- For a radio unit transmission with one or two data codewords, the radio unit shall be capable of decoding an address codeword in the second forward channel slot following the start of the radio unit transmission.

- For a radio unit transmission with three or four data codewords, the radio unit shall be capable of decoding an address codeword in the third forward channel slot following the start of the radio unit transmission.

If a radio unit receives a command to change channel (MOVE, GTC; see 7.4.2 and 9.2.2.5), it shall be capable of receiving on the new channel within 35 ms after the end of the TSC message, unless the unit is a called unit in an interprefix call, in which case it may delay the channel change by one slot and shall be capable of receiving on the new channel within 142 ms after the end of the TSC message (see 9.2.2.5).

6.2.2 Traffic channel discipline for Radio Units

6.2.2.1 Monitoring

Whilst receiving on the forward traffic channel, the radio unit shall monitor the channel continuously for messages from the TSC and shall take appropriate action; see section 3 for the TSC signalling formats and sections 9.2.3.2, 9.2.3.3, 9.2.3.4, 9.2.3.7, 9.2.3.8, 11.3.1 and 15.2 for procedures. If the radio unit is required to transmit a response to a message received from the TSC, its response shall conform to the timings specified in section 6.2.2.2.

If a radio unit receives a command to change channel (see 9.2.3.4 and 9.2.3.8), it shall be capable of receiving on the new channel within 35 ms after the end of the TSC message.

The radio unit shall not give to its user any information which is not pertinent to that radio unit.

6.2.2.2 Signal timing

The format for standardised messages transmitted on a traffic channel by the radio unit is defined in section 3. In particular, unless the unit is already transmitting, each transmission shall be introduced by at least 12 bit periods (10 ms) of link establishment time. If the radio unit sends unsolicited messages (e.g. an Include request, a Pressel On message or Disconnect messages), the link establishment time shall not exceed 24 bit periods (20 ms). The preamble duration shall be 16 bits, and messages shall commence with the traffic channel codeword synchronisation sequence. After the final ("hang-over") bit of a standardised transmission, unless the radio unit is required to continue transmitting for user communication, it shall cease transmission so that power is reduced by at least 60 dB within 6 bit periods (5 ms).

The transmission of standardised messages on a traffic channel shall conform to the timings specified in sections 6.2.2.2.1 and 6.2.2.2.2.

6.2.2.2.1 Radio unit response

When the radio unit sends a response (e.g. an acknowledgement to an Ahoy message from the TSC), its transmission shall conform to the following timings, which are measured in bit periods, numbered from the end of the last codeword in the received message.

The radio unit shall not commence r.f. transmission before the start of bit 21, nor shall it reach 90% of its maximum power later than the start of bit 37; the 16-bit preamble shall not begin before the start of bit 36 nor later than the start of bit 49; after sending the "hang-over" bit and reducing power, the radio unit shall retune to the forward channel in time to be capable of decoding another message whose codeword synchronisation sequence may begin at the start of bit 183 + (64 x number of data codewords transmitted by the radio unit).

6.2.2.2.2 Unsolicited transmission that requires a response

When a radio unit sends an unsolicited standardised message that requires a response (e.g. an Include request), it shall conform to the following timings, which are measured in bit periods, numbered from the end of the last codeword of its transmission.

After transmitting the unsolicited message, the radio unit shall retune to the forward traffic channel in time to be capable of decoding a message which may begin (i.e. first bit of codeword synchronisation sequence) at the start of bit 52.

If the radio unit has not received a codeword synchronisation sequence by the start of bit NT+16, it shall either abandon its unsolicited access attempt or make another unsolicited transmission, timing the next message to begin (i.e. first bit of codeword synchronisation sequence) no earlier than the start of bit NT+144.

If, while waiting to transmit an unsolicited standardised message, the radio unit receives a codeword synchronisation sequence SYNT, it shall wait to determine whether there is a message relevant to it before making its transmission.

6.2.3 Data channel discipline for radio units

6.2.3.1 Monitoring

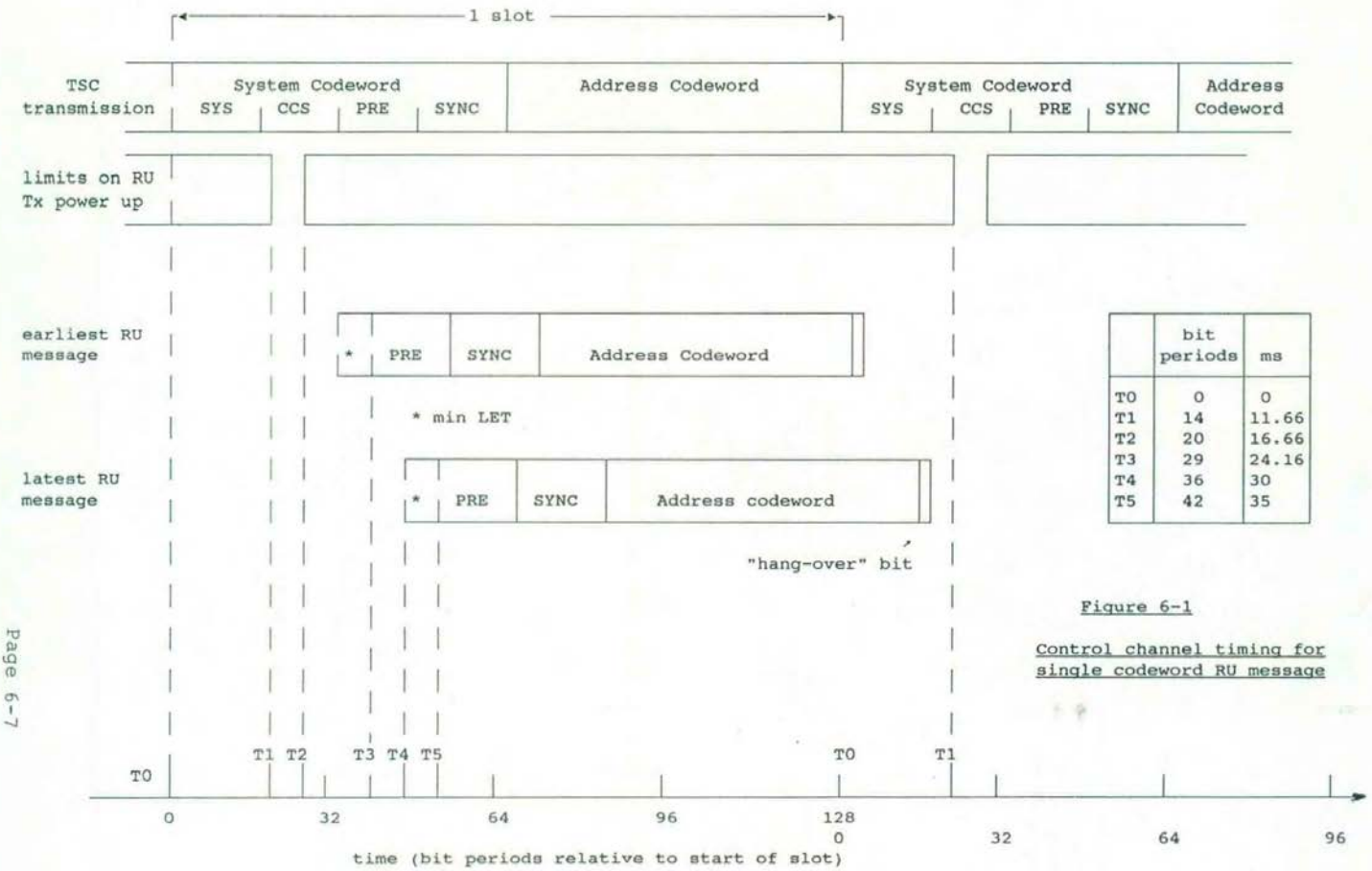
Whilst receiving on the forward channel, the radio unit shall monitor the channel to take appropriate actions for all relevant received messages.

If a radio unit receives a command to change data channel (see 17.2.6.2), it shall be capable of receiving on the new channel within 35 ms of the end of the TSC message.

6.2.3.2 Signal Timing

At the standard transmission rate, when the radio unit transmits a message the timing shall conform to 6.2.1.3 (but using SYNT instead of SYNC).

Details of transmission timing at a customised rate must be specified elsewhere.



	bit periods	ms
T0	0	0
T1	14	11.66
T2	20	16.66
T3	29	24.16
T4	36	30
T5	42	35

Figure 6-1

Control channel timing for single codeword RU message

7. RANDOM ACCESS PROTOCOL

This section defines the random access protocol, which is based on slotted Aloha with a superimposed framing structure that can be used to:

- control clashing of messages from different radio units,
- minimise access delays,
- ensure stability, and
- maintain peak throughput under heavy traffic loads.

