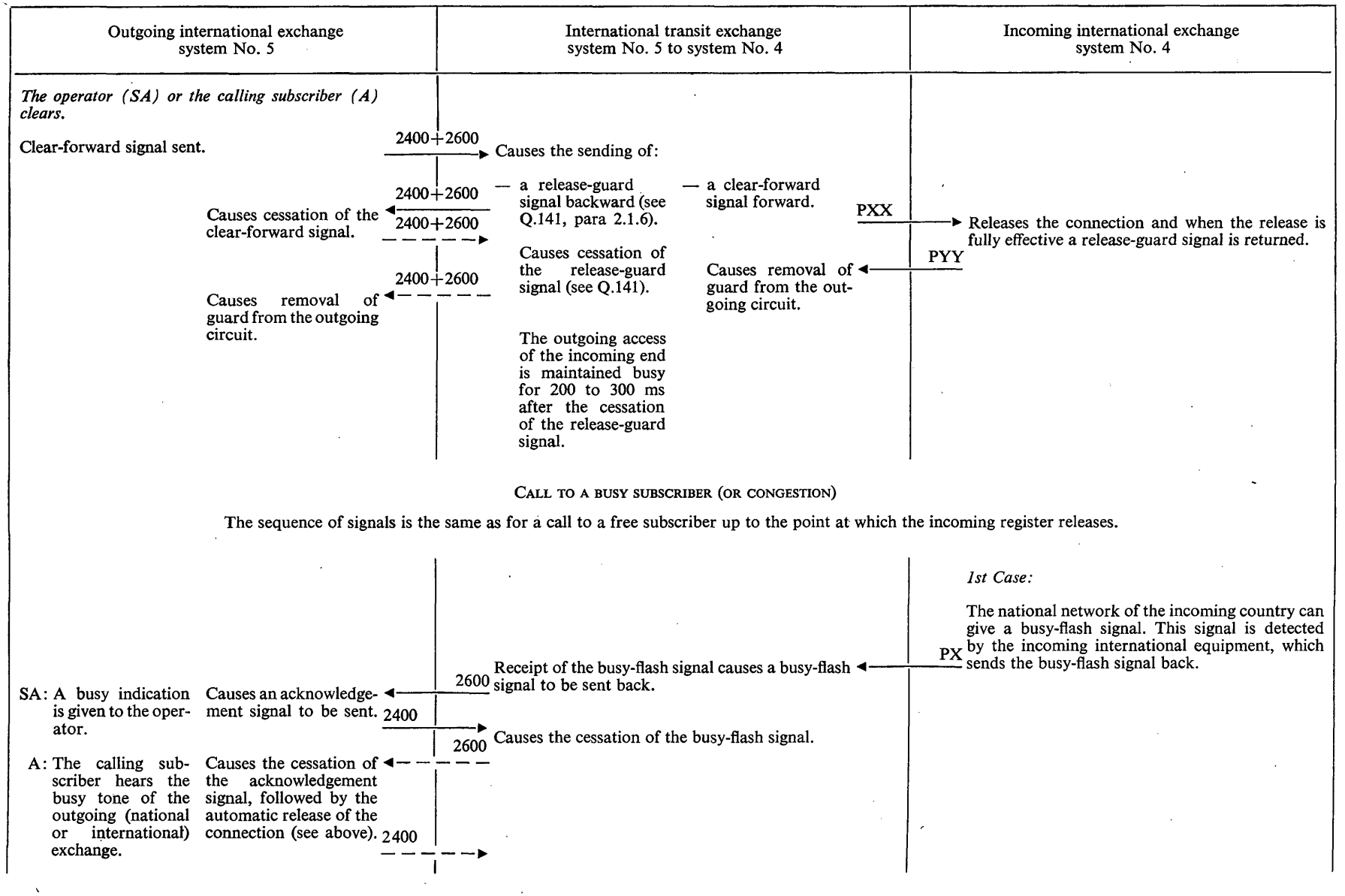
ANNEX 2

SIGNALLING SEQUENCES IN INTERWORKING FROM SYSTEM No. 5 TO SYSTEM No. 4



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.
PXX
Releases the connection and when the release is fully effective a release-guard signal is returned.
2400+2600
Causes cessation of the clear-forward signal.
2400+2600
Causes cessation of the release-guard signal (see Q.141).
PYY
Causes removal of guard from the outgoing circuit.
2400+2600
Causes removal of guard from the outgoing circuit.
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.
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.
PX
Receipt of the busy-flash signal causes a busy-flash signal to be sent back.
2600
SA: A busy indication is given to the operator.
Causes an acknowledgement signal to be sent.
2400
Causes the cessation of the busy-flash signal.
2600
A: The calling subscriber hears the busy tone of the outgoing (national or international) exchange.
Causes the cessation of the acknowledgement signal, followed by the automatic release of the connection (see above).
2400

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
		2nd Case:
The operator and/or the calling subscriber hears the busy tone and releases the connection (see above). ◄		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. 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.

PART XII

SIGNALLING SYSTEM No. 5 *bis*

INTRODUCTION

PRINCIPLES OF No. 5 *bis* SIGNALLING SYSTEM

General

System No. 5 *bis* 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—both forward and backward directions.

a) *Line signalling*

System No. 5 *bis* uses the same line signalling as system No. 5. This line signalling is specified in Recommendations Q.141 to Q.146.

b) *Register signalling*

This is a link-by-link 2/6 multifrequency (m.f.) in-band pulse signalling system with forward and backward signalling. The frequencies (700 Hz .... 1700 Hz) are outside of the line signalling frequencies and are the same in both directions. Overlap sending applies at the originating international register after formation of the initial address block. The initial address block comprises not more than seven signals beginning with the X signal (Table 1/Recommendation Q.211) followed by the I, Z and N signals as subsequently explained. When sending, the outgoing register pulses out the initial block signals in a continuous sequence. Additional signals are sent individually as soon as each one is available in the outgoing register. The trunk/TASI channel association established by the seizing signal is maintained by the TASI speech hangover during the interval between cessation of the seizing signal (on receipt of the " proceed-to-send " signal) and the transmission of the X signal. Upon completion of X signal transmission the guard and TASI-locking frequency [1] (1850 Hz) is applied. This guard and TASI-locking frequency is thereafter trans-

[1] The term " guard and TASI-locking frequency " indicates the double function of this frequency. The guard function inhibits the response of m.f. signal receivers to spurious signals and detects interruptions.

mitted during the intervals between subsequent signals until register dismissal. Cessation of the " proceed-to-send " signal will be followed immediately (within the TASI hangover time) by a guard and TASI-locking frequency in the backward direction having the same characteristics as that used in the forward direction. This makes possible the sending of signals at any time in either direction because TASI association is ensured.

Overlap register signalling applies (except for the initial block) 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 m.f. pulses, system No. 5 *bis* functions correctly in the presence of compandors.

Backward register signalling may commence immediately after receipt of the first forward interregister signal on a given circuit. Interregister signalling on a given circuit is completed when a backward signal appropriately selected from Table 4 (Recommendation Q.211) and indicating register dismissal, is received by the outgoing international exchange at the outgoing side of that circuit.

In general, care should be taken to ensure that the insertion or enabling of echo suppressors does not interfere with the simultaneous backward and forward transmission of interregister signals.

CHAPTER I

DEFINITION AND FUNCTION OF SIGNALS

Recommendation Q.200

DEFINITION AND FUNCTION OF SIGNALS

1.1 The definitions and functions of the line signals given in Recommendation Q.140, paragraphs 1.1, 1.2, 1.8, 1.10 and 1.11 apply completely to system No. 5 *bis*.

1.2 The signals given in Recommendation Q.140, paragraphs 1.6, 1.7 and 1.9 apply to system No. 5 *bis* with the following notes:

i) *Busy-flash signal* (Q.140, paragraph 1.6)

Because of the availability of additional interregister signals in system No. 5 *bis*, the busy-flash signal is sent only after the release of the incoming register. In the event that a busy-flash signal is received from a subsequent part of the connection prior to register release, a congestion signal from Table 4 (Recommendation Q.211) should be sent.

ii) *Answer signal* (Q.140, paragraph 1.7)

The answer signal will *not* start metering the charge to the calling subscriber if, prior to this signal, a no-charge interregister signal is also received. Moreover, the measurement of call duration for international accounting may not be started when a no-charge interregister signal is also received.

iii) *Clear-forward signal* (Q.150, paragraph 1.9)

In addition to the cases mentioned for system No. 5, the clear-forward signal will be sent after the receipt of a backward interregister signal calling for release of the connection by the outgoing international exchange.

1.3 *Initial forward interregister signal*

The initial forward interregister signal is designated as an " X " signal and has meanings as tabulated in Table 1.

1.4 *Other forward interregister signals*

These signals provide information to switch the call as required. The initial sequence of numerical signals including the X-signal described in 1.3 above is designated as the *Initial Address Block* and will normally take the following forms:

a) X I_1 Z N_1 N_2 N_3 N_4
b) X I_1 I_2 Z N_1 N_2 N_3
c) X I_1 I_2 I_3 Z N_1 N_2

} See 3.5.2 and Tables 1, 2 and 3 (Recommendation Q.211) for symbol meanings.

The initial address block may contain less than seven signals only if the total address comprises less than seven signals, in which case a suffix signal ST will indicate the shorter length and that forward transmission is complete. The ST signal may be sent in any case to show that no more forward interregister signals are intended. The ST signal is always sent in semi-automatic working and may be sent in automatic-working provided that no register dismissal signal has been received. (See paragraphs 1.5 and 3.2.1.)

