



INTERNATIONAL TELECOMMUNICATION UNION

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

Q.724

(11/88)

SERIES Q: SWITCHING AND SIGNALLING

Specifications of Signalling System No. 7 –
Telephone user part

Signalling procedures

ITU-T Recommendation Q.724

Extract of **Blue Book Fascicle VI.8 (1988)**

NOTES

1 ITU-T Recommendation Q.724 was published in Fascicle VI.8 of the *Blue Book*. This file is an extract from the *Blue Book*. While the presentation and layout of the text might be slightly different from the *Blue Book* version, the contents of the file are identical to the *Blue Book* version and copyright conditions remain unchanged (see below).

2 In this Recommendation, the expression “Administration” is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

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SIGNALLING PROCEDURES

1 Normal call set-up

In this Recommendation the signalling procedures are described for the normal call set-up of an international call. The messages and signals are defined in Recommendation Q.722 and the format and content are given in Recommendation Q.723.

1.1 Initial address message

An *initial address message* which is sent as the first message of a call set-up generally includes all of the information required by the next international exchange to route the call. The seizing function is implicit in the reception of this initial address message.

The sending sequence of address information will be the country code (not sent to an incoming international exchange) followed by the national (significant) number. For calls to operator positions (code 11 and code 12), refer to Recommendation Q.107 [1].

All digits required for routing the call through the international network will be sent in the initial address message. On calls with a country code in the address (except in the case of calls to special operators), the initial address message will contain a minimum of 4 digits and should contain as many digits as are available. All digits of the address may be included; however, the initial address message can contain one digit in specific circumstances, e.g. national applications.

Selection of the outgoing national circuit normally can start at the incoming international exchange on receipt of the initial address message and signalling can proceed on the first national link.

When no echo suppressor or nature-of-circuit indication is received from a preceding circuit using a signalling system with fewer facilities, the indicators will be considered as received *no*, unless exchange data indicates otherwise.

Note – When additional signalling information (e.g. related to supplementary services) is to be sent, an initial address message with additional information may be used.

1.2 Subsequent address message

The remaining digits, if any, of the address may be sent individually in one-digit messages or in groups in multidigit messages. Efficiency can be gained by grouping together as many digits as possible.

However, to prevent an increase in post-dialling delay in those cases where overlap operation with subscribers' dialling is used, it may be desirable to send the last few digits individually. With reference to the withholding of digits, sufficient digits should be withheld to avoid the operation at subsequent exchanges of the short 4-6 second timeout which may be used in certain cases to determine the address complete condition. (See Recommendation Q.608, § 8.2.1).

Subsequent address messages can be sent on the national network as they are received. If a continuity-check has to be performed on one or more of the international circuits involved in the connection, appropriate measures [e.g. by withholding the last digit(s) of the national number] must be taken at the last common channel exchange to prevent ringing the called subscriber or alerting the operator until the continuity of such speech circuits has been verified.

Note – If in the international network the code 0000 in the number of address signals field is received the message is considered as faulty.

1.3 End-of-pulsing (ST) signal

The end-of-pulsing (ST) signal is always sent in the following situations:

- a) semiautomatic calls,
- b) test calls, and
- c) when the end-of-pulsing signal is received from a preceding circuit.

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In automatic working, the end-of-pulsing signal will be sent whenever the outgoing international exchange is in a position to know, by digit analysis, that the final digit has been sent. Digit analysis may consist of an examination of the country code and counting the maximum (or fixed) number of digits of the national number. In other cases, the end-of-pulsing signal is not sent and the end-of-address information is determined by the receipt of one of the address-complete signals from the incoming international exchange.

#### 1.4 Continuity-check of the telephone circuits

Because the signalling in Signalling System No. 7 does not pass over the speech path, facilities should be provided for making a *continuity-check* of the speech path in the circumstances described below.

The application of the continuity-check depends on the type of the transmission system used for the telephone circuit.