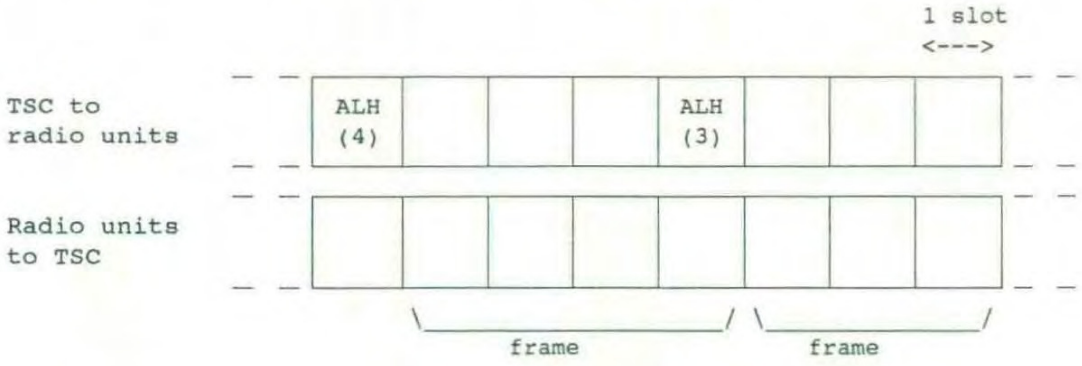
The slotting structure of the control channel and timing constraints for the transmission of messages are defined in sections 3 and 6.

7.1 The Principle

The basic principle of the access protocol is described with reference to the example below, which illustrates signalling on a control channel.

The TSC transmits a synchronisation message (indicated by ALH in the example) to establish slot timing and to invite radio units to send random access messages. The ALH message contains a parameter (N) which indicates the number of following timeslots, constituting a frame, that are available for access. If a frame is already in progress when a call is initiated, the radio unit may send its random access message in the next immediate slot. Otherwise the unit waits for a frame to be started and then chooses a random slot from the frame for its message. A unit wishing to send a repeat transmission after an unsuccessful message (corrupted by fading or clashing) must wait for a new frame before choosing another slot.

The TSC can monitor activity on the control channel and can optimise the system performance by varying the framelength to prevent excessive clashing and to minimise the access delays. System designers should choose a control algorithm appropriate to the type of system.



Example Two random access frames, each marked by an ALH message. (Random access frames can be marked by Aloha, Acknowledgement and Go To Channel messages.)
Contiguous frames are shown in the example; frames may overlap. Frames need not be contiguous.

7.2 TSC Random Access Facilities

7.2.1 Marking random access frames

The TSC shall designate sections of a return control channel as random access frames, each containing a whole number of timeslots. Aloha messages (see 5.5.1) sent on the forward control channel contain an Aloha number, and can be used to mark random access frames. The Acknowledgements and Go To Channel message also contain an Aloha number and may substitute for an Aloha message. For example, ACK(4) acknowledges a message from a radio unit and also marks a four-slot frame.

The zero Aloha number (N=0) is a special value indicating "this is not the beginning of a frame". Thus, for example, ACK(0) can be sent within a frame to acknowledge a message.

All other Aloha numbers mark the beginning of a frame.

Aloha and Acknowledgement messages contain a four-bit Aloha number and the Go To Channel message contains a two-bit Aloha number. The Aloha number is coded, so that longer frames can be achieved than a pure binary representation would permit; the explicit numbers of slots in a frame indicated by the four- and two-bit Aloha numbers are given in Table 7-1 (see 7.3.3). If the required framelength is too long to be designated by a GTC message then an Aloha message or Acknowledgement must be used.

7.2.2 Subdividing the radio unit population

The TSC may divide the radio unit population into subsets, where each subset can be permitted random access in turn. The division is performed by using the address qualifier (M) in Aloha messages. This parameter instructs a radio unit to compare the M least significant bits of its individual address (prefix/ident) with the M least significant bits of the address (PFIX/IDENT1) from the Aloha message when choosing a slot. the unit is allowed to transmit non-emergency random access messages only if the M bits match (see 7.3.1) when the slot is chosen. The subdivision is applied to subsequent frames marked by non-Aloha messages, until changed by the next Aloha message. (However, note that radio units which have recently acquired the control channel or have missed Aloha messages may be unaware of the subdivision and that the latest Aloha message received by the unit is applied by the unit when chosing a slot.)

In this way, the radio unit population is effectively divided into 2^M subsets:

- If M = 0 then no address bits are compared, so there is no subdivision. (Under normal traffic loading, this will usually be the case.)

- If M = 1 then only units whose least significant address bit matches the Aloha address may send non-emergency random access messages. Thus the radio unit population has been divided into two subsets.

- This process continues up to M = 19.

- If M = 20 then all twenty bits of the address must be compared, and this indicates that the Aloha message is applicable to only one unit or a specified group of units. Note that M = 20 is a special case in which the radio unit compares the Aloha address with each of its designated addresses, not just its individual address; in this way a group of units may be invited to send random access messages. Note also that an Aloha message with M = 20 and the Aloha address set to an individual address demands a response from that unit, rather than just inviting a random access message (see 7.4.1). If the TSC sends an individually addressed Aloha message, it shall set the Aloha number (N) to 1.

7.2.3 Inviting specific types of random access message

The TSC may limit random access to particular types of message by means of specific Aloha messages: ALH, ALHS, ALHD, ALHE, ALHR, ALHX, ALHF (see 5.5.1 and 7.3.2); for example, ALHR invites registration or emergency requests only. The limitation is applied to subsequent frames until changed by a different Aloha message. (However, note that radio units which have recently acquired the control channel will assume an Aloha function of ALHX. While those that have missed Aloha messages may be unaware of the current function and will apply the limitations of the last received Aloha function. Once a slot is chosen the radio unit applies that Aloha function throughout the frame for the purpose of random access.)

7.2.4 TSC responses

After receiving a random access message, the TSC shall send a response; valid responses are specified in the sections detailing the call procedures. The response may be sent in the slot following the random access message or it may be delayed. The TSC shall specify, using the WT field in the Aloha messages, the time (in slots) a radio unit must wait before deciding to retransmit and choosing another slot from a new frame (see Table 7-2 in section 7.3.7).

7.2.5 Withdrawing slots from frames

During a frame, the TSC may transmit messages that demand a response from a specified radio unit; the response is sent in the slot(s) following the last codeword of the TSC's message.

The TSC's message inhibits random access in the first following return slot (see 7.3.6), and so reserves that slot for the response. For a multi-codeword response, the TSC shall take appropriate action to reserve the subsequent return slot(s) if they are still within the frame (e.g. by sending the AHY message with both idents set to DUMMYI). Note that:

a. All TSC address codewords that do not contain an Aloha number, except AHY(AD=1), AHYQ(IDENT2=IPFIXI), MARK, MOVE, BCAST and HEAD, inhibit random access in the following slot.

b. An Aloha message with M = 20 inhibits access by radio units that are not explicitly addressed.

c. All data codewords transmitted by the TSC in the second half of a slot preceding a designated random access slot contain a Return Slot Access flag RSA (bit number 2), which shall be set to indicate whether the following slot is reserved for a response; for example, see section 5.6.2. Note that, for TSC messages containing an odd number of data codewords (e.g. AHY(AD=1) and AHYQ(IDENT2=IPFIXI)), a "filler" data codeword is appended to the message (see 3.3.3.2); if the message demands a response from a radio unit, the RSA flag in the filler codeword shall be set to '0', to inhibit random access.

7.3 Radio Unit Random Access Protocol

These procedures shall be obeyed by all radio units that are required to attempt random access.

7.3.1 Checking subsets of the radio unit population

A radio unit shall note the population subdivision contained in each Aloha message that it receives. When attempting random access the radio unit shall check if the population subdivision is applicable to it. This is done using the 5-bit address qualifier (M) and the address (PFIX/IDENT1) from the Aloha message. For M = 0 to 19, the message is applicable to the unit if the M least significant bits of the Aloha address match the M least significant bits of its individual address (prefix/ident). For M = 20, the message is applicable to the unit if the Aloha address matches any of its designated addresses for this system (including its group addresses).

The unit shall not choose a slot for random access in the frame designated by the Aloha message, or frames designated by subsequent Acknowledgement or Go To Channel messages, unless:

the Aloha message is applicable to it, for non-emergency messages,
or the Aloha message is applicable to it or M < 20, for emergency requests (ie RQE or RQD (E = 1).

Note that slots are chosen either immediately for the first try option (see 7.3.4) or on receipt of a frame marker when the limit needs to make a random access attempt (see 7.3.5).