1.5 *Interregister signals sent in the backward direction*

These signals provide an element of information as indicated in Table 4 (Recommendation Q.211). The final signal sent in the backward direction also indicates register dismissal.

1.6 *Signal sequence diagrams*

The sequence of signals in semi-automatic and automatic working is shown in Tables 1 and 2 of Annex 1 to this Part XII.

CHAPTER II

LINE SIGNALLING

Recommendation Q.201

LINE SIGNALLING

2.1 System No. 5 *bis* uses the same line signalling as system No. 5, specified in Recommendations Q.141 to Q.145. However, with regard to:

i) *The busy-flash line signal* (Q.141, paragraph 2.1.6 d)

This signal is sent only if the release of the incoming register has already occurred. In the event that a busy-flash signal is received from a subsequent part of the connection prior to the release of the incoming register, a congestion signal from Table 4 (Recommendation Q.211) should be sent.

ii) *The answer signal* (Q.141, paragraph 2.1.7 b)

The procedures for overlap compelling of the answer signal apply equally to the interconnection of:

— two No. 5 *bis* circuits;
— a No. 5 circuit and a No. 5 *bis* circuit, and
— a No. 5 *bis* circuit and a No. 5 circuit.

Recommendation Q.202

2.2 SPEED OF SWITCHING IN INTERNATIONAL EXCHANGES

2.2.1 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.

2.2.2 At the outgoing international exchange the seizing of the circuit and the setting up for the connection should take place as soon as the initial address block is available.

At an international transit exchange, switching may begin before the complete initial address block is registered but forward pulsing should be restrained until the complete initial address block is received. See paragraphs 3.5.2 of Recommendation Q.215.

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.

2.2.3 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.

CHAPTER III

REGISTER SIGNALLING

Recommendation Q.211

REGISTER SIGNALLING

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 must be accumulated in an outgoing international register until enough information is available to form an initial address block. As soon as an initial address block can be formed, 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 the initial address block is transmitted by the register. Thereafter additional signals are sent as soon as digits are available. TASI association is ensured throughout the interregister signalling period in both directions by means of the guard and TASI-locking frequency inserted between pulses, as covered in the introduction to the No. 5 *bis* specification.

2) Link-by-link register signalling applies. The register signals are always sent with an initial address block followed by additional signals if the address length demands this. Overlap switching and pulsing applies at all international exchanges in accordance with paragraph 2.2.2.

3) The register signalling is 2-out-of-6 multifrequency code with forward and backward signalling as shown in Tables 1, 2, 3 and 4.

The signals 1-15 mentioned in these tables are all composed of 2-out-of-6 frequency combinations and these combinations are identical for similarly numbered signals in all Tables. The combinations are shown only in Table 1.

3.1.2 *Sending sequence of register signals*

A. FORWARD SIGNALS

a.1) The forward sequence of interregister signals begins with an initial address block with typical composition as in the examples that follow:

1) X I_1 Z N_1 N_2 N_3 N_4
2) X I_1 I_2 Z N_1 N_2 N_3
3) X I_1 I_2 I_3 Z N_1 N_2

The following exceptional initial address blocks (fewer than seven signals in the block) may be encountered:

4) X I_1 Z Code 11, ST
5) X I_1 Z N_1 Code 11, ST
6) X I_1 Z Code 12, ST
7) X I_1 Z Code 12 [1], N_2 ST
8) X I_1 Z N_1 Code 12, ST
9) X I_1 I_2 Z Code 11, ST
10) X I_1 I_2 Z Code 12, ST

The signals following the initial address block (if any) are taken from Table 3 and are normally sent as soon as received by the outgoing international register.

In the present world numbering plan the maximum number of signals in a full address sequence is 15, made up as follows:

12 signals for country code + national number
1 signal X
1 signal Z
1 signal ST

In the event of a failure to satisfy a 2-out-of-6 or other logic check during forward signalling, the incoming exchange will request that the address be retransmitted on a given circuit (see paragraph b.3 below).

When retransmission is necessary this will always commence with the repeated transmission prefix (signal 13, Table 3) and will be followed by the initial address block and any subsequent digits available in the sequence as previously sent. If an error should occur in any of the first five signals of an initial address block, the backward error detected signal should be deferred until the fifth signal of the initial block has been received. (This procedure avoids a possible conflict between signals Z = 13 and N = 13). If address transmission has begun on the circuit immediately following the circuit engaged in error correction, the correction process should not cause retransmission of valid information already sent on that following circuit.

a.2) The ST end-of-pulsing signal should be transmitted on all semi-automatic calls and may also be transmitted on automatic calls.

a.3) 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.

B. Backward signals

b.1) The backward signals will be selected as required from Table 4. During initial use of system No. 5 *bis* there will normally be one backward signal on each link. It is possible, however, for an error-detected signal to be sent on a given circuit when an error is detected on forward signalling. In the event that the first error-detected signal results in a successful retransmission, a backward signal relating to normal register dismissal will follow ultimately, unless a second error should occur during forward signalling on the same circuit. In this case a second error-detected signal will be transmitted and no further backward signalling will take place since the outgoing register receiving the error-detected signal for the second time will clear the connection forward. A backward signal in accordance with Recommendation Q.217 paragraph 3.7.2 should then be sent.

[1] Code 12 is N_1, in this pattern.

b.2) The backward sequence described in b.1 above can be extended in the future if route monitoring is required. In this event a backward sequence headed by the route monitoring prefix (signal 13, Table 4) will be sent from each international exchange (other than the outgoing international exchange). This backward sequence, called a "route monitoring block", is of fixed length, and is transmitted promptly upon receipt of the forward " X " digit. Such blocks are then repeated backward link-by-link. The error-detected signal, when required, is sent after a route monitoring block, but not until the first five signals of the initial address block have been received.

b.3) A backward signal on any link may be corrupted to the extent that it does not satisfy the 2-out-of-6 check of multi-frequency pulses. The international exchange receiving and detecting this corruption will transmit backwards signal 15 (Table 4) as a substitute for the erroneous pulse. This substitute signal is ultimately received at the originating international exchange and the action to be taken at this international exchange will be based upon the following rules:

a) if the substitute occurs within the framework of the route monitoring block (excluding the route monitoring prefix itself) the switching should not be affected;

b) in all other cases receipt of signal 15 should cause release of the connection.

TABLE 1

FORWARD SIGNALS

Content of the X signal

Signal No.	Frequency (compound) Hz	Meaning
1	700+ 900	Incoming half echo suppressor not required and no satellite link included
2	700+1100	Incoming half echo suppressor required and no satellite link included
3	900+1100	Incoming half echo suppressor required and a satellite link included
4	700+1300	Outgoing half echo suppressor required and no satellite link included
5	900+1300	Spare (see note)
6	1100+1300	
7	700+1500	
8	900+1500	
9	1100+1500	
10	1300+1500	
11	700+1700	
12	900+1700	
13	1100+1700	Reserved to facilitate interworking with system No. 5
14	1300+1700	
15	1500+1700	Unavailable to avoid conflict with backward signal of same characteristic (signal 15 of Table 4)

Note. — The spare signals are available for future use:

a) to extend the precision of echo suppressor control, e.g. when a number of circuits of low propagation type are connected in tandem;

b) to monitor the number of TASI circuits in a connection.

TABLE 2

FORWARD SIGNALS

Content of the Z signals

Signal No.	Meaning	
1 2 3 4 5 6 7 8	Language digits as in Recommendation Q.104, with the assignment of signal 7 for use as the Z signal on calls requiring access to test equipment[a].	Semi-automatic calls
9	Spare	
10	Equals " 0 "; subscriber without priority	Discriminating digits for automatic calls
11	Subscribers with priority	
12	Data transmission	
13	Spare	
14	Spare	
15	Note	

[a] Test call address formats should be as in a, b or c below:

a) X I_1 7 " 12 " 0 N N ST;
b) X I_1 I_2 7 " 12 " 0 N N ST;
c) X I_1 I_2 I_3 7 " 12 " 0 N N ST.

Note. — Signal 15 is reserved to have the same meaning (end of pulsing) as in the "N" digit table (Table 3).

TABLE 3

FORWARD SIGNALS

Content of the N signals

Signal No.	Meaning
1 2 3 4 5 6 7 8 9	Digits 1-9 (see Note)
10	Digit 0 (see Note)
11	Code 11 operator
12	Code 12 operator or component of the test code pattern when associated with Z = 7
13	Repeated transmission prefix
14	Spare
15	ST—end of pulsing

Note. — The signals 1-10 are used for the country code and national number digits.

TABLE 4

BACKWARD SIGNALS

Signal No.	Meaning *(Note 1)*	
1	International switching equipment	Congestion
2	International circuit group	
3	National network	
4	Spare	
5	Address-complete, charge	Called-party line conditions
6	Subscriber-free, charge	
7	Subscriber free no charge	
8	Subscriber busy	
9	Number-unobtainable	
10	Subscriber-transferred (changed number)	
11	Error detected	
12	Spare	
13	Route monitoring prefix *(Note 2)*	
14	Spare *(Note 2)*	
15	Substitute for erroneous pulse	

Note 1. — Any of the backward signals, except signal 15, may be given meanings independent of those listed if they appear in the route-monitoring block.