For transmission systems having some inherent fault indication features giving an indication to the switching system in case of fault, a continuity check is not required. This situation commonly occurs when fully digital circuits are used. However, a per-call continuity check may be needed on fully digital circuits when circuits or bundles of circuits in primary multiplex groups are dropped and inserted en route between switches and alarm indications carried on bits of the primary multiplex frame structure are lost in passing through an intermediate transmission facility that does not relay them transparently. Typically, per-call continuity checks may be needed when the transmission link between switches contains a TDMA satellite system, a digital circuit multiplication system or a digital access and crossconnection system, where fault indications are lost.

When an initial address message is received with a request for a continuity-check relating to a digital circuit having inherent fault indication, one of the following actions is taken:

- a) the continuity-check request is disregarded; or
- b) a continuity-check loop is connected and the maintenance system is alerted. In this case the call may fail since no continuity signal may be received from the distant end.

*Note* – The reception of such a request could only be caused by an abnormal condition such as administrative errors or the occurrence of signalling errors.

When the circuit type is unknown to a Signalling System No. 7 exchange, or in an application where both analogue and digital circuits may be served, or when no inherent fault indication is available, a continuity-check loop should always be connected in the following cases:

- i) when the exchange has the capability to process initial address messages with continuity-check request and such messages are received;
- ii) when continuity-check requests are received.

For analogue circuits with pilot supervision it is sufficient to perform the continuity-check on a statistical basis or by test calls (see § 7.5)<sup>1)</sup>. For analogue circuits not using pilot supervision and for mixed circuits, i.e. analogue and digital circuits, the continuity-check should be performed on a per call basis. Within mixed connections, i.e. connections composed of circuits with and without continuity-check on a per call basis, it shall be ensured that the continuity signal be forwarded to the destination point although no continuity-check may have been performed on one or more parts of the end-to-end connection.

The continuity-check is not intended to eliminate the need for routine testing of the transmission path.

The continuity-check of the speech circuit will be done, link-by-link, on a per call basis or by a statistical method prior to the commencement of conversation. Procedures and requirements are specified in § 7.

The actions to be taken when pilot supervision is used are described in § 9.

<sup>1)</sup> The application to the international circuits and the quantitative aspects (in particular, the frequency of performing the continuity-check) are for further study.

## 1.5 Cross-office check

For digital exchanges the requirements mentioned in Recommendation Q.504 [2] shall be met. For other exchanges Administrations shall ensure the reliability of a connection through a switching machine (cross-office check) either on a per call basis or by a statistical method. With either method, the probability of the connection being established with an unacceptable speech path transmission quality should not exceed  $10^{-5}$  as the long-term average.

## 1.6 Address-complete signals

An *address-complete* signal will not be sent until the continuity signal has been received and the cross-office check made, if they are applicable.

If the succeeding network does not provide electrical called-party's-line-condition signals, the last Signalling System No. 7 exchange shall originate and send an address-complete signal when the end of address signalling has been determined and a possible GRQ/GSM cycle has been completed:

- a) by receipt of an end-of-pulsing signal;
- b) by receipt of the maximum number of digits used in the national numbering plan;
- c) by analysis of the national (significant) number to indicate that a sufficient number of digits has been received to route the call to the called party;
- d) by receipt of an end-of-selection signal from the succeeding network (e.g. number received signal in Signalling System No. 4); or
- e) exceptionally, if the succeeding network uses overlap signalling and number analysis is not possible, by observing that 4 to 6 seconds have elapsed since the last digit was received, and that no fresh information has been received; in such circumstances, transmission to the national network of the last digit received must be prevented until the end of the waiting period which causes an address-complete signal to be sent over the international circuit. In this way, it is ensured that no national answer signal can arrive before an address-complete signal has been sent.

Specifically, in cases d) and e) above, the address-complete charge signal should be sent.

*Note* – If the succeeding network provides electrical called-party's-line-condition signals, the last Signalling System No. 7 exchange shall originate and send address-complet signal when that condition has been received from the succeeding network and a possible GRQ/GSM cycle has been completed.

If in normal operation, delay in the receipt of an address-complete or equivalent signal from the succeeding network is expected, the last common channel signalling exchange will originate and send an address-complete signal 15 to 20 seconds after receiving the latest address message. This time-out condition is an upper limit considering the clauses of § 6.4.1 (20 to 30 seconds for outgoing international exchanges in abnormal release conditions).