When a radio unit becomes active on a control channel, including when returning from a traffic channel, it shall either assume that the population is not subdivided (i.e. that the last Aloha message was applicable to all radio units) or wait for an Aloha message before attempting random access.

7.3.2 Checking the Aloha function

A radio unit shall note the function (FUNC) from each Aloha message it receives. The requests invited by each Aloha function are as follows:

ALH	Invites	RQS,	RQD(E=0),	RQD(E=1),	RQX,	RQT,	RQE,	RQR,	RQQ, RQC
ALHS	Invites	RQS,			RQX,	RQT,	RQE,	RQR,	RQQ, RQC
ALHD	Invites		RQD(E=0),	RQD(E=1),	RQX,	RQT,	RQE,	RQR,	RQQ, RQC
ALHE	Invites			RQD(E=1),			RQE		
ALHR	Invites			RQD(E=1),			RQE,	RQR	
ALHX	Invites	RQS,	RQD(E=0),	RQD(E=1),	RQX,	RQT,	RQE,		RQQ, RQC
ALHF	Fall-back mode; messages invited only from radio units which know the fall-back method used by this system.								

(The rules defining the Aloha functions appropriate to customised random access messages are system-dependent.)

The unit is not required to recognise the meaning of all these functions. However, it shall not choose a slot for random access message in the frame designated by the Aloha message, or frames designated by subsequent Acknowledgement or Go To Channel messages, unless it recognised the Aloha function and its random access message is of a type invited by the Aloha message.

When a radio unit becomes active on a control channel, including when returning from a traffic channel, it shall assume an Aloha function of ALHX.

7.3.3 Frames defined by Aloha numbers

A radio unit shall use Table 7-1 to derive the explicit number of slots in a frame indicated by the four-bit Aloha number within the Aloha and Acknowledgement messages and the two-bit Aloha number within the Go To Channel message. (The zero Aloha number indicates that the message does not mark a frame.)

Four-bit Aloha number:

Aloha Number	Framelength	Aloha Number	Framelength
0	Not a frame marker	8	8
1	1	9	9
2	2	10	10
3	3	11	12
4	4	12	15
5	5	13	19
6	6	14	25
7	7	15	32

Two-bit Aloha number:

Aloha Number	Framelength
0	Not a frame marker
1	1
2	3
3	6

Table 7-1 Number of slots in a frame indicated by Aloha numbers

The radio unit shall monitor the forward control channel and shall note which sections of the return control channel are designated as random access frames (using the framing Aloha numbers contained in Aloha, Acknowledgement and Go To Channel messages). The first access slot in a frame starts at the end of the forward control channel codeword containing the framing Aloha number and respective coincidence is maintained for subsequent slots.

7.3.4 First try option

When a radio unit is required to transmit a new message, it is permitted to transmit in the next immediate slot, provided that:

a. the slot is within a frame and the most recently received Aloha message does not inhibit access. (see 7.3.1, 7.3.2, 7.3.3),

and b. the slot is not withdrawn (see 7.3.6).

However, if it does not wish to use this option or if the slot is not within a suitable frame or if the slot is withdrawn, then the unit shall choose a slot from a new frame (see 7.3.5).

7.3.5 Choosing a slot from a new frame

A radio unit that requires to select a slot from a new frame shall wait for a message marking a frame available for it to use (see 7.3.1 and 7.3.2); it shall then choose a slot randomly from the specified framelength, using a uniform distribution. The most recently received Aloha message parameters are enforced at the moment of slot choice. The unit shall transmit its message in the chosen slot, provided that the slot is not withdrawn (see 7.3.6); for access timing, see 6.2.1.3.

A radio unit shall not choose more than one slot from a frame. Therefore, if it has to repeat the selection of a slot (either because a chosen slot was withdrawn or to make a repeat transmission), it shall count to the last slot of the previous frame before using another Aloha number. For example, if the last selection was from a frame with 8 slots, designated by an ALH message, the unit shall not use frame marker messages received in the 7 slots after the ALH message to choose its next slot. (Counting slots is required to allow for multi-site systems with time division of a single control channel, in which radio units may receive messages from several sites and frames designated by different sites may overlap in time.)

7.3.6 Check for withdrawn slot

Before transmitting its random access message in a chosen slot, a radio unit shall check whether the slot is still available for random access by attempting to decode the second codeword on the forward channel in the slot immediately preceding the chosen slot. If any of the following is received then random access is permitted:

a. Any address codeword containing an Aloha number, except an Aloha message with M = 20 and the Aloha address (PFIX/IDENT1) not applicable to the unit (see 7.3.1).

b. The following address codewords:

   - AHY with AD = 1
     (unless the AHY is addressed to the unit)
   - AHYQ with IDENT2 = IPFIXI
     (unless the AHYQ is addressed to the unit)
   - MARK
   - a MOVE message not applicable to the unit (see 7.4.2)
   - BCAST
   - HEAD (unless the HEAD is addressed to the unit).

c. A data codeword with the Return Slot Access flag RSA (bit number 2) set to '1', (unless the codeword is part of a message addressed to the unit).

d. If permitted by the type of system, a codeword that is not decodeable (or no signal is received).

Otherwise the unit shall refrain from transmitting and shall choose again from a new frame.

(Future enhancements of the standard protocol, and customised messages, may result in additional messages that permit access for those radio units which can recognise these additional messages.)

7.3.7 Noting the response delay

A radio unit shall note the delay parameter WT from each Aloha message it receives and shall use Table 7-2 to derive from it the number of slots, WAIT, by which the TSC's response to a random access message may be delayed. (WAIT = 0 means that the response should be received in the slot following the random access message.) At the start of a session, until it receives an Aloha message, the unit shall assume a value of WAIT = NW (see Appendix 1).

WT	WAIT	WT	WAIT
0	0	4	4
1	1	5	5
2	2	6	10
3	3	7	15

Table 7-2 Response delays indicated by the delay parameter WT

7.3.8 Retry decision and time-outs

After sending a random access message, a radio unit shall wait to receive a response from the TSC. Various messages shall be accepted as a valid response (as specified in the sections detailing the call procedures).

If the radio unit does not receive a response within the WAIT+1 slots after its message, it shall assume that the message was unsuccessful. Then it shall either:

a. abandon its access attempt (see below), or

b. choose another slot, from a new frame (using a frame marker message received in or after the WAIT+1 th slot after the unsuccessful message); however, if the unit receives a valid response before sending a repeat message, it shall accept the response and not retransmit.

The radio unit shall abandon its access attempt if it has sent the maximum permitted number of transmissions and received no valid response. This number depends on the function of the message:

- For requests RQS, RQD(E=0), RQX, RQT, RQR, RQQ and RQC, it is NR.
- For emergency requests RQE and RQD(E=1), it is NE.

The unit shall also operate a time-out TC on the maximum time it spends trying to achieve access, and abandon the attempt if this time-out expires.

If the unit's access attempt fails, then:

i) If the message was a cancellation/abortion request RQX, the unit shall return to waiting for signalling for the original transaction (for example, see sections 9.2.1.7 and 9.2.1.6).

ii) For access attempts for other messages:

- if the unit has not sent a message, it shall return to the idle state (and may indicate the failure to the user);
- otherwise, it shall wait for further signalling for the transaction (until the relevant time-out TW or TJ has expired - for example, see sections 9.2.1.1 and 9.2.1.6).

7.4 Related Procedures for All Radio Units on a Control Channel

7.4.1 Individually addressed Aloha message

If a radio unit on a control channel receives an Aloha message with M = 20 and Aloha address (PFIX/IDENT1) matching its individual address for this system, then it shall send a message in the next slot:

a. If the unit recognises the Aloha function and is currently attempting random access with a message of a type invited by the Aloha message, it shall transmit its message and then continue to obey the procedures in section 7.3 (regarding the transmission as if it were a random access).

b. Otherwise, if the Aloha message is ALHR and the unit has the ability to register, it shall send a registration request RQR and then wait until it receives a response or for WAIT+1 slots. While waiting for a response, the unit shall not seek to transmit messages by random access. See also section 8.3.2.

c. Otherwise, the unit shall send an acknowledgement ACKX(QUAL=0) with PFIX/IDENT2 set to its individual address and IDENT1 set to TSCI. (It will not be sent a response to this message.)

7.4.2 MOVE message

If a radio unit on a control channel receives a MOVE message that is applicable to it (see below), then it shall move to the specified forward control channel and shall be able to receive within 35 ms after the end of the MOVE address codeword; after becoming active on the specified control channel, the unit shall retain the same state as on the old control channel except that, if currently attempting random access, it shall choose a slot from a new frame, using a frame marker message received on the new control channel (see 7.3.5).