Note 2. — In the event that route-monitoring blocks of different lengths are used in the future, signal 14 is available as an additional route-monitoring prefix.

Recommendation Q.212

3.2 END-OF-PULSING CONDITIONS—REGISTER ARRANGEMENTS

3.2.1 *End of forward pulsing*

The end of forward pulsing may be indicated in an incoming international exchange:

a) by an examination of the received number or other suitable measures as indicated in Q.120, paragraph 1.5.5; or

b) by receipt in some cases of an ST signal.

3.2.2 *End of backward pulsing*

The end of backward pulsing is synonymous with register dismissal. The incoming exchange indicates the end of backward pulsing by an appropriate signal from Table 4.

Recommendation Q.213

3.3 SIGNAL TRANSMISSION REQUIREMENTS

3.3.1 *Signalling frequencies to be used in both directions*

a) 700, 900, 1100, 1300, 1500 and 1700 Hz

A multifrequency signal shall consist of a combination of any two of these six frequencies. The frequency variation shall not exceed $\pm$ 6 Hz of each nominal frequency.

b) 1850 Hz

The guard and TASI-locking frequency shall consist of 1850 Hz.

The frequency variation shall not exceed $\pm$ 6 Hz.

3.3.2 *Transmitted signal level*

a) Two out of six m.f. signalling frequencies:

A level of -7 ± 1 dBm0 per frequency should be used. The difference in transmitted level between the two frequencies comprising a signal should not exceed 1 dB.

b) Guard and TASI-locking frequency:

This frequency, transmitted in the gaps between m.f. signals, shall be sent in the forward direction initially at a level of -7 ± 1 dBm0 and shall continue at this level until a new MF signal is sent or until expiration of an interval of 90 ± 30 ms. If the interval between MF signals requires continuation of the guard frequency beyond 90 ± 30 ms, the frequency level should be reduced to -15 ± 1 dBm0. In the backward direction a uniform level of -15 ± 1 dBm0 should be used.

Note. — The level of the leak current transmitted to line should be at least:

a) 50 dB below the -7 dBm0 single-frequency level when no signal frequency (either MF or guard and TASI-locking frequency) is being transmitted;

b) 30 dB below the -7 dBm0 single-frequency level during transmission of either an MF signal or of the guard and TASI-locking frequency.

3.3.3 *Signal durations and related time intervals*

— all m.f. signals: 55 ± 5 ms;

— interval between MF signals:
  — within the initial address block: 55 ± 5 ms;
  — later intervals: not less than 55 ± 5 ms.

— interval between cessation of the seizing line signal and the transmission of the first register signal: 80 ± 20 ms;

— interval between cessation of the proceed-to-send signal and transmission of the backward guard and TASI-locking frequency: 80 ± 20 ms;

— interval between cessation of the X-signal frequencies and the first application of the guard and TASI-locking frequency: 1 ± 1 ms.

After initial application in both directions, the guard and TASI-locking frequency shall be sent for the duration of the gap between signals and shall persist until register dismissal. The separation intervals between MF signals and the guard and TASI-locking frequency should not exceed 1 ± 1 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.214

3.4 MULTIFREQUENCY SIGNAL RECEIVER AND GUARD FREQUENCY DETECTOR

A. 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 Hz of the nominal signalling frequency;

b) the absolute power level N of each unmodulated signal shall be within the limits:

$$(-14 + n \leqslant N \leqslant n) \text{ dBm}$$

where n is the relative power level at the signal receiver input. These limits give a margin of ±7 dB 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;

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 m.f. 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.

Note 1. — The tolerances given in a, b and c are to allow for variations at the sending end and in line transmission.

Note 2. — The test values 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, n being the relative power level at this point. This limit is 17 dB 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 intervals of 10 ms or less.

d) Arrangements should be made to ensure non-acceptance of 2-out-of-6 signals in the presence of the guard and TASI-locking frequency.

3.4.3 *Steady noise*

Considering that unweighted noise of a level —40 dBm0 (100 000 pW) and uniform spectrum energy may arise on the longest international circuit, the multifrequency receiver and guard tone detector should satisfy the condition indicated in paragraph 3.4.1 d, 3.4.5 c, and 3.4.6 respectively for minimum signal and interval durations in the presence of noise of level —40 dBm0 and uniform spectrum energy over the frequency range 300 to 3400 Hz.

3.4.4 *Input impedance*

The composite input impedance of the multifrequency receiver and guard frequency detector should be such that the return loss over a frequency range 300 to 3400 Hz against a 600-ohm non-inductive resistor is greater than 20 dB.

B. Guard frequency Detection

3.4.5 *Operating limits*

The guard frequency detector must respond under the following conditions:

a) the frequency of the received signal is within ±15 Hz of the nominal 1850 Hz guard frequency (signals of the level in b below but outside the range 1850 ± 100 Hz should not cause operation of the guard detector);

b) the level of the received signal is in the range 0 to —22 dBm0. Signals of levels below —32 dBm0 should not cause operation of the guard frequency detector;

c) the duration of the received signal at the input of the receiver is in the range 15 to 25 ms in the presence of noise as specified in section 3.4.3.

3.4.6 *Release limits*

The guard frequency detector must release when a signal satisfying the conditions given in 3.4.5 above has been reduced to a level of —37 dBm0 or below at the input of the guard frequency detector for an interval of 10 to 20 ms and in the presence of noise as specified in section 3.4.3.

3.4.7 *Input impedance*

The composite input impedance of the multifrequency receiver and guard frequency detector should be such that the return loss over a frequency range 300 to 3400 Hz against a 600-ohm non-inductive resistor is greater than 20 dB.

C. Error Determination

3.4.8 *Absence of a valid signal*

If in the forward direction for an interval of 20 to 30 ms there is no valid signal present at the output of both the multifrequency receiver and the guard frequency detector, an error condition should be indicated. This error condition should result in the backward transmission of an error-detected signal unless the error occurs after reception of an ST signal. No provision need to be made for detecting and acting upon discontinuities in the guard and TASI-locking frequency used in the backward direction.

Recommendation Q.215

3.5 ANALYSIS OF REGISTER SIGNALS FOR ROUTING

3.5.1 *General requirements for the transit exchange*

In an international transit exchange an analysis of some of the register signals is required to determine the routing [1] to the desired international incoming exchange or to another international transit exchange. As a general rule the X, I and Z signals [2] are subject to this analysis. In some cases an analysis of more or fewer signals 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 register signals to be analyzed in an international transit exchange*

The standard initial address block will take the form given in paragraph 3.1.2 a.1, Recommendation Q.211, and will provide a basis for making routing choices. Although signal analysis for routing may be extended at the option of an international exchange, there will be no general requirement in an international exchange receiving a standard initial address block to analyze more than six of the seven signals. The signal which is underlined in the patterns below need not be analyzed if an international exchange wishes to limit analysis to six signals. At transit exchanges switching may begin before the full initial address block is registered, but forward register signalling should be restrained until the full initial address block is received since uninterrupted transmission of the initial address block on the outgoing route must be guaranteed. This takes account of possible retransmissions for error correction.

$$\begin{array}{rccccccc} & X & I_1 & Z & N_1 & N_2 & N_3 & \underline{N_4} \\ & X & I_1 & I_2 & Z & N_1 & N_2 & \underline{N_3} \\ & X & I_1 & I_2 & I_3 & Z & N_1 & \underline{N_2} \\ \text{or} & X & I_1 & I_2 & I_3 & \underline{Z} & N_1 & N_2 \end{array}$$

where: $I_1\ I_2\ I_3$ = digits of the country code, Z = discriminating signal (D) or language digit (L), $N_1 \ldots N_n$ = digit of the national (significant) number as indicated in Table 3 (Recommendation Q.211).

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).

3.5.3 *Signal analysis for routing at the outgoing international exchange*

The *maximum* number of signals which have to be analyzed in the outgoing international exchange to determine the routing is also six, as in section 3.5.2 for the transit exchange.

3.5.4 *Signal analysis for inserting (or detecting) the language or discriminating signal*

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 digit or the discriminating signal 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.

---

[1] See Recommendation Q.11, paragraph 1.2.

[2] The I signals constitute the country code of the destination country.

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.215)

Example of the signal analysis in a transit exchange

A list of possible cases for the signal 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).

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: $\underbrace{X\ I_1\ I_2\ Z\ N_1\ N_2 \ldots}_{\text{analyzed}}$

b)[1] Semi-automatic calls to code 11 or code 12 operators.

Examples: $\underbrace{X\ I_1\ I_2\ L\ N_1\ C_{11} \ldots}_{\text{analyzed}}$ or $\underbrace{X\ I_1\ I_2\ L\ N_1\ C_{12} \ldots}_{\text{analyzed}}$

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 signal (D).

Examples: $\underbrace{X\ I_1\ I_2\ L \ldots}_{\text{analyzed}}$ or $\underbrace{X\ I_1\ I_2\ D \ldots}_{\text{analyzed}}$

3.[1] 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: $\underbrace{X\ I_1\ I_2\ L\ N_1\ C_{11}}_{\text{analyzed}}\ ST$ or $\underbrace{X\ I_1\ I_2\ L\ N_1\ C_{12}}_{\text{analyzed}}\ N_3\ N_4\ ST$

[1] 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.