On receipt of an address-complete signal, the first Signalling System No. 7 exchange will through-connect the speech path of the interconnected circuit<sup>2)</sup>.

After an address-complete signal, only the following signals relating to the call set-up may be sent in the backward direction:

- a) in normal operation, one of the answer or release-guard signals;
- b) call-failure signal; or
- c) the national network congestion signal; or
- d) the circuit group congestion signal.

*Note* – Cases b), c) and d) can only occur after an address complete signal without subscriber free.

Any further information about the called-party's-line-condition will be transmitted to the calling subscriber or operator as audible tones or announcements.

<sup>2)</sup> It is envisaged that in the future evolution of the Telephone User Part (e.g. in the context of an integrated services digital network) the through-connection immediately after sending of the initial address message may become a mandatory requirement.

The address-complete signal with the subscriber-free indication is sent when it is known that the called subscriber's line is free (not busy). It must be originated in the called subscriber's exchange, and therefore cannot be followed by one of the unsuccessful backward set-up information signals.

If an incoming international exchange has sent a general request message, then an address complete message must not be sent until a general forward set-up information message has been received in response to that general forward set-up information message.

#### 1.7 *Address-incomplete signal*

The determination that the proper number of digits has not been received can be made at once if the end-of-pulsing signal is received or by receipt of an *address-incomplete* signal (or equivalent) from the national network. When overlap working is used and the end-of-pulsing signal has not been received, the address-incomplete signal will be sent by the last common channel Signalling exchange 15 to 20 seconds after receipt of the latest digit.

Each Signalling System No. 7 exchange on receipt of the address-incomplete signal will send the signal to the preceding Signalling System No. 7 exchange, if any, and clear forward the connection. The first Signalling System No. 7 exchange will send a suitable signal on the preceding circuit if the related signalling system permits to do so; otherwise the appropriate tone or announcement for the national network concerned will be sent to the calling party.

#### 1.8 *Congestion signals*

As soon as the congestion condition is detected one of the *congestion* signals (see Recommendation Q.722, § 3.4) is sent without waiting for the completion of a possible continuity-check sequence.

Reception of a congestion signal at any Signalling System No. 7 exchange will cause the clear-forward signal to be sent and cause an appropriate signal to be sent to the preceding exchange if the signalling system allows this or an appropriate tone or announcement to be sent to the originating subscriber or operator.

#### 1.9 *Called-party's-line-condition signals*

The *called-party's-line-condition* signals (see Recommendation Q.722, § 3.4) will be sent when the appropriate electrical signals are received at the incoming international exchange from the national network.

The *called-party's-line-condition* signals will be sent without waiting for the completion of a possible continuity check. On receipt of one of these signals, the first Signalling System No. 7 exchange (or the outgoing international exchange) will clear forward the connection and cause an appropriate signal to be sent to the preceding exchange if the signalling system allows this or an appropriate tone or announcement to be sent to the originating subscriber or operator.

Each Signalling System No. 7 exchange on receipt of one of these signals has to clear forward the connection.

#### 1.10 *Answer signals*

The signals *answer*, *charge and answer*, *no charge* are sent as received from the national network or from the succeeding international link.

The signals *answer*, *charge and answer*, *no charge* are used only as a result of the first off-hook signal from the called party.

#### 1.11 *Clear-back signal*

A *clear-back* signal must not disconnect the speech path at a Signalling System No. 7 exchange. The requirements for the release of a connection in the event that a clear-forward signal is not received are given in Recommendation Q.118 [3].

#### 1.12 *Reanswer and clear-back signal sequences*

Subsequent off-hook, on-hook signals from the called party, such as will result from switch-hook flashing, will cause the following sequence of signals to be sent:

- clear-back,
- reanswer,
- clear-back,
- reanswer,
- etc.

It is necessary that a flashing sequence be retransmitted to the operator (or the preceding link) and that the final condition of the circuit represents the final position of the called party's switch hook.

