All drawings contained in this Recommendation have been done in Autocad.

Recommendation Q.724

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.

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)[1)]. 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.

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

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.

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[2)].

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2) 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.

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.

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)

Outgoing international exchange		Incoming international exchange
Normal call to a free subscriber (using continuity-check)		
Address signals from the national network are analysed		
The outgoing circuit is seized.		
The initial address message is sent: - all address signals including ST in "en bloc" operation, or - all available address signals in overlap operation (a minute of 4 digits)	Initial address message a)	The address message is analysed to determine: - the circuit to be sized - country code not included - nature-of-circuit (satellite or terrestrial) - echo suppressor control - calling-party's-category - continuity-check control.
The echo suppressor, if present, is disabled so that the speech path continuity-check may be performed. The transceiver for the speech path continuity-check is attached, and the check-tone is transmitted on the outgoing circuit		The echo suppressor, if present, is disabled so that the speech path continuity-check may be performed. The loop for the speech path continuity-check is attached to the incoming circuit
	Check-tone a)	
When the speech path continuity-check and cross-office check have been completed, and if the incoming circuit is used with common, channel signalling, when the continuity signal has been received from the national network, the continuity signal is sent, and the transceiver is removed.		Set-up the call in the national network begins when enough address signals are received for routing (overlap operation).
	Check-tone	
	Continuity	The check-loop is removed and the echo suppressor, if present, is enabled. Address signals are passed into the national network. The speech path is switched through.
(When the continuity-check fails, the continuity-failure signal is sent forward. An automatic repeat attempt is made.) The echo suppressor, if present, is enabled as appropriate. The remaining address signals are sent forward in overlap operation.	Subsequent address messages	
On receipt of the address-complete signal, registers (if any) are released and the speech path through-connected, the address signals are erased. Subsequent supervisory signals are handled by the processor as appropriate	Address complete	The address messages are analysed to determined that all the required address signals have been receive (where applicable)b). Set-up of the speech path is completed. Subsequent supervisory signals are handled by the processor as appropriate.
The operator (SA), or the calling subscriber (A) hears ringing tone.	Audible ringing tone	Ringing tone of the country of destination is sent back.
On receipt of the answer signal, charging a) measurement of call duration and conversation begin.	Answer	Signals from the national network are passed to the outgoing international exchange as follows The called subscriber answers (charge or not charge)
"Clear-back" is recognized	Clear-back	The called subscriber hangs up.
SA: A clearing supervisory signal to 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.		SA and A: After 2-3 min., if there is no clear-forward signal, the national part of the connection is released.
The outgoing operator (SA) or the calling subscriber (A) clears. When the outgoing equipment is released, the clear-forward signal is sent.	Clear-forward	"Clear-forward" is recognized. The connection is released, and "clear-forward" is sent to the national network of destination
"Release-guard" is recognized, and the outgoing circuit is made available for new traffic	Release-guard	When the incoming equipment has released, a release-guard signal is sent back. The circuit is made available for new traffic

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)

Semiautomatic (SA) and automatic (A) transit 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).

Tables are in file named "924T2-E.DOC"

b) The 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 3 of 4)

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

2 Dual seizure with both—way operation

2.1 *Dual seizure*

Since Signalling System No. 7 circuits have the capability of *both—way* operation, it is possible that the two exchanges will attempt to seize the same circuit at approximately the same time.

2.2 *Unguarded interval*

Considering that with Signalling System No. 7:

a) signalling data link propagation time may be relatively long,

b) there may be significant delay due to retransmissions,

c) quasi—associated operation may add extra message transfer time(s) at signalling transfer points,

the unguarded interval during which *dual seizure* can occur may be relatively long in some instances. The exchange must therefore detect dual seizure and take action as defined in § 2.5.

2.3 *Detection of dual seizure*

A dual seizure is detected by an exchange from the fact that it receives an initial address message for a circuit for which it has sent an initial address message (see also § 7.5.1).

2.4 *Preventive action*

Different methods for circuit selection can be envisaged to minimize the occurrence of dual seizure. In the following, two methods are described. Further study is required to determine the field of application of each method and to ensure that the two methods do interwork satisfactorily.

Other methods for circuit selection may also be used provided that they give the same degree of protection against dual seizure also when one of the methods specified is used at the other end.

Method 1

An opposite order of selection is used at each terminal exchange of a both—way circuit group.