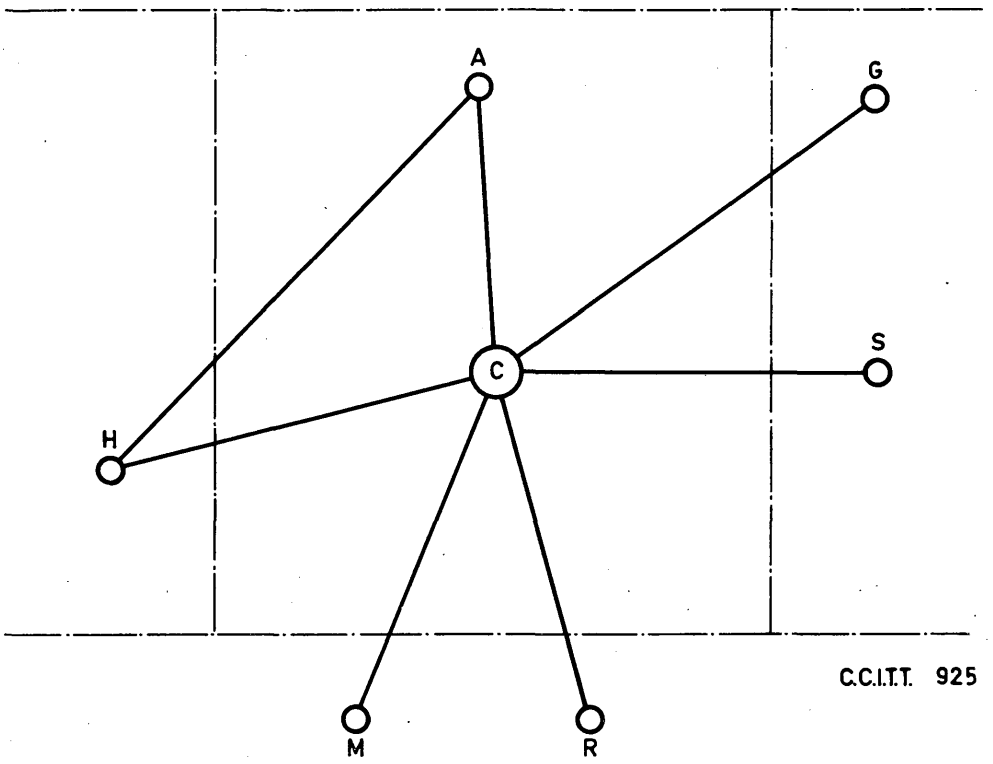


FIGURE 1/Q.215. — **Example of the signal analysis in a transit exchange.**

Recommendation Q.216

3.6 X-SIGNAL USAGE

3.6.1 *General*

The X-signals 1-12 have been made available to indicate switching control information beyond that carried in the normal address and in the Z-signal. Initially, the added information has application to echo suppressor control and to routing constraints imposed by satellites. A single X-signal uniquely characterizes all additional control information of interest. Table 1 (Recommendation Q.211) lists the assignments given for X = 1 through X = 4. Eight assignments remain spare.

3.6.2 *Echo suppressor control*

The signal assignments X = 1 through X = 4 anticipate the need to control a single standard type of half echo suppressor. The originating international exchange determines the X-signal to be sent by analyzing the country code and by taking note of the circuit to be used. Rules for application are as follows :

1) if the originating international exchange cannot provide a half echo suppressor, use signal X = 4. If the call is transit, the first transit international exchange should require the use of a half echo suppressor on its outgoing circuit and should change the X value sent onward to X = 2 or 3 as appropriate;

2) if the originating international exchange chooses a transit route and can provide a half echo suppressor, use X = 2 or 3 as appropriate;

3) if the originating international exchange chooses a terminal route and can provide a half echo suppressor, the nature of the connection as known to the originating international exchange determines a choice of signal X = 1, X = 2 or X = 3;

4) a transit international exchange should change the X-signal from X = 2 to X = 3 if a satellite circuit is selected;

5) a transit international exchange, having received signal X = 2 or X = 3, and having selected a terminal circuit not arranged for echo suppressors, should insert the terminating half echo suppressor. The X-digit transmitted to the incoming international exchange should be passed unchanged (as X = 2 or X = 3) to retain satellite routing information. Since the incoming international exchange cannot supply a half echo suppressor in any event, this assignment procedure saves an X-signal assignment.

If echo suppressors are taken from a pool and none are free to satisfy a call requirement, the congestion signal 1 of Table 4 (Recommendation Q.211) should be sent back.

3.6.3 *Satellite routing constraints*

Each of the signal assignments used for echo-suppressor control has an application to satellite routing as well. These assignments show if there has or has not been prior usage of a satellite circuit. In this way the X-digit guides subsequent routing choices to avoid tandem satellite links. If a call which has already traversed one satellite circuit cannot advance without recourse to a second satellite circuit, the transit international exchange must decide whether to return the congestion signal 2 of Table 4 (Recommendation Q.211) or to accept the tandem satellite circuit connection.

3.6.4 *Other X-signals*

X-signals 13 and 14, which have the same frequency combinations as KP1 and KP2 of system No. 5 have been reserved to ease the parallel working of system No. 5 and system No. 5 *bis* in the event of common equipment for those two systems.

Signal 15 is not available as, in Table 4 (Recommendation Q.211), signal 15 is a substitute for an erroneous pulse. If X-signals were to be sent backwards within a route monitoring block, the use of X = 15 would produce a conflict.

3.6.5 *X-signal usage in the backward direction*

If it is decided in the future that an X-signal be sent backwards from any transit or incoming register to the originating register as part of a route-monitoring block, it will be the same X-signal which was transferred in the forward direction on the last circuit. However, in the case of an interface switching point an additional route monitoring block could be generated by the interworking equipment.

Recommendation Q.217

3.7 RELEASE OF INTERNATIONAL REGISTERS

3.7.1 *Normal release conditions*

a) An outgoing register shall be released [1] when it has received an appropriate backward inter-register dismissal signal or when the connection is cleared earlier by the outgoing side.

[1] Except in the case of register dismissal due to the backward signals 6 and 7 (Table 4, Rec. Q.211), release of the outgoing international register will cause the connection of the appropriate tones or announcements to the calling party.

b) An incoming international register shall be released when it has transmitted a backward interregister dismissal signal [1] or when the connection is cleared earlier by the outgoing side.

c) An international transit register shall be released when it has sent a backward interregister dismissal signal or when the connection is cleared earlier by the outgoing side.

3.7.2 *Abnormal release conditions*

a) An outgoing international register shall release[2] and clear the forward connection in any of the following five cases:

1. if 10-20 seconds after the start of the seizing signal no proceed-to-send signal is received;
2. if 20-30 seconds after the reception of the proceed-to-send signal, owing to fault conditions, the outgoing register has not pulsed out;
3. if 20-30 seconds after the sending of the last valid forward register signal, no register dismissal signal is received;
4. if a backward error-detected signal is received for the second time;
5. if a " substitute for erroneous pulse " signal is received, provided it is not part of the route-monitoring block.

b) An incoming international register shall release and clear the forward connection, if any, in the following case:

No digits or insufficient digits to establish a connection have been received and 15-30 seconds have elapsed since the end of the proceed-to-send signal or the receipt of the last forward register signal. In this case signal 2 (Table 4 (Recommendation Q.211) is transmitted backwards prior to release.

c) An international transit register shall be released in any one of the cases stated for the release of the outgoing and incoming international registers as in paragraphs 3.7.2 a and b above. When releasing because of the reception of an error-detected signal for the second time, the international transit register will send signal 2 of Table 4 (Recommendation Q.211) backwards prior to release.

Recommendation Q.218

3.8 SWITCHING TO THE SPEECH CONDITION

At the incoming and transit international exchange the circuit shall be switched to the speech condition when the register is released after sending a backward signal indicating number received or called party line conditions as per Table 4 (Recommendation Q.211).

At the outgoing international exchange the circuit will be switched to the speech position when the register is released due to the reception of the backwards signals 6 or 7. In other cases the appropriate tones should be sent or other measures taken.

---

[1] At the discretion of the incoming international exchange the forward transmission path may be kept split until the forward guard and TASI-locking frequency ceases.

[2] See the footnote to paragraph 3.7.1.

CHAPTER IV

MANUAL TESTING ARRANGEMENTS

Recommendation Q.221

MAINTENANCE MANUAL TEST ARRANGEMENTS FOR SIGNALLING SYSTEM No. 5 *bis* [1]

1. *General*

The testing arrangements for signalling system No. 5 *bis* are essentially the same as indicated in Recommendations Q.161 to Q.164 for system No. 5. However, the different time specification and the introduction of backward register signals should be taken into account.

The performance of the guard frequency detector may be checked according to the requirements of paragraph 3.4 of Recommendation Q.214 of the system No. 5 *bis* specification.

---

[1] See Recommendation Q.49/O.22: " Specifications for the C.C.I.T.T. automatic transmission measuring and signalling testing equipment ATME No. 2 ".

PAGE INTENTIONALLY LEFT BLANK

PAGE LAISSEE EN BLANC INTENTIONNELLEMENT

ANNEX TO SIGNALLING SYSTEM No. 5 *bis* SPECIFICATIONS

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, the arrows have the following meanings:

——► transmission of a signalling frequency (permanent or pulse emission).

— — ► end of transmission of the signalling frequency in the case of its permanent transmission.

· · · ► transmission of an audible tone.