The unit uses the address qualifier (M) and the address (PFIX/IDENT1) from the MOVE message to decide whether the message is applicable to it. For M = 0 to 19, the message is applicable to the unit if the M least significant bits of the MOVE address match the M least significant bits of its individual address. For M = 20, the message is applicable to the unit if the MOVE address matches any of its designated addresses for this system (including its group addresses).

Note: If field CONT in an applicable MOVE message is equal to '0000000000', then the channel movement is system-dependent.

8. REGISTRATION PROCEDURES

Registration enables a radio unit to inform a system that it is within a session on that system. This section defines signalling procedures for radio units and TSCs that are required to employ registration.

Additional specifications will be needed for a specific system implementation, for example, to define:

- the criteria for when a radio unit should initiate registration
- the radio unit action after a registration denial or failure.

These specifications are likely to be system-dependent and therefore are not included in this standard.

8.1 Registration Facilities

The registration procedures in this standard provide the following facilities for the TSC:

a. The TSC shall indicate, by the value of field FUNC in Aloha messages, whether random access registration request messages are invited from radio units. (See also sections 7.2.3 and 7.3.2.)

   i) ALH, ALHS, ALHD and ALHR invite registration requests.
   ii) ALHE and ALHX do not invite registration requests.
   iii) The function of ALHF will be determined by the customised fall-back mode.

b. The TSC may vary the value of the address qualifier (M) in Aloha messages to invite registration requests from:

   - the whole radio unit population (M = 0),
   - a section of the radio unit population (0 < M < 20), or
   - members of a selected group only (M = 20 and PFIX/IDENT1 set to a group address).

   See also sections 7.2.2 and 7.3.1.

c. The TSC may demand registration from a specific radio unit by transmitting the ALHR message, with PFIX/IDENT1 set to the individual address of the wanted radio unit and M set to 20.

d. The TSC may reject individual registration requests.

e. The TSC may transmit the BCAST message with SYSDEF='00011', to broadcast registration parameters to radio units. See 5.5.4.5d.

The procedures for registration by random access and registration on demand are specified in sections 8.2 and 8.3 respectively.

8.2 Procedures for Registration by Random Access

8.2.1 TSC Procedures

The TSC shall use the random access protocol to control the generation of registration requests by the radio unit population, as described in section 8.1 above. If the TSC indicates, in the manner described therein, that registration requests are invited then it shall be prepared to receive RQR messages from radio units.

8.2.1.1 Responses to a random access RQR message

A radio unit requests to register by generating an RQR message, complying with the random access protocol. On receiving an RQR message, the TSC shall send a response - ACKI(QUAL=1), ACKX or ACK(QUAL=0) - with PFIX/IDENT2 as the unit's individual address and IDENT1 set to REGI. For acceptable delay, see 7.2.4. See also 8.2.1.2.

8.2.1.2 Acknowledgements sent to indicate progress of registration

The TSC may send the following acknowledgement messages (with PFIX/IDENT2 as the unit's individual address and IDENT1 set to REGI) to indicate to a radio unit the progress of its registration:

ACKI (QUAL=1)	-	Intermediate acknowledgement; the decision to accept or reject the registration has been postponed; more signalling to follow.
ACKX (QUAL=0)	-	Invalid request; registration denied.
ACKX (QUAL=1)	-	System overload; registration failed.
ACK (QUAL=0)	-	Registration accepted.

8.2.1.3 TSC time-out

The TSC may instruct a radio unit to restart its waiting timer TJ, by sending the AHY message with bit POINT set to '1', PFIX/IDENT2 set to the unit's individual address and IDENT1 set to REGI; see 9.1.1.7 and 9.2.2.3. If a time TJ (minus the tolerance on the radio unit's timer) elapses since the last message it received for the registration, the TSC shall not send any further signalling for the registration. See also 8.2.2.4.

8.2.2 Radio Unit Procedures for Registration by Random Access

8.2.2.1 Criteria for registration

At the start of a session, a radio unit shall decide (by examination of the system identity code in codewords received on the forward control channel) whether it should seek to register with the system. The process by which the unit decides whether to seek to register is system-dependent and is not included in this standard.

A radio unit seeking to register with a system may attempt to make calls prior to registration (but shall be prepared to register on demand before being accepted for traffic; see 7.4.1 and 8.3.2.1).

8.2.2.2 Registration request and valid responses

A radio unit requests to register by sending the RQR message on a control channel, complying with the random access protocol (see 7.3). The fields in the RQR message shall be set appropriately (see 5.5.3.1.6); however, note particularly that PFIX/IDENT1 is set to the radio unit's individual address agreed for the system, and field INFO may contain additional (customised) information.

The unit shall attempt access until it receives a valid response (see below) or until the access attempt fails (i.e. the unit has sent the maximum number of transmissions NR and received no response, or its access time-out TC has expired (see 7.3.8)). In the case of access failure, if the unit has not sent a request, it shall return to the idle state (further actions to be taken by the unit are system-dependent); otherwise, it shall wait for further signalling for the registration - see 8.2.2.3 and 8.2.2.4.

The unit shall accept acknowledgements ACKI(QUAL=1), ACKX or ACK(QUAL=0), with PFIX/IDENT2 as its individual address and IDENT1 as REGI, as a valid response to its RQR and send no more requests. For other actions on receiving these messages, see section 8.2.2.3.

8.2.2.3 Acknowledgement received

If a radio unit attempting access or waiting for signalling for a registration receives ACKI(QUAL=1), with PFIX/IDENT2 as its individual address and IDENT1 as REGI, then it shall wait for further signalling for the registration. (For time-out, see 8.2.2.4.)

If a radio unit attempting access or waiting for signalling for a registration receives ACKX or ACK(QUAL=0), with PFIX/IDENT2 as its individual address and IDENT1 as REGI, then it shall return to the idle state:

ACKX (QUAL=0) - Invalid request; registration denied.
ACKX (QUAL=1) - System overload; registration failed.
ACK (QUAL=0) - Registration accepted.

Other actions to be taken by the radio unit on receiving ACKX or ACK(QUAL=0) are system-dependent. (For example, receipt of ACKX(QUAL=0) could restrict or ban random access on the system for the duration of the session).

8.2.2.4 Time-out after waiting

A radio unit waiting for further signalling for a registration shall return to the idle state if a time TJ has elapsed since the last message it sent for the registration, viz.

RQR, requesting registration (see 8.2.2.2 and 8.3.2.1)
or ACK(QUAL=0), sent in response to an AHY message with bit POINT = 1 and IDENT1 set to REGI (see 9.2.2.3).

The unit shall assume that the outcome of the registration attempt is unknown. (Further actions to be taken by the unit are system-dependent.)

8.3 Procedures for Registration on Demand

8.3.1 TSC Procedures for Demanding Registration

The TSC may demand a registration message from any radio unit which may be within a session on the system. For example, it may use this facility after sending a response to a call request from a radio unit that has not registered.

The TSC demands registration from a radio unit by transmitting the ALHR message on the control channel, with:

- PFIX/IDENT1 set to the individual address of the radio unit
- the address qualifier (M) set to 20.
- the Aloha number (N) set to 1.

The ALHR message instructs the addressed radio unit to send a reply (RQE, RQR or ACKX(QUAL=0)) in the next slot; see sections 7.4.1 and 8.3.2.1. If the TSC does not successfully decode a reply, it may repeat the ALHR message when convenient.

If the reply is RQE, the TSC shall send a response as soon as possible (see 10.1.1 and 10.1.2).

If the reply is RQR, the TSC shall decide whether to accept the registration. Valid responses are:

ACKX (QUAL=0) - Invalid request; registration denied.
ACK (QUAL=0) - Registration accepted.

with PFIX/IDENT2 set to the radio unit's individual address and IDENT1 set to REGI. See also section 8.3.2.2.

8.3.2 Radio Unit Procedures for Registration on Demand

8.3.2.1 Individually addressed ALHR message

If a radio unit on a control channel receives an Aloha message with M = 20 and PFIX/IDENT1 matching its individual address for the system, then it shall send a message in the next slot, as specified in section 7.4.1. For convenience, the procedure is repeated here, for the specific case of FUNC = ALHR.

a1. If the unit is currently attempting random access for an emergency call, it shall send an emergency request RQE or RQD(E=1) and then continue to obey the procedures in sections 7.3 and 10.2 or 17.1.2.2 (regarding the transmission as if it were a random access).

a2. Otherwise, if the unit is currently attempting random access for registration, it shall send a registration request RQR and then continue to obey the procedures in sections 7.3 and 8.2.2 (regarding the transmission as if it were a random access).

b. Otherwise, if the unit has the ability to register, it shall send a registration request RQR and then wait until it receives a response or for WAIT+1 slots; see 8.3.2.2. While waiting for a response, the unit shall not seek to transmit messages by random access.

c. Otherwise, the unit shall send ACKX(QUAL=0) with PFIX/IDENT2 set to its individual address and IDENT1 set to TSCI.