### 1.13 *Forward-transfer signal*

The *forward-transfer* signal may be sent in semiautomatic working in either of the following two cases:

- a) following a call switched automatically to a subscriber, or following a call established via a special operator, the controlling operator wishes to call in an assistance operator. On receipt of the forward-transfer signal at the incoming international exchange, an assistance operator is called in;
- b) following a call via code 11 and 12, the controlling operator wishes to recall the incoming operator at the incoming international exchange. Receipt of the forward-transfer signal at the incoming international exchange recalls the incoming operator on calls completed via the operator positions at the exchange.

### 1.14 *Clear-forward and release-guard sequences*

The *clear-forward* signal is overriding and all exchanges must be in a position to respond by releasing the circuit and sending a *release-guard* signal at any time during the progress of a call and even if the circuit is in the idle condition. If sent while a circuit is blocked it will not result in unblocking the circuit concerned (see § 5). The fact that the circuit is blocked will not delay the transmission of the release-guard signal.

### 1.15 *Reset of circuits and circuit groups*

In systems which maintain circuit status in memory there may be occasions when the memory becomes mutilated. In such a case the circuits must be reset to the idle condition in both exchanges to make them available for new traffic. Since the exchange with the mutilated memory does not know whether the circuits are idle, busy outgoing, busy incoming, blocked, etc., reset-circuit signals or a circuit group reset message should be sent as appropriate for the affected circuits. The reset-circuit signal may also be sent, in certain cases, when a signalling fault occurs (see § 6.2 and 6.5).

#### 1.15.1 *Reset-circuit signal*

If only a few circuits are concerned a reset-circuit signal should be sent for each affected circuit.

On receipt of a reset-circuit signal the unaffected exchange will:

- a) accept the signal as a clear-forward signal and respond by sending a release-guard signal, after the circuit has been made idle, if it is the incoming exchange on a connection in any state of call set-up or during a call;
- b) accept the signal as a clear-back or call-failure signal, whichever is appropriate, and respond by sending a clear-forward signal immediately if it is the outgoing exchange on a connection;
- c) accept the signal as a clear-forward signal and respond by sending a release-guard signal if the circuit is in the idle condition;
- d) if it has previously sent a blocking signal, or if it is unable to release the circuit as described above, respond by the blocking signal. If an incoming or outgoing call is in progress, this call should be disconnected and the circuit returned to the idle (blocked) state. A clear-forward or release-guard signal may be sent. The blocking signal should be acknowledged by the affected exchange. If the acknowledgement is not received, the repetition procedure specified in § 6.4.4 should be followed;
- e) if it had previously received the blocking signal, respond by disconnecting any connected call, remove the blocked condition and restore the circuit to the idle state. If an outgoing call had been in progress, respond with a clear-forward or, in all other cases, a release-guard signal;
- f) if a reset-circuit signal is received after the sending of an initial address message but before receipt of a backward signal relating to that call, clear the circuit and make an automatic repeat attempt on another circuit if appropriate.
- g) if a reset-circuit signal is received after having sent a reset-circuit signal, respond by a release-guard signal. The circuit should be restored to traffic;
- h) send an appropriate clearing signal on an interconnected circuit (e.g., clear-forward, or a suitable backward signal).

The affected exchange will then reconstruct its memory according to the received acknowledgement to the reset-circuit signal, and respond to the signals received in the normal way, i.e. release-guard in response to a clear-forward, blocking-acknowledgement in response to a blocking signal.

In addition, an interconnected circuit may be cleared by the use of an appropriate signal. If no acknowledgement to the reset-circuit signal is received before 4-15 seconds, the reset-circuit signal should be repeated. If an acknowledgement for the signal is not received within 1 minute after the sending of the initial reset-circuit signal, maintenance personnel should be notified to permit manual restoration procedures. However, the sending of the reset-circuit signal should continue at 1-minute intervals until maintenance intervention occurs.

### 1.15.2 *Circuit group reset message*

If a considerable number of circuits or all circuits are affected by the memory mutilation, circuit group reset messages should be used to make these circuits available for new traffic.

Since the effect of erroneous circuit group reset messages generated by undetected errors may seriously affect the quality of service, each circuit group reset message has to be sent twice.