Method 2

Each terminal exchange of a both—way circuit group has priority access to the group of circuits which it is controlling (see § 2.5). Of this group the circuit which has been released the longest is selected *(first—in — first—out)*. In addition each terminal exchange of a both—way circuit group has nonpriority access to the group of circuits which it is noncontrolling. Of this group the latest released circuit is selected *(last—in — first—out)*.

For call control purposes a both—way circuit group can be subdivided into subgroups in an exchange.

It is necessary to take preventive action in cases where Signalling System No. 7 uses a signalling data link with long propagation time.

2.5 *Action to be taken on detection of dual seizure*

Each exchange will control one half of the circuits in a both—way circuit group. On detection of a dual seizure, the call being processed by the control exchange for that circuit will be completed and the received initial address message will be disregarded.

Under these conditions, the call being processed by the control exchange will be allowed to complete although, when continuity—check has to be performed, the continuity of the circuit may have been checked in the direction from noncontrol to control only. The call being processed by the noncontrol exchange will be backed off, switches released, the continuity—check transceiver removed, and the check—loop connected unless or until a continuity signal has been received from the control exchange. A clear—forward signal will not be sent. The noncontrol exchange will make an automatic repeat attempt on the same or on an alternative route.

For the purpose of resolution of dual seizure on both—way circuits, the exchange with the higher signalling point code will control all even—numbered circuits (circuit identification code) and the other exchange the odd—numbered circuits. The designation of control may also be used for maintenance control purposes.

3 Automatic repeat attempt

Automatic repeat attempt, as defined in Recommendation Q.12 [4], is provided in Signalling System No. 7.

An automatic repeat attempt will be made:

— upon failure of the continuity—check (see § 7.3);

— on detection of dual seizure (at the noncontrol exchange) (see § 2.5);

— on receipt of the blocking signal after sending an initial address message and before any backward signal has been received (see § 6);

— on receipt of a reset—circuit signal after sending an initial address message and before a backward signal has been received;

— on receipt of unreasonable signalling information after sending an initial address message and before one of the backward signals required for call set—up has been received.

4 Speed of switching and signal transfer in international exchanges

4.1 *Outgoing international exchange*

At the outgoing international exchange:

— if overlap operation is used, the sending of the initial address message shall take place as soon as sufficient digits are received and analyzed to permit the selection of an outgoing circuit;

— if "en bloc" operation is used, the initial address message should be sent as soon as all the digits of the address including the end—of—pulsing signal are available and the outgoing circuit has been chosen.

4.2 *International transit exchange*

At the international transit exchange, the selection of an outgoing circuit should begin as soon as the digits necessary to determine the routing have been received and analyzed.

4.3 *Incoming international exchange*

At the incoming international exchange:

— if overlap operation is used in the national network, the setting—up of the national part of the connection should start as soon as a sufficient number of digits has been received for routing;

— if "en bloc" operation is used in the national network, the setting—up of the national part of the connection should start as soon as all the digits of the address including the end—of—pulsing signal have been received.

5 Blocking and unblocking of circuits and circuit groups

The circuit blocking (unblocking) signal and the group blocking (unblocking) message are provided to permit the switching equipment or maintenance personnel to remove from (and return to) traffic, the distant terminal(s) at a circuit or circuit group because of fault or to permit testing. Specific conditions for automatic sending of blocking and unblocking signals and messages by the switching equipment in case of use of the interruption control on interexchange circuits appear in § 9.

Since circuits served by Signalling System No. 7 have both—way capability, the blocking signal or a group blocking message can be originated by either exchange. The receipt of the blocking signal or a group blocking message will have the effect of prohibiting calls on the relevant circuit(s) outgoing from that exchange until an unblocking signal or the appropriate group unblocking message is received, but will not in itself prohibit calls incoming to that exchange. Acknowledgement sequences are always required for the blocking and unblocking signals as well as for the group blocking and group unblocking messages, using the blocking—acknowledgement signal, the unblocking—acknowledgement signal, the appropriate group blocking—acknowledgement message and the appropriate group unblocking—acknowledgement message, respectively. The acknowledgement is not sent until the appropriate action, either blocking or unblocking, has been taken. The clear forward signal should not override a blocking condition and return circuits to service which might be faulty. (A) blocked circuit(s) will be returned to service on transmission of the unblocking—acknowledgement signal or the appropriate group unblocking—

acknowledgement message at one exchange and on receipt of the unblocking—acknowledgement signal or the appropriate group unblocking—acknowledgement message at the other exchange.