8.3.2.2 Responses to RQR sent on demand

After sending a demanded RQR in reply to ALHR with M=20, the radio unit shall accept either of the following acknowledgements, with PFIX/IDENT2 as its individual address and IDENT1 as REGI, as a valid response to its RQR:

ACKX (QUAL=0) - Invalid request; registration denied.
ACK (QUAL=0) - Registration accepted.

If ACKX(QUAL=0) is received, the action to be taken by the radio unit is system-dependent (as in 8.2.2.3).

If ACK(QUAL=0) is received, the unit shall return to the state it was in directly prior to receiving the ALHR message (unless signalling messages received in the interim have changed this state). After receiving ACK(QUAL=0) in response to a registration on demand, the unit shall assume that its current registration requirements are satisfied, as if it had successfully registered by random access (see 8.2.2.3).

If the unit receives no response within the WAIT+1 slots after its RQR, then it shall return to the state it was in directly prior to receiving the ALHR message (unless signalling messages received in the WAIT+1 slots have changed this state).

9. BASIC CALL PROCEDURES

This section defines the basic call procedures for non-emergency speech calls and calls requiring a channel over which non-prescribed data may be sent. The procedures cover both short addressing and extended addressing calls. They cater for calls between the following parties:

radio unit	--->	radio unit, line unit or group
radio unit	--->	all units in system
radio unit	--->	PABX extension (with extension number that can be represented by 13 bits, or with a "long" extension number)
radio unit	--->	PSTN destination (prearranged or general)
line unit	--->	radio unit, group or all units in system
PABX extension	--->	radio unit, group or all units in system
PSTN telephone	--->	radio unit, group or all units in system.

These calls from radio units are requested using the "Simple" Call Request Message RQS; see section 5.5.3.1.1. Bit DT in the RQS message specifies whether the unit is requesting a conversation or a channel over which any appropriate audio signalling, even a non-standard modulation or format, may be sent to the called unit(s).

The RQS message contains all the information necessary to request a short addressing call viz. a common-prefix call, a system-wide call, a call to a prearranged PSTN destination or a call to a "short" PABX extension number. However, for an interprefix call, a general call to the PSTN or a call to a "long" PABX extension number, the call details cannot be accommodated in a single address codeword. For these types of call, the RQS message requests entry into the extended addressing mode; the radio unit sets IDENT1 in the RQS to the appropriate gateway ident (viz. IPFIXI, PSTNGI or PABXI), and the TSC then demands the full called party information using the AHYC message.

The basic procedures for the TSC and radio units are specified in sections 9.1 and 9.2 respectively. These procedures cover:

a) call set-up

- call request procedures for Simple calls
- instruction to send extended address information
- call cancellation while waiting for a call
- checking availability of radio units
- traffic channel allocation

b) call maintenance and call clear-down.

Other sections define related procedures (such as call diversion and Include call requests), and procedures for status messages, short data messages, data interrogation and emergency calls. Note particularly that status messages (RQQ - see section 13) are used for:

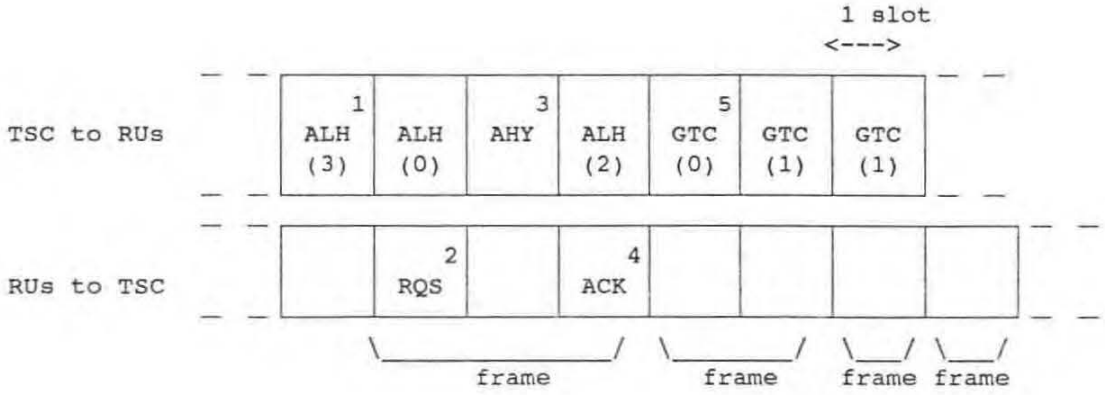
a) the "Called Party Answer" mechanism

b) cancellation of a requested speech call after the called unit has accepted the call for call-back.

Examples of typical message sequences to set up:

a) a short addressing call
b) an extended addressing call

between two radio units are illustrated below. Both sequences include the call request, availability check and channel allocation signalling. (In these examples, the TSC checks only that the called unit is in radio contact before allocating a traffic channel i.e. the called party answer mechanism is not employed.) The extended addressing example has an extra phase: after receiving the RQS message, the TSC sends AHYC to instruct the calling unit to transmit the full called address information.



Example A message sequence on a control channel to set up a common-prefix call between two radio units on the same site.

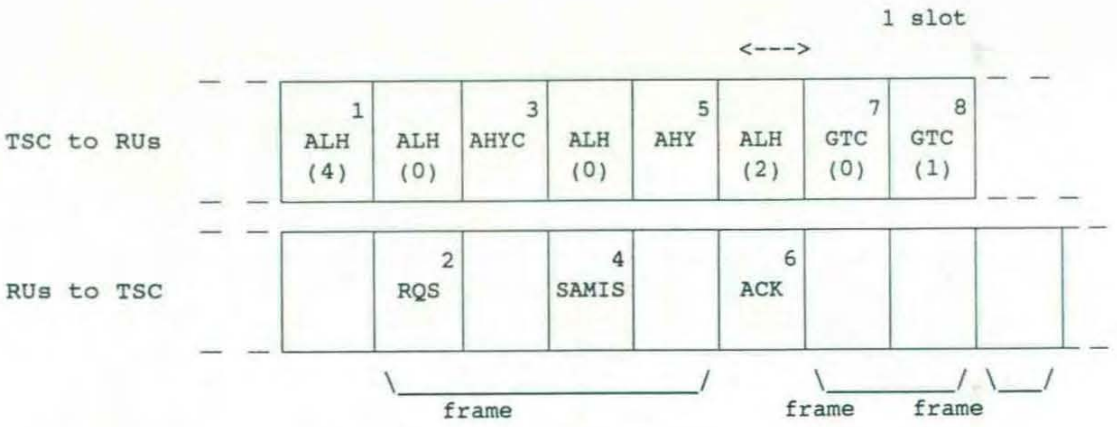
1. ALH : General Aloha invitation (three-slot frame).

2. RQS : Random access request for a Simple call.

3. AHY : Availability check message
   - acknowledges the RQS message
   - demands a response from the called radio unit
   - inhibits random access in the next slot.

4. ACK : Acknowledgement ACK(QUAL=0) from the called radio unit.

5. GTC : Go To Channel message instructing both radio units to switch to a designated traffic channel for their call. In this example the GTC is repeated immediately, for added reliability. (Note that repeat messages may be delayed for other signalling.)



Example A message sequence on a control channel to set up an interprefix call between two radio units on the same site.

1. ALH : General Aloha invitation (four-slot frame).

2. RQS : Random access request for an interprefix Simple call (IDENT1 set to IPFIXI).

3. AHYC : Short data invitation message
   - acknowledges the RQS message
   - instructs the calling unit to send the called address
   - inhibits random access in the next slot.

4. SAMIS : Single Address Message from the calling radio unit, containing the prefix and ident of the called unit.

5. AHY : Availability check message - demands a response from the called radio unit.
   In this example, the availability check is a single-codeword message i.e. the address of the calling unit is not supplied.

6. ACK : Acknowledgement ACK(QUAL=0) from the called radio unit.

7. GTC : Go To Channel message instructing the called radio unit to switch to a designated traffic channel for the call.

8. GTC : Go To Channel message instructing the calling radio unit to switch to the designated channel for the call.

9.1 Basic Call Procedures for TSC

This subsection describes the basic call facilities available for use by the TSC. However, note that the TSC is allowed a great deal of flexibility and it need not implement all these facilities. Also, system designers are left free to choose an appropriate strategy for scheduling messages on the control channel.