On receipt of two circuit group reset messages with 5 seconds for the same group or parts thereof the unaffected exchange will:

- i) If the range field is not coded all zero:
  - a) restore the circuits involved to the idle state;
  - b) send the appropriate group blocking message(s) if it had previously sent a hardware failure oriented and/or software generated group blocking message;
  - c) respond by a circuit group reset-acknowledgement message in which the status indicator bits of the circuits available for service or blocked for reasons of hardware failure or a software generated alarm are coded 0 and the status indicator bit of all circuits blocked for maintenance reasons are set to 1.
- ii) If the range field is coded all zero (national option)
  - a) send the appropriate group blocking message(s) if it had previously sent a hardware oriented and/or a software generated group blocking message;
  - b) start the restoration of the circuits on a per circuit basis in the same way as after receipt of a reset circuit for each circuit within the group (see § 1.15.1);
  - c) respond by a circuit group reset-acknowledgement message indicating that the restoration of the circuits concerned was started.
- iii) Independent from the coding of the range field the following actions should take place in the unaffected exchange after receipt of two circuit group reset signals within 5 seconds:
  - a) if it had previously received (a) blocking signal(s) or (a) blocking message(s) for one or more of the circuit(s) involved the blocked condition will be removed and the circuits will be made available for service;
  - b) if a circuit group reset message is received after having sent a circuit group reset message or (a) reset circuit signal(s) the circuits involved in both the sent and the received message/signal(s) are made available for service;
  - c) appropriate signals should be sent on interconnected circuits to release them.

The affected exchange will then reconstruct its memory according to the possibly received blocking messages and the received circuit group reset-acknowledgement message. It will respond to the possibly received group blocking messages in the normal way.

If no acknowledgement to a circuit group reset message is received before 4-15 seconds the circuit group reset message should be repeated (twice). If acknowledgement for the message is not received within 1 minute after sending the initial circuit group reset message maintenance personnel should be notified to permit manual restoration procedures. However, the sending of the circuit group reset message should continue at 1 minute intervals until maintenance intervention occurs.

1.16 *Analysis of digit information for routing*

(See Recommendation Q.107 bis.)

1.17 *Diagrams showing signal sequence*

Some examples of call set-up sequences are shown diagrammatically (Tables 1/Q.724 and 2/Q.724).