ANNEX

TABLE 1. — SEMI-AUTOMATIC (SA) AND AUTOMATIC (A) TERMINAL TRAFFIC

Outgoing international exchange		Incoming international exchange
CALL TO A FREE SUBSCRIBER		
After the initial address block is registered in the outgoing register, a seizing signal is sent forward (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	
	← 1850	Upon the cessation of the proceed-to-send signal the incoming register sends back the guard and TASI-locking frequency.
The cessation of the seizing signal is followed (in 80 + 20 ms) by the sending en bloc in MF code of the initial address block. The initial address block typically consists of 7 signals: — the X signal — I digit(s) (country code) — the Z signal — N digits (initial part of national number)	1st MF 2/6 code → 1850 → 2nd MF 2/6 code → 1850 → etc.	The MF 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 X and Z signals (typically X is an echo suppressor/satellite link control signal). In SA operation for code 11 or 12 calls, the register directs the call to the operators' positions.
When the initial address block consists of less than 7 signals (e.g., code 11 or 12 calls), a suffix SI signal terminates the block. The ST is always sent on SA calls.		
The " guard and TASI-locking frequency " is sent during the signal gaps beginning after the X signal until the register is dismissed.	1850 →	
Any address signals which follow the initial address block are forwarded as received.		

TABLE 1 *(continued)*

Outgoing international exchange		Incoming international exchange
	1850 ◄- - - - - - - - - - - - - - - -	After performing all necessary functions, the register sends back a register dismissal signal. The incoming register releases without further transmission of the backward guard and TASI-locking frequency. The speech path through the incoming exchange is established (the return path immediately, the forward path after the forward guard and TASI-locking frequency ceases, if the incoming international exchange chooses this option).
Upon receiving the register dismissal signal the register releases.	MF 2/6 code ◄————————	
Release of the register causes the guard and TASI-locking frequency to cease. The speech path through the outgoing exchange is established.	1850 - - - - - - - - - - - - - - - - ►	
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
Receipt of the answer signal causes an acknowledgement signal to be sent.	2400 ————————►	
	2400 ◄- - - - - - - - - - - - - - - -	Receipt of the acknowledgement ceases the answer signal.
The end of reception of the answer signal ceases the acknowledgement signal.	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.
	2600 ◄- - - - - - - - - - - - - - - -	
The end of reception of the clear-back signal ceases the acknowledgement signal.	2400 - - - - - - - - - - - - - - - - ►	

TABLE 1 *(continued)*

Outgoing international exchange		Incoming international exchange
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.
	← 2400 + 2600	The clear-forward signal is sent to the country of destination.
The receipt of the release-guard signal ceases the clear-forward signal.	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 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 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 signal sequence is the same as for a call to a free subscriber, up to the point where the busy subscriber (or congestion) is encountered.

	1850 →	*1st case*
	← 1850	The national network of the incoming country gives a busy flash, a congestion, or a busy signal. These signals should cause the incoming register to send back signal 8 of Table 4 in case of busy and signal 3 of Table 4 in the other cases. The incoming register releases. The speech path through the incoming exchange is established.
	⇠ 1850	
The release of the outgoing register is initiated. The path through the outgoing exchange is established.	← MF 2/6 code	
The outgoing register releases	1850 ⇢	
SA: A "busy" indication is given to the operator.	← 2600	The busy-flash signal may also be returned via the line signalling system after register dismissal upon receipt of a busy-flash signal from the national network.
The busy-flash signal causes the acknowledgement signal to be sent.	2400 →	The acknowledgement signal ceases the busy-flash signal.
A: The calling subscriber hears the busy tone of the outgoing (national or international) exchange.	⇠ 2600	
The end of reception of the busy-flash signal ceases the acknowledgement signal.	2400 ⇢	
After busy, congestion, or busy-flash signalling via the interregister or line signalling system is completed, the clear-forward signal is automatically sent 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.

TABLE 1 *(concluded)*

Outgoing international exchange	Special conditions	Incoming international exchange
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.
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.

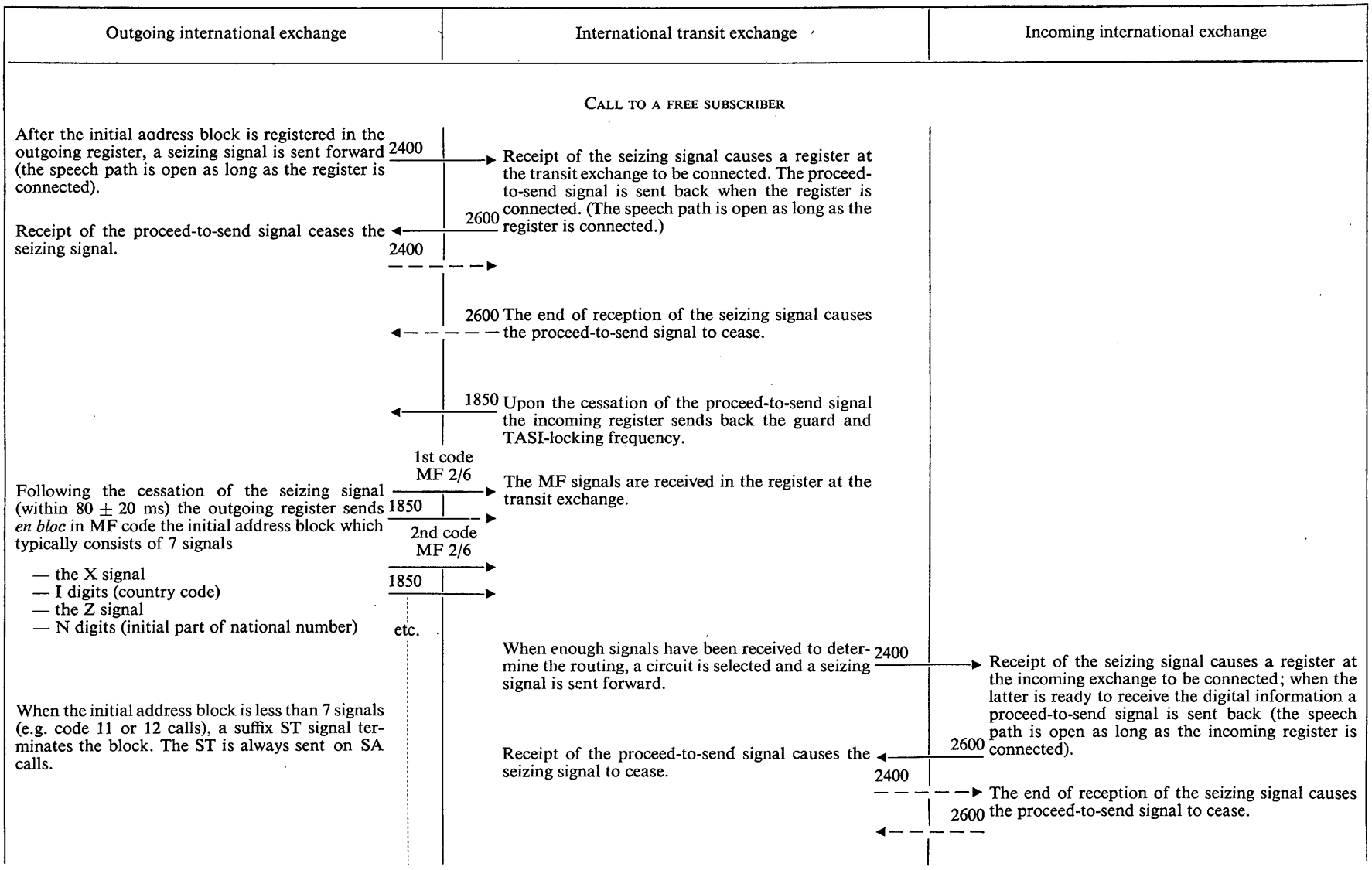
The two ends of the circuit send and receive the seizing signal for a sufficiently long time to ensure that the signal can be recognized at both ends.
The two ends recognize the double seizing by this condition.
The equipment is cleared at each end without the sending of a clear-forward signal; then:

a) either a second automatic attempt to set up the connection takes place, or

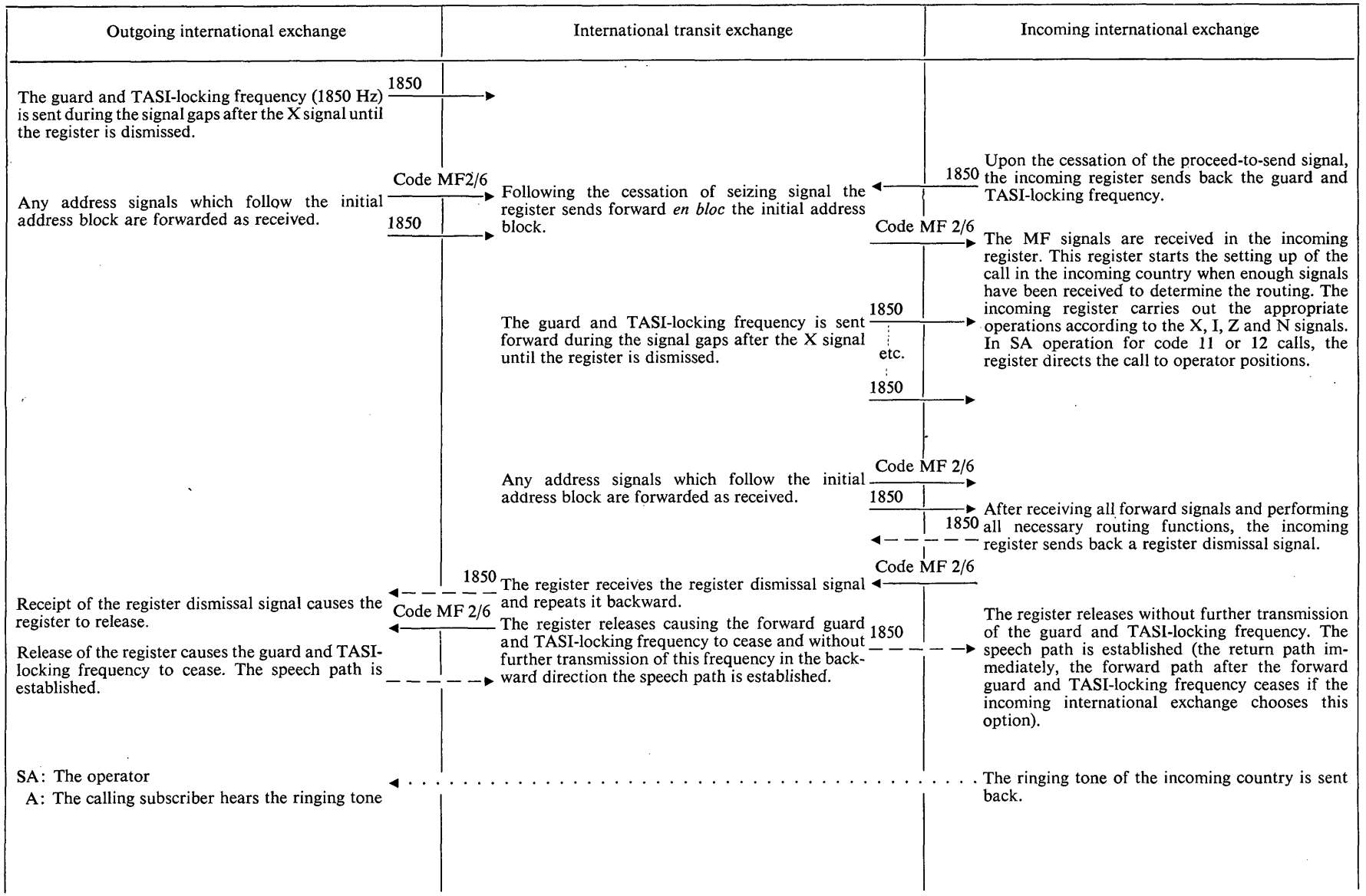
b) { SA: a re-order indication is given to the operator;
   { A: a busy tone is sent to the subscriber.

ANNEX

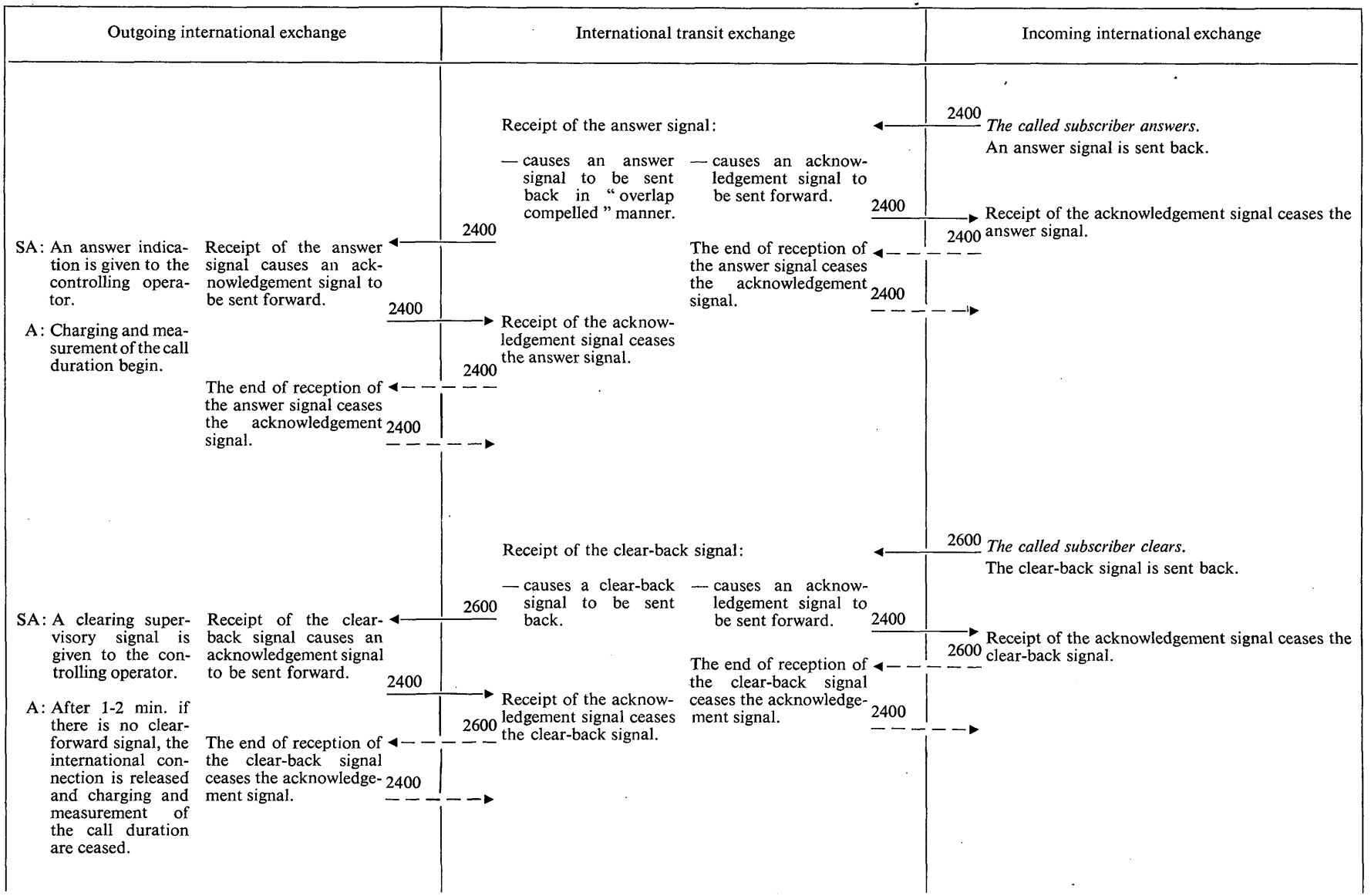
TABLE 2 — SEMI-AUTOMATIC (SA) AND AUTOMATIC (A) TRANSIT TRAFFIC



ANNEX — TABLE 2 *(continued)*



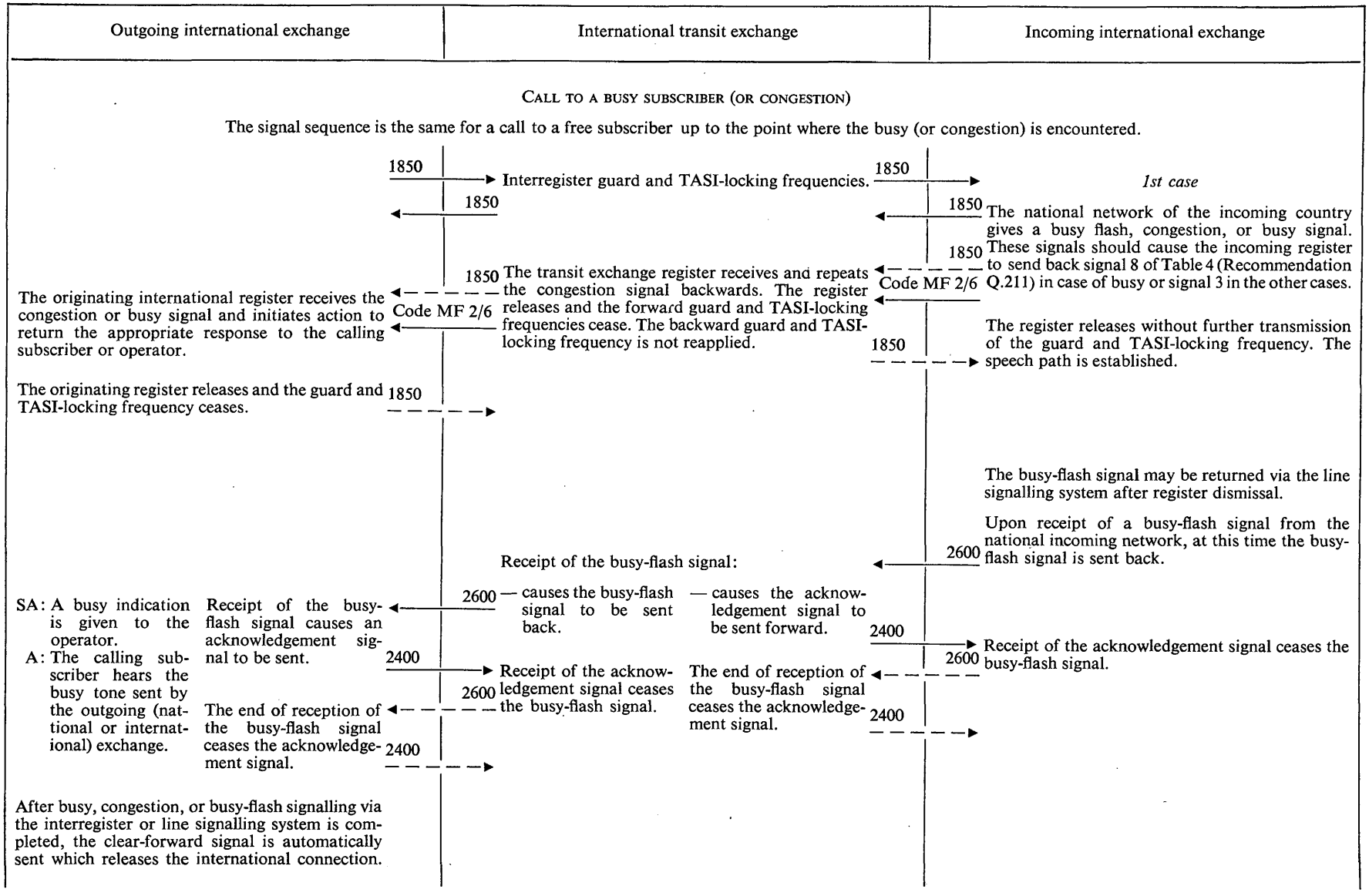
ANNEX — TABLE 2 *(continued)*



ANNEX — 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 ←	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 ← - - - - -	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.
	The outgoing access of the incoming end is maintained busy for 200 to 300 ms after the cessation of the release-guard signal.	