9.1.1 Basic TSC Procedures for Setting Up Calls

9.1.1.1 Responses to a short addressing RQS message

A radio unit requests a short addressing Simple call by generating an RQS message (with EXT = 1, or with EXT = 0 and IDENT1 set to a valid called party ident), complying with the random access protocol. On receiving a short addressing RQS message, the TSC shall send a response (so that the radio unit will not retransmit its message). The response may be sent in the slot following the RQS or it may be delayed; for acceptable delay, see 7.2.4.

The following messages are valid responses to a short addressing RQS message (though a TSC need not be able to provide all of these messages):

a. An acknowledgement ACKI, ACKQ, ACKX, ACKV or ACKB(QUAL=0), with PFIX/IDENT2 as the calling unit's individual address and IDENT1 as the called ident (or PABXI for a call to a PABX extension) - see 5.5.2.1.

b. An acknowledgement ACKT(QUAL=0), with PFIX/IDENT2 as the calling unit's individual address - see 5.5.2.1 and 9.1.1.4.

c. An AHY message (i.e. availability check) for this call - see 9.1.1.5 and 9.1.1.7.

d. A Go To Channel message GTC for this call, or a call with which this call has been amalgamated - see 9.1.1.9 and 9.1.1.12.

The response is thus a direct acknowledgement (as in a. and b.) or an indirect acknowledgement (as in c. and d.).

The acknowledgement messages may also be sent to the calling unit at appropriate times to indicate the progress of the call set-up - see 9.1.1.4.

9.1.1.2 Responses to an extended addressing RQS message

A radio unit requests an extended addressing Simple call by generating an RQS message (with EXT = 0 and IDENT1 = IPFIXI, PSTNGI or PABXI), complying with the random access protocol. On receiving an extended addressing RQS message, the TSC shall send one of the following responses, with the same prefix and idents as the RQS:

a. An acknowledgement ACKI(QUAL=1), ACKX or ACKV(QUAL=0).

b. AHYC (i.e. an instruction to send the full called address information).

For acceptable delay, see 7.2.4. See also 9.1.1.3 and 9.1.1.4.

9.1.1.3 Instruction to send extended address information

After receiving an extended addressing RQS message, the TSC may demand the full called address from the calling radio unit; it uses the AHYC message, with the same prefix and idents as the RQS and field DESC set to indicate the appropriate gateway (see 5.5.3.2.8). In the AHYC message, the SLOTS parameter shall be set to correspond to the request as follows:

For an interprefix or PABX call, SLOTS = '01'
For a general PSTN call, for up to 9 digits, SLOTS = '01'
for 10 to 31 digits, SLOTS = '10'.

The AHYC message instructs the calling unit to send the called party address information in the following SLOTS slot(s) (see 9.2.2.1). If the TSC does not successfully decode the address information, it may repeat the AHYC message or transmit ACKV(QUAL=0) to indicate failure of the call.

After decoding the full address information successfully, the TSC may send appropriate acknowledgements to the calling unit (see 9.1.1.4).

The TSC may send AHYC in any slot on the forward control channel. However, note that AHYC bars random access only in the next return slot. For SLOTS = '01', this is sufficient for the unit's response; however, for SLOTS = '10', the TSC shall take appropriate action to reserve the second return slot if it is within a random access frame (e.g. by sending the AHY message, with both idents set to DUMMYI, in the slot following the AHYC).

9.1.1.4 Acknowledgements sent to calling unit to indicate progress of Simple call

The TSC may send acknowledgement messages at appropriate times to indicate to a calling radio unit the progress of its Simple call - for idents in acknowledgements, see 5.5.2.1. (For extended addressing calls, only ACKI(QUAL=1), ACKX and ACKV(QUAL=0) are appropriate until the full address information has been obtained.) Note that the criteria for setting the maximum delay of repeats of acknowledgements ACKX, ACKV, ACKB and ACKT should take account of time-out TB (described in 9.2.1.4).

The TSC may send ACKI or ACKQ to indicate to a calling radio unit the progress of the signalling for its Simple call:

ACKI (QUAL=0) - Called unit alerting but user/ data equipment not ready.
ACKI (QUAL=1) - Intermediate acknowledgement; more signalling to follow.
ACKQ (QUAL=0) - All traffic channels in use. TSC has queued the call.
ACKQ (QUAL=1) - Conflicting call in progress (e.g. called unit engaged), or higher in queue. TSC has queued the call.

It may send ACKX or ACKV to indicate to the calling unit that its Simple call request will not be complied with:

ACKX (QUAL=0) - Invalid call e.g. calling unit is blacklisted, or called address is unobtainable, or called unit cannot accept the call.
ACKX (QUAL=1) - System overload; request rejected.
ACKV (QUAL=0) - Called unit not in radio contact or call set-up abandoned.

ACKV (QUAL=1) - Conflicting call in progress or higher in queue (and call has not been queued), or called user does not wish to receive this call.

It may send ACKB(QUAL=0) to indicate to the calling unit that its Simple call request has been accepted for call-back by the called unit.

If the TSC has previously accepted a diversion request RQT requesting that this type of call be redirected to another party, then it shall send ACKT(QUAL=0) with PFIX/IDENT2 as the calling unit's individual address and:

a. IDENT1 as the diversion ident, or
b. IDENT1 as a gateway (viz. IPFIXI, PSTNGI or PABXI); in this case, the diversion address follows in concatenated data codeword(s). Note that IDENT1 is set to IPFIXI to indicate either an interprefix diversion address or that the diversion address is of a different type (group/individual) from the called address; see 5.5.2.1.

(On receiving ACKT, the radio unit will either return to the idle state or re-attempt access calling the diversion address - see 9.2.1.4.)

9.1.1.5 Availability check on called radio unit

After receiving a request for an individual call to a radio unit, the TSC shall at least check that the called unit is in radio contact before making a traffic channel allocation; (the TSC is exempted from this requirement when operating in fall-back mode). The TSC may check also that the called user/ data equipment is ready for the call before allocating a channel.

The TSC checks availability of a called radio unit by sending the AHY message, with:

- bit POINT set to '0'
- bit CHECK set to indicate whether the TSC is checking:
  a) only that the called unit is in radio contact (CHECK=0), or
  b) that the called user/ data equipment is ready (CHECK=1)
- bits D and E set appropriately (see 5.5.3.2.1)
- PFIX/IDENT1 as the called unit's address
- IDENT2 as the calling ident (or gateway).

If IDENT2 = IPFIXI, the TSC may append a data codeword containing the calling unit's address; if so, it shall set bit AD in the AHY to '1' (and shall set flag RSA in the "filler" data codeword to '0' - see 7.2.5).

The AHY message demands a response from the called unit (see 9.2.2.2A). If the response is ACKI(QUAL=0), ACKX(QUAL=0), ACKV(QUAL=1) or ACKB(QUAL=0), the TSC may send appropriate acknowledgement(s) to a calling radio unit (see 9.1.1.4). If the TSC does not successfully decode a response, or if the response is ACKB(QUAL=1) or ACKI(QUAL=0), it may repeat the AHY message at intervals. If the called unit cannot be contacted, the TSC may indicate the failure to the calling unit by sending ACKV(QUAL=0).

After sending ACKI(QUAL=0) in response to an AHY message with CHECK = 1, a radio unit may attempt random access with RQQ(STATUS='00000') addressed to the TSC when its user/ data equipment is ready to receive the call. After responding with ACKI(QUAL=0) or ACK(QUAL=0), the unit may send RQQ(STATUS='11111') if its user no longer wishes to receive the call. The TSC shall send appropriate responses to these "off-hook" and "on-hook" RQQ messages; see 13.1.1.1.

Note that, if a radio unit is waiting for an incoming traffic channel call and receives an AHY message checking its availability for a different incoming traffic channel call, then it abandons any signalling for the first call and obeys the new AHY (see 9.2.2.2A, 9.2.2.4 and 13.1.2.8). Therefore, if the TSC sends an AHY message for a new call, it shall not send any further acknowledgements for any previous "off-hook" or "on-hook" RQQ message from the called unit. Note also that, if the TSC receives an "off-hook" or "on-hook" RQQ message from a called radio unit before it has received a response to an AHY message for the call, then the RQQ message could be for an old call.

9.1.1.6 Availability check for calls to PABX extensions and PSTN destinations

For calls to PABX extensions or onto the PSTN, the TSC may check that the called telephone has been answered before allocating a traffic channel. This check may be made either manually or automatically.

9.1.1.7 Availability check on requesting radio unit

The TSC may check the availability of a requesting radio unit by sending the AHY message, with:

- bit AD set to '0'
- bit POINT set to '1'
- bit CHECK set to '0'
- bits D and E set appropriately (see 5.5.3.2.1)
- PFIX/IDENT2 as the requesting unit's address
- IDENT1 as the called ident or gateway (or REGI for a registration request; see 8.2.1.3).