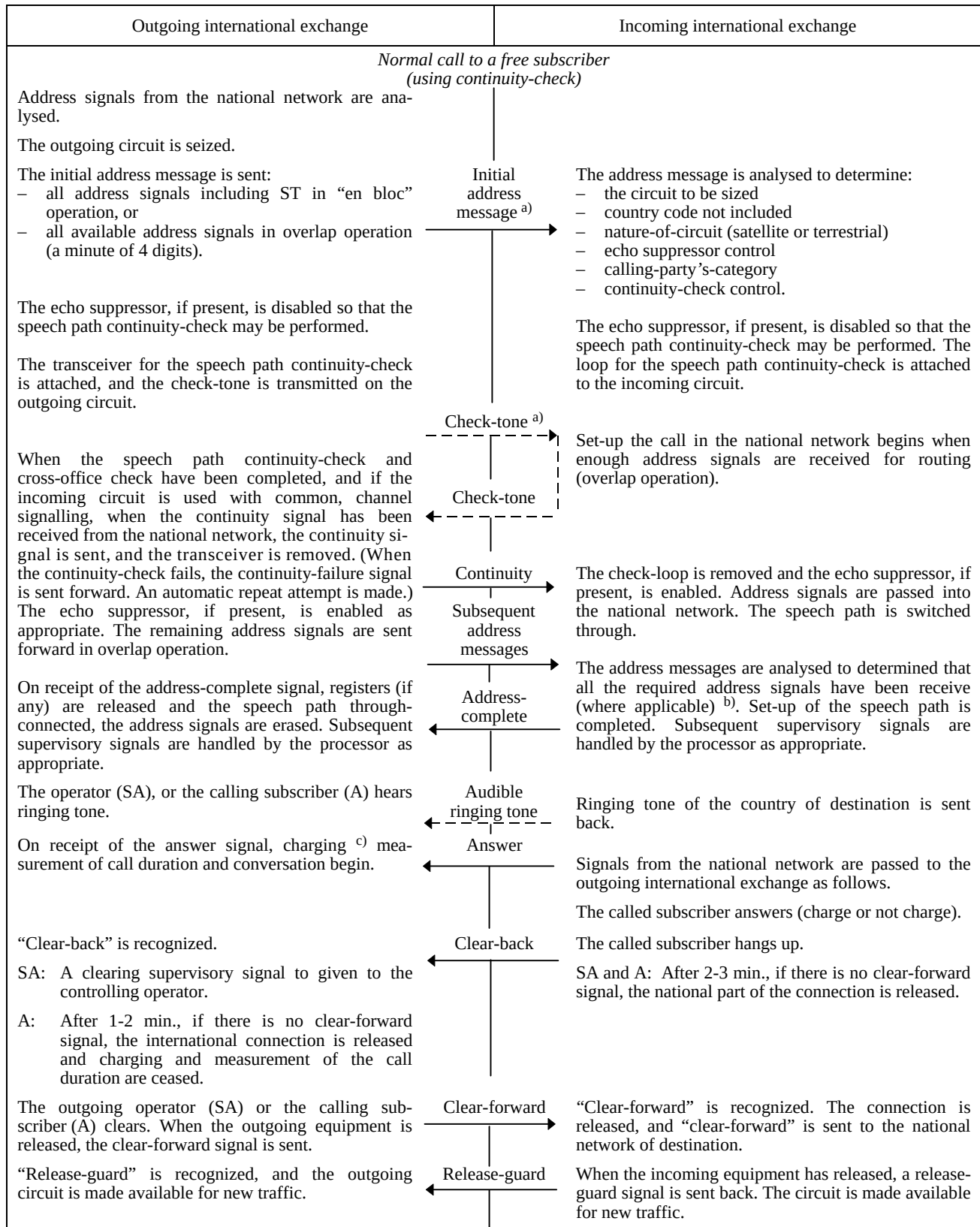
1.18 *Use of the General Request Message and the General Forward Set-up Information Message (GRQ/GSM)*

The following procedures shall be applicable to exchanges generating or receiving GRQ or GSM messages:

- a) The GRQ/GSM protocol can only be initiated during call set-up.
- b) A unique GSM must be sent in response to a GRQ and must only contain answers to all requests contained in the GRQ.
- c) At a transit exchange, once a GRQ has been sent, there is no requirement to wait for the resultant GSM before setting up a connection to a succeeding exchange, unless the information requested is necessary for routing/analysis functions for that call.
- d) An exchange having sent a GRQ should wait until the GSM is received before sending an Address Complete Message (ACM). However, in a whole Signalling System No. 7 international network there is no requirement in the international transit exchange to delay sending the ACM, even if the GRQ/GSM cycle is not completed (i.e. ignore GSM).
- e) A subsequent GRQ must not be sent from the same exchange before a reply (GSM) has been received in response to the previous GRQ. Consequently any GRQ's received by an exchange subsequent to the first GRQ and prior to replying with a GSM shall be ignored.
- f) The GRQ-GSM interchange shall always take place on a link-by-link basis. This means that an exchange receiving a GRQ for which it does not hold the information, must initiate a separate GRQ/GSM cycle on the preceding link.
- g) Information received in the GSM, other than that specifically requested in the associated GRQ, will be ignored.
- h) An exchange shall store any information gained on a call by using the GRQ/GSM interchange or receipt of an IAM/IAI, until the call is completed successfully or failed.
- i) If a call attempt fails (e.g., receipt of CGC, NCC, CFL, etc.) during the period when an exchange is waiting for a GSM, then the appropriate backward call failure shall be sent without waiting for the GSM.
- j) Failure to receive a GSM in response to a GRQ will result in the preceding exchange failing the call due to non-receipt of the ACM (T2 timer expires in 20-30 seconds).