ANNEX — TABLE 2 *(continued)*



ANNEX — TABLE 2 *(concluded)*

Outgoing international exchange	International transit exchange	Incoming international exchange
		2nd case
SA: The operator, or A: the calling subscriber hears the busy tone and clears. The clear-forward signal is sent.	◄ · · · · · · · · · · · · · · · · · · ·	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.

PAGE INTENTIONALLY LEFT BLANK

PAGE LAISSEE EN BLANC INTENTIONNELLEMENT

PART XIII

INTERWORKING OF SYSTEM No. 5 *bis* WITH SYSTEMS No. 4 AND No. 5[1]

Recommendation Q.230

1. INTRODUCTION

Since system No. 5 *bis* is expected to be suitable for use in existing international exchanges of electromechanical design and will be an improved system furnishing additional features, Administrations may wish to install such equipment to gain these advantages. Then situations where the No. 5 *bis* system may be operated in parallel with existing No. 5 and other systems will arise.

The following arrangement might be considered:

1.1 Use of the respective equipments to serve different routes.

1.2 Use of two separate circuit groups between the same two international exchanges. Unless the two separate groups are large, this may lead to inefficient use of the circuits and would then only be acceptable for a short, transient, period of time. The disadvantage of insufficient circuit usage might be reduced by applying overflow techniques between the two groups. The group served by system No. 5 *bis* may be used particularly for transit calls whilst the other is reserved solely for terminal traffic.

1.3 The principles discussed above are applied in the network pattern of Figure 1/Q.230.

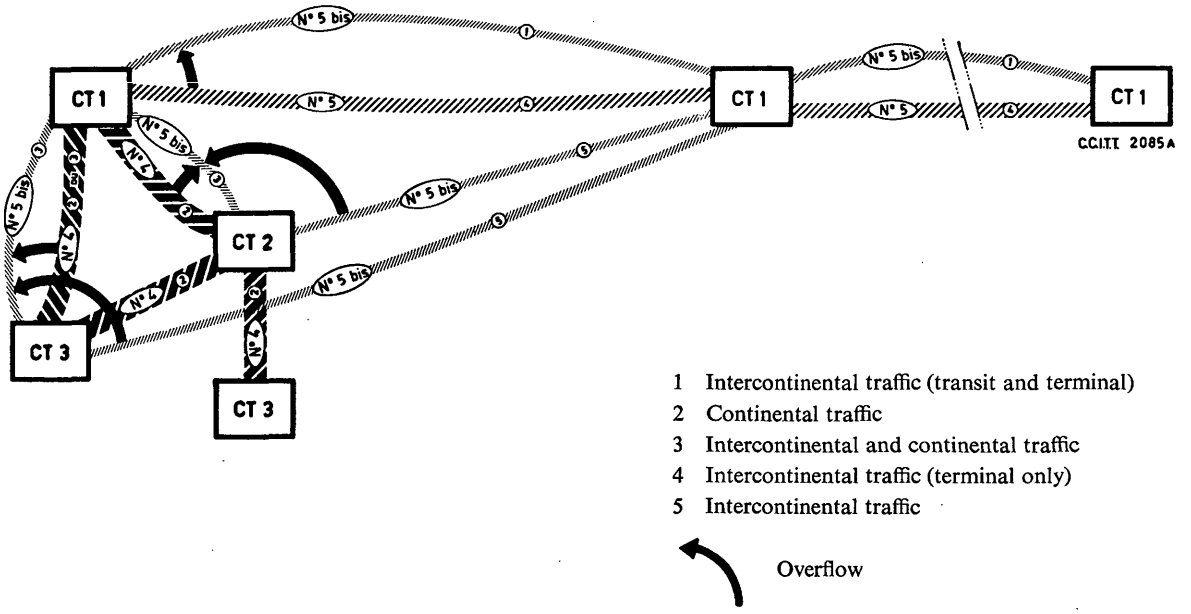


FIGURE 1/Q.230.

[1] Interworking with system No. 6 is described in the Specifications of that system, Part XIV, Chapter IV.

Reference to Figure 1/Q.230 suggests the following conclusions:

— A No. 4 circuit group may be operated in parallel with a No. 5 *bis* circuit group; if overflow is applied to increase circuit usage, then it should preferably be from No. 4 to No. 5 *bis* for the same reasons as described in paragraph 1.2.

— No. 5 circuits connecting CT1s should preferably be reserved for routing of traffic directed to the zone served by the CT1 at their incoming end and not for handling traffic necessitating the switching in tandem of a further link of the intercontinental type (traffic towards the same and only the same continent).

Recommendation Q.231

2. INTERWORKING OF SYSTEMS No. 5 AND No. 5 *bis*

2.1 *General*

It is possible to ensure satisfactory operation for both semi-automatic and automatic service when interworking takes place between signalling systems No. 5 and No. 5 *bis* in either the " 5 to 5 *bis* " or " 5 *bis* to 5 " direction.

The interworking is simplified because:

— the line signals (i.e. the supervisory signals) have exactly the same meaning and the same function in both systems;
— the numerical (address) information is sent in the same sequence in both systems;
— the language digits in the semi-automatic service are the same in both systems.

In a transit exchange where there is interworking of systems No. 5 and No. 5 *bis*, special precautions are necessary with regard to signals which are lacking in one system or are used differently in the two systems. This applies for the following signals:

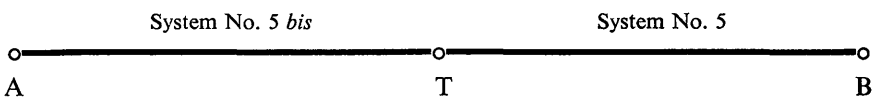
a) the X-signal in system No. 5 *bis* has no corresponding signal in system No. 5;

b) the number of discriminating signals in system No. 5 *bis* is more extended than in system No. 5;

c) there are no backward register signals in system No. 5.

Note. — The register at the interface point may determine the X-signal information not furnished by the adjacent signalling system from other sources and take care of its further transmission.

2.2 *Calls from system No. 5* bis *to system No. 5*



2.2.1 *Semi-automatic calls*

1. In semi-automatic operation the outgoing centre A ends the transfer of information in the forward direction over link AT by the ST end-of-pulsing signal (code 15) [1].

[1] It is assumed that whenever the "Z" digit has a value of 1 to 8, the ST end-of-pulsing signal is sent by rule.

2. When a No. 5 outgoing circuit TB has been seized effectively, which operation is only to be started on recognizing the above-mentioned end-of-pulsing signal, the number-received signal No. 6 (Table 4 of Part XII of the Specifications of system No. 5 *bis*) is sent backward over link AT. The other No. 5 *bis*—number-received signal No. 7 (no charge) is not used because the relevant information cannot be obtained via link TB.

3. In case equipment or circuit congestion in T should occur, signal No. 1 or 2 is sent toward A. Signal No. 1 may be sent before the end-of-pulsing signal is received when there is cross-office equipment congestion and it is known that the congestion condition will last.

4. The reception of the backward signals 1 or 2 will provoke the dismissal of the outgoing No. 5 *bis* register at A.

5. At T, the outgoing No. 5 register sends the numerical information in the *en bloc* non-overlap mode over link TB. The No. 5 outgoing register is released as soon as the end-of-pulsing signal has been transmitted to B. The incoming No. 5 *bis* register at T is released after the number-received signal has been sent to A. If instead of the two registers one combined register is used, the end-of-pulsing condition determines the dismissal of the combined register.

6. With regard to signals which are used differently in the two systems, the following requirements are to be met in the case of terminal traffic:

— generate the KP1 signal,
— suppress the X-signal and the I digits which must not be sent over the link TB.

Note. — The case in which at B a further international transit is effected is not dealt with, since it represents a non-preferred arrangement (see paragraph 1.2 in Recommendation Q.230).

7. At T the X-signal received over link AT is interpreted to ensure correct routing of the call (satellite/no satellite) and to control insertion of an echo suppressor if no echo suppressor is available at B.

8. The facility of the No. 5 *bis*-interregister signalling system to carry information concerning the called subscriber's line (Nos. 8 and 9, Table 4 of the Specifications of system No. 5 *bis*) is not used since no corresponding signals are supplied over the link BT.