The AHY message demands a response from the requesting unit (see 9.2.2.3) and also instructs the unit to restart its waiting timer for the requested call or transaction. The message therefore has two functions:

a. To restart the unit's timer (TW or TJ), enabling the TSC to use a variable queueing time limit; for example, see 8.2.1.3, 9.1.1.10, 10.1.7, 12.1.7, 13.1.1.4, 13.2.1.7 and 14.1.9.

b. To check that the calling unit is still in radio contact, before a traffic channel is allocated for a call. (If the call will not be set up, the TSC may inform the called unit; see 9.1.1.8.)

9.1.1.8 Call cancellation

A calling radio unit may cancel a requested Simple call by generating an RQX message (see 5.5.3.1.3), complying with the random access protocol. On receiving an RQX message cancelling a Simple call, the TSC shall send a response. Valid responses are:

a. ACK(QUAL=1), with the same prefix and idents as the RQX.
b. AHYX, with the same prefix and idents as the RQX.

If a call is cancelled (for example, on the request of the calling unit or after an availability check on the calling unit or if the TSC's queueing time limit is exceeded), then the TSC may inform a called radio unit by sending the AHYX message with PFIX/IDENT1 as the called unit's address and IDENT2 as the calling ident (or gateway). The TSC may repeat the AHYX message if it is not acknowledged by an ACK(QUAL=1) message from the called unit (see 9.2.2.4).

If the TSC receives an RQX message on a control channel, and does not currently hold a corresponding call or transaction request from that unit, it shall send a response: ACK(QUAL=1), with the same prefix and idents as the RQX.

9.1.1.9 Call amalgamation

The TSC shall either amalgamate any (non-emergency) individual speech calls in its queues which are between the same parties, or refuse to accept more than one speech call between the same individuals. See also section 10.1.8b.

(The TSC shall not amalgamate speech calls to the same group, or data calls.)

9.1.1.10 Queue management and queue time-out

The TSC may order its queue of calls (non-priority and priority, between any parties) in any way acceptable to the system operator.

The TSC may operate a time-out on the maximum time for which it queues a call (for example, waiting for a traffic channel or for the called party to be free). See also 9.2.1.6 and 9.2.2.4.

The TSC may instruct a calling radio unit to restart its waiting timer, by sending the AHY message with bit POINT set to '1'; see 9.1.1.7 and 9.2.2.3. If a time TW, minus the tolerance on the radio unit's timer, elapses since the last message it received for a Simple call (from the calling unit), the TSC shall not send any further signalling for the call, except that it may send AHYX to inform a called radio unit that the call will not take place (see 9.1.1.8).

9.1.1.11 Resolving call conflicts

It is recommended that the TSC uses suitable rules to decide on priorities for resolving call conflicts. For instance:

a. it should not send an individually addressed GTC command to a radio unit that is known to be currently engaged in another call;

b. for a system-wide call, it may wait until all traffic channel activity has ceased before allocating a channel (so that the system-wide call can be heard by all powered-on units).

Similar conflicts may arise for group/subgroup calls. (Note, however, that the TSC is not required to know the membership of groups i.e. it need not check for call conflict involving individual called units in a group.)

9.1.1.12 Traffic channel allocation

The TSC shall allocate traffic channels using the Go To Channel message GTC (see 5.4). It shall set bit D in the GTC message to '0' when setting up a speech call or to '1' when setting up a data call (e.g. a Simple call requested with bit DT set to '1'). It may repeat the GTC command.

In the case of a multi-site call on a system employing time-shared control channels where the calling and called parties are active on the same control channel, the GTC to the calling party may contain DUMMYI in IDENT1 and the GTC to the called party may contain DUMMYI in IDENT2.

In the case of an interprefix call between radio units, at least two GTC messages must be transmitted: one to instruct the called unit (or group) and one to instruct the calling unit. For a multi-site call, these GTC messages may be sent at different sites.

Note that a called radio unit in an interprefix call is permitted to remain on the control channel for one timeslot after receiving GTC, to see whether the next message is a GTC for the calling unit; see 9.2.2.5. It is recommended that the TSC schedules GTC messages appropriately.

9.1.2 Basic TSC Procedures for Maintenance and Clear-Down of Calls

It should be noted that the transmission of standardised messages on a traffic channel during a call requested with RQS, DT=1 could corrupt non-prescribed data signalling. It is recommended that any use of the facilities described below takes this into account.

9.1.2.1 Call maintenance options

All speech items transmitted by radio units on an allocated traffic channel end with at least one Pressel Off message (see 9.2.3.1). The TSC may also require that any radio unit which transmits a speech item shall start the item with at least one Pressel On message, and that the unit shall interrupt the item at intervals to send a call maintenance message. The TSC indicates activation or deactivation of these options, the maximum duration of the interval and the required setting of PFIX/IDENT1 for call maintenance messages in group calls, by sending the BCAST message with SYSDEF='00010' (see 5.5.4.5c) on the control channel.

9.1.2.2 Availability check on a traffic channel

During a call, when appropriate, the TSC may query whether an individual radio unit is on the traffic channel by sending (on the traffic channel) an AHY message with bit AD = 0 and:

POINT = 0 and PFIX/IDENT1 as the unit's individual address
or POINT = 1 and PFIX/IDENT2 as the unit's individual address.

The AHY message demands an acknowledgement from the addressed radio unit; see 9.2.3.2.

Note that the AHY message with POINT set to '1' (and IDENT1 set to the called ident or gateway) may be sent to instruct an Including unit to restart its waiting timer TI. See section 11.1.7.

9.1.2.3 Disabling user transmission

During a call, the TSC may send call maintenance message MAINT, OPER='111' on the traffic channel to instruct radio units to inhibit user transmission; see 5.5.4.2 and 9.2.3.3. It can disable individually addressed units, called units in a group or all radio units.

For instance, the TSC may send this message at the start of a group call if the calling unit requested that the called users be disabled from replying.

9.1.2.4 Allocating replacement traffic channel

During a call, the TSC may send GTC messages on the traffic channel to move radio units already in communication to a replacement traffic channel; see 5.4 and 9.2.3.4. (For instance, the TSC could send this message if one traffic channel has special facilities and an emergency call requiring these facilities is requested when the channel is in use for another call.)

Note that the TSC may send MAINT, OPER='111' during an item to disable radio users from replying, and then send GTC at the end of the item. Receipt of the GTC message re-enables user transmission on the replacement channel (unless IDENT1 = ALLI); see 9.2.3.4.

9.1.2.5 Clearing down unwanted radio units during a call

During a call, the TSC may send call maintenance message MAINT, OPER='110' on the traffic channel to clear down any radio units that should not be there. The address (PFIX/IDENT1) in the message "labels" the ongoing call, so that only unwanted radio units leave the channel; see 5.5.4.2 and 9.2.3.7.

Note that:

a. If radio units with different prefixes are occupying the traffic channel then transmission of MAINT, OPER='110' would clear units with the other prefix.

b. After an Include call, the use of MAINT, OPER='110' could clear the included party.

9.1.2.6 Call clear-down

The TSC shall clear down a call in which the Include facility has not been used if any one of the following criteria is satisfied; (after an Include call, criteria a. and b. may be relaxed as specified in 11.1.9):

a. If it receives a valid Disconnect message (indicating the end of channel use) on the return traffic channel, from either unit in an individual call or from the calling unit in a group/system-wide call; see 5.5.4.2 and 9.2.3.5.

b. If either party in an individual call is a line/PABX/PSTN user, or if the calling party in a group/system-wide call is a line/PABX/PSTN user, and the TSC detects appropriate indication (from the line unit/PABX/PSTN) that the call has ended.

c. If the time without apparent transmission (e.g. without detected carrier, without receiving valid call maintenance messages or without receiving a response to availability checks) is excessive.

d. If an overall TSC call time limit is reached.

Also, if required by the type of system, the TSC may clear down a system-wide call or a group call in which the called users have been disabled from replying, if it receives a valid Pressel Off message from the calling unit.

The TSC shall clear down a call by sending at least two CLEAR messages on the forward traffic channel; see also 3.3.2, 5.5.4.3 and 9.2.3.8.

9.2 Basic Call Procedures for Radio Units

It is recommended that a radio unit be equipped with a ready-for-communication control (RFCC) e.g. a switch-hook. Optionally the unit may be equipped with a "Busy control" which, if in the busy state, shall override an active RFCC state.

A radio unit attempting access or waiting for further signalling for a call may be sent an availability check message AHY or Go To Channel message GTC for an incoming call (see 9.2.2.2A and 9.2.2.5). Note that:

i) If the unit were to transmit ACKI(QUAL=0) in response to an AHY message with CHECK = 1, then it would not be able to send the "off-hook" message until its own call had been completed.

ii) The unit can reject an incoming individual call by sending ACKV(QUAL=1) in response to the AHY message.

iii) A radio unit is required to obey individually addressed GTC messages and system-wide calls (except in emergency), though it may ignore other group call GTCs if the user does not wish to receive group calls.