TABLE 1/Q.724

**Semiautomatic (SA) and automatic (A) terminal traffic**  
(error-free operation assumed)

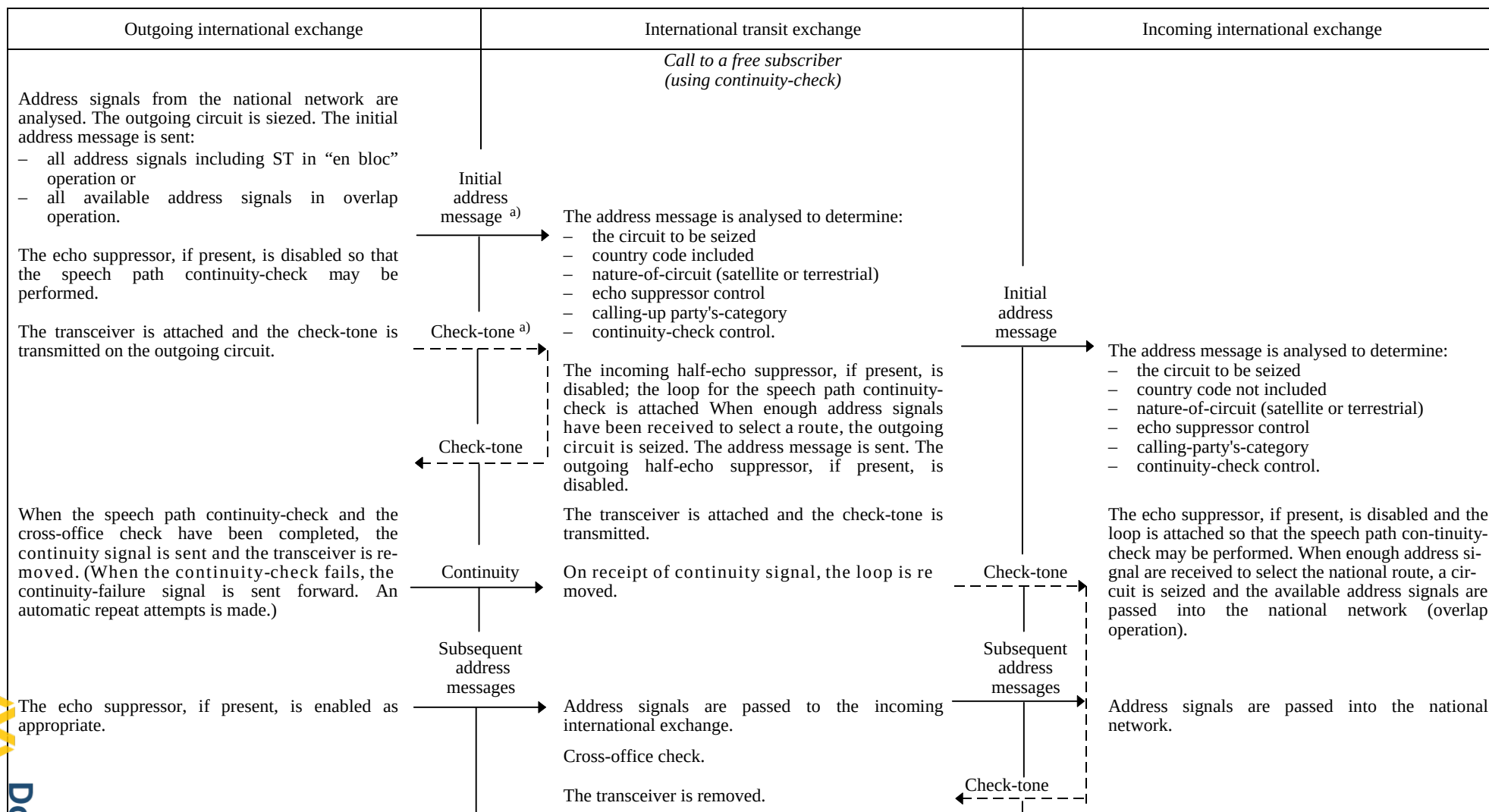


a) Solid arrows denote common channel signals; dotted arrows are tones sent via the speech path (check-tone and audible tones).

b) Address-complete signal may come from the national network.