A circuit that has been maintenance blocked by a blocking signal can be unblocked by either an unblocking signal or a maintenance oriented group unblocking message. A circuit that has been maintenance blocked by a maintenance oriented group blocking message can be unblocked by either an unblocking signal or a maintenance oriented group unblocking message.

5.1 *Other actions on receipt of a blocking signal*

In the event of the receipt of a blocking signal:

— after an initial address message has been sent, and

— before a backward signal relating to that call has been received,

an automatic repeat attempt will be made on another circuit. The exchange receiving the blocking signal should clear forward the original attempt in the normal manner after sending the blocking—acknowledgement signal.

If the blocking signal for a circuit is received:

— in the outgoing exchange after at least one backward signal relating to a call has been received, or

— in the incoming exchange after at least one backward signal relating to a call has been sent,

the exchange will not seize that circuit for subsequent calls.

The fact that the circuit is engaged on a call will not delay transmission of the blocking (unblocking)—acknowledgement signal.

If a blocking signal is sent and subsequently an initial address message is received in the opposite direction, the following action is taken:

— for test calls, the call should be accepted, if possible. In the case where the test call cannot be accepted, the blocking signal must be returned;

— for calls other than test calls, the blocking signal must be returned.

Blocking of a circuit that has not been withdrawn from service by use of the blocking signal should not exceed five minutes, after which an alarm should be given at each terminal of the circuit. Should a call be in progress on the circuit involved, the five minutes time will commence when that call is cleared. If the work on the circuit must exceed five minutes, the circuit should be withdrawn from service.

5.2 *Group blocking and unblocking messages*

The following group blocking (unblocking) messages and the appropriate acknowledgement messages are provided:

— maintenance oriented group blocking (unblocking) message;

— hardware failure oriented group blocking (unblocking) message;

— software generated group blocking (unblocking) message (national option).

The range of circuits to be blocked (unblocked) is dependent on the coding of the range field:

— if the range field is not coded all zero, the circuits indicated in the status field have to be blocked (unblocked);

— if the range field is coded all zero all circuits of the predetermined circuit group have to be blocked (unblocked).

The same rule applies to the acknowledgements.

Since the effect of erroneous group blocking (unblocking) messages generated by undetected errors may seriously affect the quality of service, each group blocking (unblocking) message has to be sent twice. Therefore, at the receiving exchange actions only take place after a blocking (unblocking) message was received twice within 5 seconds.

For the circuits blocked for maintenance reasons the same conditions apply and the same actions have to be taken as described in § 5.1.

For the circuits blocked for reasons of hardware failure or software generated alarm, the following actions will be taken:

— the maintenance personnel will be alerted;

— all interconnected circuits will be released by the appropriate signals;

— the affected circuits will be set to the condition idle/hardware or software blocked without any exchange of clearing signals.

6 Release of international connections and associated equipment

6.1 *Normal release conditions*

Connections are normally released in the forward direction as a result of the receipt of a clear—forward signal from the preceding exchange.

In addition, the normal release of connections (or circuits) occurs as follows:

— on continuity—check failure (see § 7.3);

— on receipt of an address—incomplete signal (see § 1.7);

— on receipt of one of the congestion signals (see § 1.8);

— on receipt of one of the called—party's—line—condition signals (see § 1.9);

— on receipt of the blocking signal or the maintenance oriented group blocking message after sending an initial address message and before a backward signal relating to that call has been received (see § 5);

— on receipt of unreasonable signalling information after sending an initial address message and before one of the backward signals required for call set—up has been received (see § 6.5).

If the conditions for the normal release of connections as described above are not fulfilled, release is provided as follows:

— in the release under abnormal conditions (see § 6.4);

— on receipt of a call—failure signal (see § 6.3);

— on failure to receive a clear—forward signal after sending a clear—back signal (see § 6.4);

— on failure to receive an answer signal (see § 6.4);

— on receipt of a reset—circuit signal or circuit group reset message (see § 1.15).

Address and routing information are released from memory in each of the exchanges of a connection as described in the following subsections.

6.1.1 *Outgoing international exchange*

Address and routing information stored at the outgoing international exchanges can be erased on receipt of one of the following backward signals:

a) one of the address—complete signals,

b) the address—incomplete signal,

c) one of the congestion signals,

d) one of the called—party's—line—condition signals,

e) the call—failure signal,

or when the connection is cleared earlier and no automatic repeat attempt has to be made.