Note. — Since the line signalling of No. 5 *bis* and No. 5 is identical, each line signal can be transferred through T. This applies in particular to the busy-flash signal.

2.2.2 *Automatic calls*

1. In automatic operation the system No. 5 *bis* link AT does not always provide for an end-of-pulsing signal from centre A; the transit exchange T will therefore have to recognize that all the digits have been received in order to:

a) determine the appropriate time to seize the circuit TB:
   — commence *en bloc* transmission;
   — send a forward end-of-pulsing signal over the No. 5 link;
b) send a backward signal No. 6 (Table 4 of the Specifications of system No. 5 *bis*) to A.

2. The points 2 to 8 under 2.2.1 are also applicable to automatic calls. Under point 6 of 2.2.1 the following requirement is to be added:

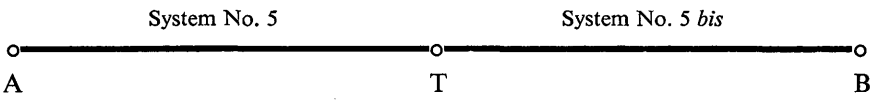
— Translation of the " Z " signals 11 and 12 into 10 (discriminating digits).

2.2.3 *Route monitoring*

1. If route-monitoring procedures are applied, the exchange at T sends back the route-monitoring block relating to the link with 5 *bis* signalling AT as specified for the 5 *bis* system.

2. If route-monitoring information relating to the link TB having No. 5 signalling is introduced, a special route-monitoring block must be generated at T and is sent in addition after the block mentioned in 1.

2.3 *Calls from system No. 5 to system No. 5* bis



2.3.1 *Semi-automatic and automatic calls*

1. At transit exchange T the incoming register [1] part of system No. 5 receives an ST end-of-pulsing signal 55 ms after reception of the last numerical signal.

2. At A, the outgoing register of system No. 5 is released after the ST signal has been sent.

3. At T, the ST end-of-pulsing signal of system No. 5 is transferred over the No. 5 *bis* link to the incoming end B.

4. At T, the incoming No. 5 register [1] releases after having transferred the ST end-of-pulsing signal.

5. At B, the incoming register of system No. 5 *bis* is released as soon as the register dismissal signal is sent backward to T.

6. At T, the outgoing register [1] of system No. 5 *bis* is released on receipt of the register dismissal signal.

7. If congestion occurs at T, the busy-flash signal is sent back to A. If congestion occurs at B a No. 5 *bis* register congestion signal is sent back to T when it has to be converted into the busy-flash signal to A.

8. If other backward signals indicating causes of ineffective calls are received at T, an appropriate audible tone may be sent back to A.

9. If backward signal 7 is received at T, an incompatibility arises and it is recommended that a subsequent answer signal not be passed from T to A. It is recognized that in some instances there will be a limit on conversation time since time-outs may occur.

[1] These register functions may be combined in a single register.

Recommendation Q.232

3. INTERWORKING OF SYSTEMS No. 4 AND No. 5 *bis*

3.1 *General*

It is possible to ensure satisfactory operation for both semi-automatic and automatic service when interworking takes place between signalling systems No. 4 and No. 5 *bis* in either the " 4 to 5 *bis* " or " 5 *bis* to 4 " direction.

The interworking is simplified 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;

— the language digits in the semi-automatic service are the same in both systems.

In a transit exchange where there is interworking of systems No. 4 and No. 5 *bis*, special precautions are necessary with regard to signals which are lacking in one system or are used differently in the two systems. This applies to the following signals:

a) the X-signal in system No. 5 *bis* has no corresponding signal in system No. 4;

Note — The register at the interface point may determine the X-signal information not furnished by the adjacent signalling system from other sources and take care of its further transmission.

b) the number of discriminating signals in system No. 5 *bis* is more extended than in system No. 4;

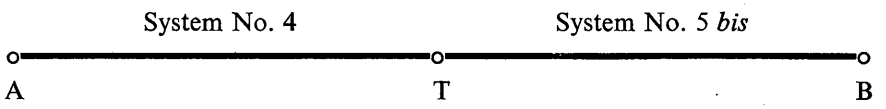
c) if route-monitoring signals are to be applied in system No. 5 *bis*, there are no corresponding signals in system No. 4;

d) the repeat transmission facility in system No. 5 *bis* does not exist in system No. 4;

e) different register dismissal signals combined with called party line conditions can be used in system No. 5 *bis* and one of these signals per call is sent as a backward register signal, while in system No. 4 the number-received signal is sent as a line signal;

f) different congestion signals can be used in system No. 5 *bis* and one of these signals per call is sent as a backward register signal, while in system No. 4 the busy-flash signal is sent as a line signal.

3.2 *Calls from system No. 4 to system No. 5* bis



3.2.1 *Semi-automatic calls*

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 " premature " number-received signal.

Note. — Instead of sending the " premature " number-received signal, it is possible to convert the called-party-line-condition signal from the system No. 5 *bis* link to the number-received signal for the system No. 4 link. However, this implies modification of an existing system No. 4 incoming register and prolonged holding time of this register.

4. At T, an end-of-pulsing signal ST is sent over link TB on system No. 5 *bis*; this ST signal is obtained by converting the end-of-pulsing signal (code 15) of system No. 4.

5. At T, the outgoing register [1] of system No. 5 *bis* will be released after the receipt of one of the register dismissal signals from B and after appropriate measures are taken. The register dismissal signal need not be converted backwards to A, as the number-received signal has already been sent by the system No. 4 incoming register [1] at T.

6. If backward signal 7 of Table 4 of Part XII in the Specifications of system No. 5 *bis* is received at T, an incompatibility arises and it is recommended that a subsequent answer signal not be passed from T to A. It is recognized that in some instances there will then be a limit on conversation time since time-outs may occur.

7. A congestion register signal from B has to be converted into the busy-flash line signal 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.

3.2.2 *Automatic calls*

1. At A, release of the outgoing register of system No. 4 depends upon reception of the number-received signal.

2. The system No. 4 link does not always provide for an end-of-pulsing signal from A in automatic operation.

In the case that an end-of-pulsing signal is received from A, the system No. 4 incoming register [1] at T will send a " premature " number-received signal to A.

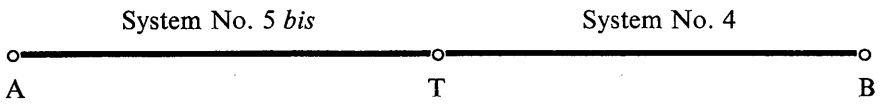
When no end-of-pulsing signal comes from A, the system No. 4 incoming register [1] at T will send the number-received signal to A as soon as a register dismissal signal is received from B. Points 5 and 6 of paragraph 3.2.1 are applicable in both cases.

3. At the incoming end of system No. 4 at T, the incoming register [1] of system No. 4 is released as soon as the number-received/signal is sent backward.

---

[1] These register functions may be combined in a single register.

3.3 *Calls from system No. 5* bis *to system No. 4*



3.3.1 *Semi-automatic calls*

1. In semi-automatic operation the outgoing exchange A of system No. 5 *bis* sends an ST end-of-pulsing signal over link AT.

Note. — It is assumed that whenever the Z-digit has a value of 1 to 8, the ST end-of-pulsing signal is sent by rule.

2. At T, the ST end-of-pulsing signal of system No. 5 *bis* is converted into an end-of-pulsing signal of system No. 4, which is sent to the incoming end B of this system.

3. At T, the system No. 5 *bis* incoming register [1] sends the " premature " called-party-line condition signal No. 6 as soon as the ST end-of-pulsing signal is received from A. This incoming 5 *bis* register releases after the sending of this signal and after pulsing the complete address information forward.

If congestion (equipment or circuit) occurs, a congestion signal (No. 1 or No. 2) is sent backward to A. For these signals recognition of the ST end-of-pulsing signal is not needed.

4. The register dismissal signal provokes the release of the system No. 5 *bis* outgoing register at A.

5. At T, the outgoing register [1] 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.

7. If a busy-flash signal is received at T before the 5 *bis* incoming register has sent a register dismissal signal No. 6 to A, the busy-flash must be converted to signal 2 of Table 4 of the Specifications of system No. 5 *bis* for sending to A.

3.3.2 *Automatic calls*

1. The system No. 5 *bis* link does not always provide for an ST end-of-pulsing signal from exchange A in automatic operation.

2. At T, the ST end-of-pulsing signal of system No. 5 *bis*, if received, is converted to the end-of-pulsing signal (code 15).

3. At T, the system No. 5 *bis* incoming register [1] will send the called-party-line-condition signal No. 6 as soon as system No. 4 outgoing circuit TB is effectively seized and

— the ST end-of-pulsing signal has been received; or

— the number-received signal has been received; or

— it has otherwise recognized that all the digits have been received.

[1] These register functions may be combined in a single register.

This register releases after the sending of this signal and after pulsing the complete address information forward.

If congestion (equipment or circuit) occurs, a congestion signal (No. 1 or No. 2) is sent backward to A. For these signals recognition of the ST end-of-pulsing signal is not needed.

4. At T, the system No. 4 outgoing register [1] will release as soon as the number-received signal has been received from B.

5. If a busy-flash signal is received at T before the 5 *bis* incoming register has sent a dismissal signal No. 6 to A, the busy-flash must be converted to signal No. 2 of Table 4 of the Specifications of system No. 5 *bis* for sending to A.

---

[1] These register functions may be combined in a single register.