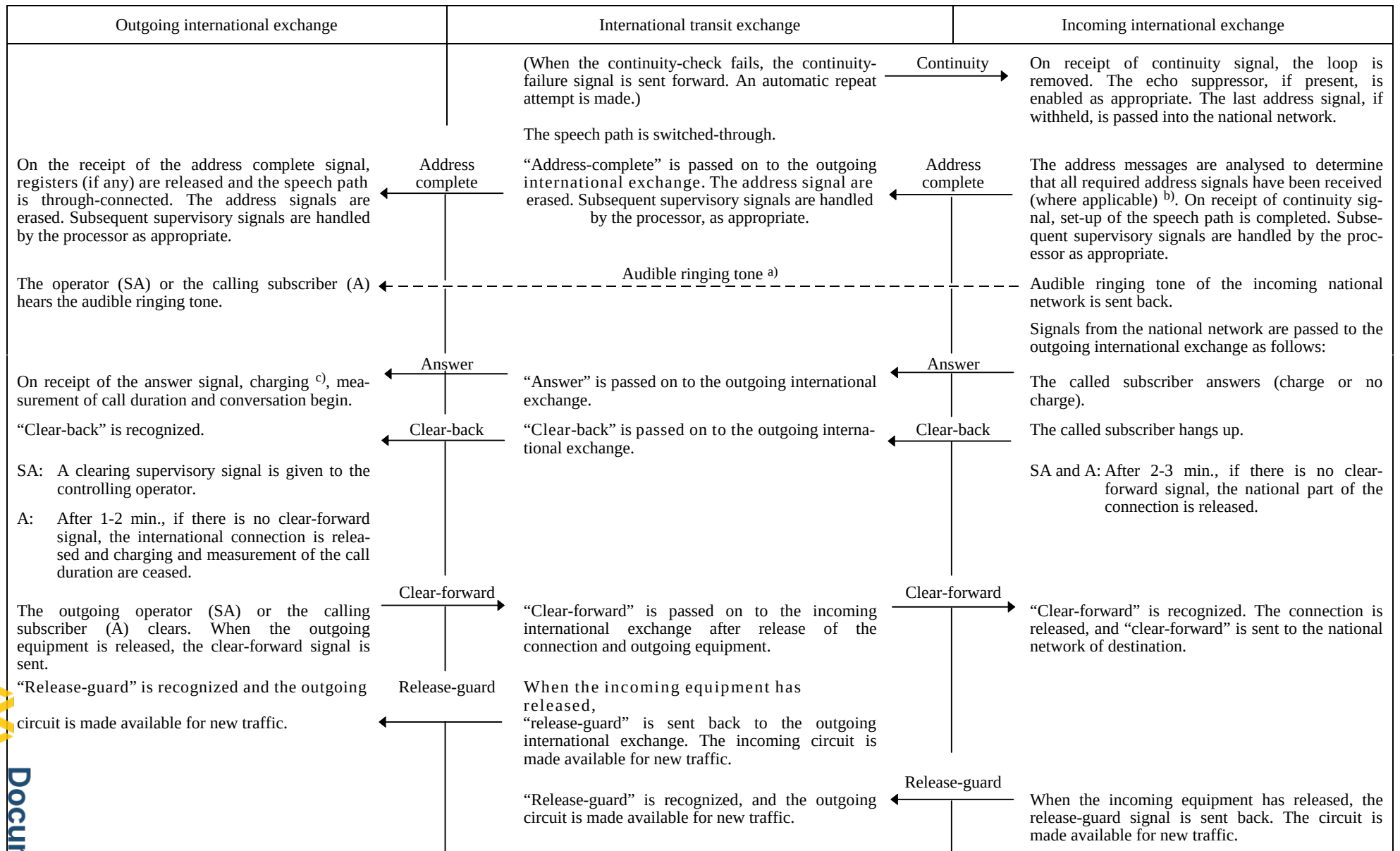
c) Unless a no-charge answer or address-complete signal has been received.

TABLE 2/Q.724 (Sheet 1 of 4)  
**Seminautomatic (SA) and automatic (A) terminal traffic**  
 (error-free operation assumed)



Solid arrows denote common channel signals; dotted arrows are tones sent via the speech path (check-tone and audible tones).

TABLE 2/Q.724 (Sheet 2 of 4)



The address-complete signal may come from the national network.

Unless a no-charge answer or address-complete signal has been received.

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