6.1.2 *Incoming international exchange*

Address and routing information stored at the incoming international exchange can be erased on receipt of one of the backward signals indicated in § 6.1.1 (or equivalent) from a national signalling system, or when one of the following signals has been originated and sent to the outgoing international exchange:

a) one of the address—complete signals,

b) the address—incomplete signal,

c) one of the congestion signals,

d) the call—failure signal,

e) the reset—circuit signal, or circuit group reset message,

or on receipt of a clear—forward signal.

6.1.3 *International transit exchange*

Address and routing information stored at an international transit exchange can be erased on receipt of one of the backward signals indicated in § 6.1.1, on receipt of a clear—forward signal, or when one of the congestion signals is originated in that exchange.

6.2 *Abnormal release conditions — Clear—forward, release—guard sequences*

6.2.1 *Inability to release in response to a clear—forward signal*

If an exchange is unable to return the circuit to the idle condition in response to a clear—forward signal, it should remove the circuit from service and send the blocking signal. Upon receipt of the blocking—acknowledgement signal, the release—guard signal is sent in acknowledgement of the original clear—forward signal.

6.2.2 *Inability to release in response to a backward signal*

If an exchange is unable to release a circuit in response to an address—incomplete, congestion, called—party's—line—condition or call—failure signal, it should remove the circuit from service by sending the blocking signal. Upon receipt of the blocking—acknowledgement signal, the clear—forward signal should be sent in reply to the original backward signal.

6.2.3 *Failure to receive a release—guard signal in response to a clear—forward signal*

If a release—guard signal is not received in response to a clear—forward signal before 4—15 seconds, the clear—forward signal will be repeated.

If, after sending a clear—forward signal, a release—guard signal is not received within a period of one minute after the first clear—forward signal, the maintenance personnel shall be alerted. The repetition of the clear—forward signal is ceased, and circuit reset is initiated.

6.3 *Call—failure signal*

The *call—failure* signal is sent as the result of time—out situations, described in § 6.4 and whenever a call attempt fails and other specific signals do not apply, viz:

— the address—incomplete signal,

— the congestion signals, or

— the called—party's—line—condition signals.

Reception of the call—failure signal at any Signalling System No. 7 exchange will cause the clear—forward signal to be sent and, if the signalling system permits to do so, the appropriate signal to be sent to the preceding exchange or the appropriate tone or announcement to be sent to the national network.

Failure to receive a clear—forward signal within 4—15 seconds of sending a call—failure signal causes the latter to be repeated. If no clear—forward signal is received within 1 minute of sending the call—failure signal, repetition of the call—failure signal is ceased, maintenance personnel is alerted and circuit reset initiated.

6.4 *Abnormal release condition — other sequences*

If the conditions for normal release as covered in § 6.1 are not fulfilled, release will take place under the following conditions:

6.4.1 *Outgoing international exchange*

An outgoing international exchange shall:

a) release all equipment and clear forward the connection on failure to meet the conditions for normal release of address and routing information as covered in § 6.1.1 before 20—30 seconds after sending the latest address message;

b) release all equipment and clear forward the connection on failure to receive an answer signal within the interval specified in Recommendation Q.118 [3];

c) release all equipment and clear forward the connection on failure to receive a clear—forward signal from the national network after having received a clear—back signal within the interval specified in Recommendation Q.118 [3].

6.4.2 *Incoming international exchange*

An incoming international exchange shall:

a) release all equipment, clear forward the connection into the national network and send back a call—failure signal in the following cases:

— on failure to receive a continuity or continuity—failure signal if applicable (see Recommendation Q.723, § 3.3.1) before 10—15 seconds after receipt of the initial address message; or

— on failure to receive one of the backward signals indicated in § 6.1.1 (or equivalent) from a national network (where expected) before 20—30 seconds after receipt of the latest address message, unless the timing for sending the address—incomplete signal (see § 1.7) is provided; or

— on receipt of an address—incomplete signal after an address—complete signal has been generated;

b) send the call—failure signal on failure to receive a clear—forward signal for the incoming circuit before 4—15 seconds after sending an address—incomplete, congestion, call—failure or a called—party's—line—condition signal indicating inability to complete the call.

If a clear—forward signal is not received within a period of one minute after sending the call—failure signal, the repetition of the call—failure signal should be ceased, maintenance personnel should be alerted, and a reset—circuit signal should be sent for the concerned circuit.

c) release all equipment and clear forward the connection into the national network on failure to receive a clear—forward signal after sending a clear—back signal within the interval specified in Recommendation Q.118 [3].

6.4.3 *International transit exchange*

An international transit exchange shall:

a) release all equipment, clear forward the connection and send back the call—failure signal in the following cases:

— on failure to receive a continuity or continuity—failure signal if applicable (see Recommendation Q.723, § 3.3.1) before 10—15 seconds after receipt of the initial address message; or

— on failure to meet the conditions for normal release as covered in § 6.1.3 before 20—30 seconds after sending the latest address message; or

b) send the call—failure signal on failure to receive a clear—forward signal for the incoming circuit before 4—15 seconds after sending an address—incomplete, congestion, call—failure or a called—party's—line—condition signal indicating inability to complete the call.

If a clear—forward signal is not received within a period of one minute after sending the call—failure signal, the repetition of the call—failure signal should be ceased, maintenance personnel should be alerted, and a reset—circuit signal should be sent for the concerned circuit.

6.4.4 *Failure in the blocking/unblocking sequence*

An exchange will repeat the blocking (unblocking) signal or the group blocking (unblocking) messages on failure to receive the appropriate acknowledgement in response to one of these signals/messages before 4—15 seconds (see § 5).

If an acknowledgement is not received within a period of one minute after sending the initial blocking (unblocking) signal or group blocking (unblocking) messages, maintenance personnel should be alerted, the repetition of the blocking (unblocking) signal or group blocking (unblocking) messages should be continued at one minute intervals.

6.5 *Receipt of unreasonable signalling information*

The Message Transfer Part of the signalling system will avoid mis—sequencing, or double delivery, of messages with a high reliability (Recommendation Q. 706, § 2). However, undetected errors at the signalling link level and exchange malfunctions may produce signalling information in messages that is either ambiguous or inappropriate.

In order to resolve some possible ambiguities in the state of a circuit when unreasonable signals are received the following will apply:

a) if a clear—forward signal is received relating to an idle circuit it will be acknowledged with a release—guard signal;

b) if a release—guard signal is received relating to a circuit for which a clear—forward signal has not been sent, the following actions will be undertaken:

— if the circuit is idle, the release—guard signal is discarded;

— if the circuit is seized by a call, the release—guard signal is considered as an ordinary unreasonable information (see item g));

c) if a blocking signal is received for a blocked circuit, a blocking—acknowledgement signal will be sent;

d) if an unblocking signal is received for an unblocked circuit, an unblocking—acknowledgement signal will be sent;

e) if a blocking—acknowledgement signal for which no blocking signal has been sent is received:

— relating to a circuit blocked by sending a blocking signal, the blocking—acknowledgement signal will be discarded,

— relating to a circuit which is not blocked by sending a blocking signal, an unblocking signal will be sent;

f) if an unblocking—acknowledgement signal for which no unblocking signal has been sent, is received:

— relating to a circuit blocked by sending a blocking signal, the blocking signal will be sent,

— relating to a circuit which is not blocked by sending a blocking signal, the unblocking—acknowledgement signal will be discarded;

g) if other unreasonable signalling information is received, the following actions will be undertaken:

— if the circuit is idle, the reset—circuit signal is sent;

— if the circuit is seized by a call, after receipt of a backward signal required for the call set—up, the unreasonable signalling information is discarded;

— if the circuit is seized by a call, before receipt of a backward signal required for the call set—up, the reset—circuit signal is sent. If the circuit is seized by an incoming call, the call will be released. If the circuit is seized by an outgoing call, an automatic repeat attempt is provided on another circuit.

7 Continuity—check for 4—wire speech circuits

7.1 *General*

This specification relates only to that part of a 4—wire connection served by Signalling System No. 7. The part of the speech path to be checked may include a circuit with speech interpolation. As the presence of active echo suppressors in the circuit would interfere with the continuity—check, it is necessary to disable the suppressors during the check and to re—enable them, if required, after the check has been completed.

The *transceiver* (check—tone transmitter and receiver) is connected to the *go* and *return* paths of the outgoing circuit at the first and each succeeding exchange, excluding the last exchange, in that part of the connection served by Signalling System No. 7. The *check—loop* should be connected to the *go* and *return* paths of the incoming circuit at each exchange except the first in that part of the connection served by Signalling System No. 7. A continuity—check is considered successful when a tone is sent on the *go* path and is received on the *return* path within acceptable transmission and timing limits.