However, if making a call of its own, the unit is required to ignore GTC messages for incoming group calls (except calls to a group the unit is itself attempting to call); see 9.2.2.5. (This rule applies also to a unit that has received an AHY message for an incoming individual call and responded with ACK(QUAL=0) or ACKI(QUAL=0).)

iv) If a unit receives and obeys a GTC message not for its own call, it returns to its previous state at the end of the incoming call, unless the time-out (e.g. TW or TJ) on the previous state has expired. (Note however that, if the unit was making a call of its own, then it may attempt cancellation/abortion if the user no longer wants his call.)

9.2.1 Procedures for Radio Units Making Simple Calls

A radio unit shall make only one call attempt at a time (except in emergency); while attempting access or waiting for further signalling for its Simple call, the unit shall not request another non-emergency call of any type (unless the user first cancels the original call).

Radio units can request calls to most PABX extensions using short addressing; in the RQS message, IDENT1 is the extension number, EXT = 1 and FLAG1/FLAG2 indicates the appropriate exchange (see sections 4 and 5.5.3.1.1). All other messages sent during the call set-up use the PABX gateway ident, PABXI.

By prearrangement with the system, radio units may request calls to a limited number of PSTN destinations using short addressing; IDENT1 in the RQS message is set to the appropriate short-form PSTN ident (see section 4).

Radio units use extended addressing procedures to request interprefix calls, general calls to the PSTN and calls to PABX extensions with "long" numbers; IDENT1 in the RQS message is set to the appropriate gateway and the unit then sends the full called address information in response to an AHYC message from the TSC.

9.2.1.1 Request for a Simple call

A radio unit requests a Simple call by sending an RQS message on a control channel, complying with the random access protocol (see 7.3). The fields in the RQS message shall be set appropriately (see 5.5.3.1.1); however, note particularly that:

a. Bit DT specifies whether the caller is requesting a speech call (DT=0) or a channel for sending non-prescribed data (DT=1).

b. An extended addressing request is indicated by setting IDENT1 in the RQS message to the appropriate gateway (viz. IPFIXI, PSTNGI or PABXI).

The unit shall attempt access until:

i) it receives a valid response (see 9.2.1.2/3), or
ii) its user cancels the call (see 9.2.1.7), or
iii) the access attempt fails (i.e. the unit has sent the maximum number of transmissions NR and received no response, or its access time-out TC has expired (see 7.3.8)). In this case:

- If the unit has not sent a request, it shall return to the idle state (and may indicate the failure to the user).
- Otherwise, the unit shall wait for further signalling for the call; see 9.2.1.4 to 9.2.1.6. (As usual, the unit may attempt cancellation while waiting; see 9.2.1.7.)

If the user tries to initiate another non-emergency call of any type or re-initiate the same call (without first cancelling it) while his unit is trying to access the system, the unit shall ignore the command.

9.2.1.2 Valid responses to short addressing RQS

For a short addressing call, the calling unit shall accept the following messages as a valid response to its RQS and send no more requests:

a. An acknowledgement ACKI, ACKQ, ACKX, ACKV or ACKB(QUAL=0), with PFIX/IDENT2 as its individual address and IDENT1 as the called ident (or PABXI if it is making a PABX call).

b. An acknowledgement ACKT(QUAL=0) with PFIX/IDENT2 as its individual address. See also 9.2.1.4.

c. An AHY message with PFIX/IDENT2 as its individual address and IDENT1 as the called ident (or PABXI for a PABX call).

d. A Go To Channel message GTC with PFIX/IDENT2 as its individual address and IDENT1 as the called ident (or PABXI for a PABX call, or DUMMYI for a multi-site call on a system employing time-shared control channels).

e. In response to an RQS with DT=0 and EXT=0: a GTC message with D=0, PFIX/IDENT1 as its individual address and IDENT2 as the called ident. Note: this is a check for call amalgamation.)

For other actions on receiving these messages, see sections 9.2.1.4, 9.2.1.5, 9.2.2.3 and 9.2.2.5.

9.2.1.3 Valid responses to extended addressing RQS

For an extended addressing call, the calling unit shall accept the following messages (with the same prefix and idents as the RQS) as a valid response to its RQS and send no more requests:

a. An acknowledgement ACKI(QUAL=1), ACKX or ACKV(QUAL=0).

b. AHYC (i.e. an instruction to send the full called address information).

For other actions on receiving these messages, see 9.2.1.4 and 9.2.2.1.

9.2.1.4 Acknowledgement received

If a radio unit attempting access or waiting for further signalling for a Simple call receives an appropriate acknowledgement then it shall take action as indicated below. Appropriate acknowledgements for a short addressing call, or for an extended addressing call after the full address information has been sent, are:

- ACKI, ACKQ, ACKX, ACKV and ACKB(QUAL=0), with PFIX/IDENT2 as the unit's individual address and IDENT1 as the called ident or gateway;
- ACKT(QUAL=0) with PFIX/IDENT2 as the unit's individual address.

Appropriate acknowledgements for an extended addressing call before the full address information has been sent are ACKI(QUAL=1), ACKX and ACKV(QUAL=0), with PFIX/IDENT2 as the unit's individual address and IDENT1 as the called gateway.

ACKI (QUAL=0)	-	Called unit alerting but user/ data equipment not ready.
ACKI (QUAL=1)	-	Intermediate acknowledgement; more signalling to follow.
ACKQ (QUAL=0)	-	All traffic channels in use. TSC has queued the call.
ACKQ (QUAL=1)	-	Conflicting call in progress (e.g. called unit engaged), or higher in queue. TSC has queued the call.
ACKX (QUAL=0)	-	Invalid call; request rejected.
ACKX (QUAL=1)	-	System overload; request rejected.
ACKV (QUAL=0)	-	Called unit not in radio contact or call set-up abandoned.
ACKV (QUAL=1)	-	Conflicting call in progress or higher in queue (and call has not been queued), or called user does not wish to receive this call.
ACKB (QUAL=0)	-	Called unit has accepted the call for call-back.
ACKT (QUAL=0)	-	Called party's calls have been diverted.

If ACKI or ACKQ is received, the unit shall wait for further signalling for the call and may indicate to the user the progress of the call.

If ACKX or ACKV is received, the unit shall return to the idle state and may indicate to the user the reason for the failure of the call; it is recommended that receipt of ACKX(QUAL=0) be indicated in a distinct manner.

If ACKB(QUAL=0) is received, the unit shall return to the idle state and may indicate to the user that the call has been accepted by the called unit for call-back. If, after receiving ACKB(QUAL=0), the user wishes to

withdraw the request, then cancellation may be attempted using an RQQ message with STATUS='11111' (addressed to the called unit); see section 13.

If a complete ACKT(QUAL=0) message is received, the unit shall either:

a. return to the idle state (and may indicate to the user that the called party's calls have been diverted), or

b. wait for a time TB (see below), and then attempt a new call to the diversion address given in the ACKT message:
   - if IDENT1 / IPFIXI, PSTNGI or PABXI, try on IDENT1;
   - if IDENT1 = IPFIXI, PSTNGI or PABXI, try the alternative called party given in the appended data codeword(s).

   Note that ACKT(QUAL=0), with IDENT1 = IPFIXI and an appended data codeword, indicates either an interprefix diversion address or that the diversion address is of a different type from the original called address. Flag GF in the appended data codeword specifies whether the diversion address is an individual or group address; see 5.5.2.1.

If an incomplete ACKT(QUAL=0) message is received (i.e. if not all the appended data codewords are decodeable), then:

i) If the unit does not require the diversion address, it shall return to the idle state (and may give an indication to the user).

ii) If the unit does require the diversion address then:
   - if still attempting access for the call, it shall ignore the message and continue to attempt access;
   - otherwise it shall wait for a repeat ACKT, returning to the idle state if a time TB elapses (in which case, it may indicate the failure to the user).

After receiving ACKX, ACKV or ACKB for its Simple call, the unit shall not request another non-emergency call of any type to the same called ident for at least a time TB; (note that this includes a call to the same gateway). After receiving ACKT for its Simple call, the unit shall not request another non-emergency call of any type for at least a time TB.

9.2.1.5 Availability check and channel allocation for own call

A calling radio unit attempting access or waiting for further signalling for a Simple call shall obey the availability check and channel allocation procedures (see 9.2.2.2 to 9.2.2.5). It shall decide whether a GTC message it receives is for its requested call by inspecting the prefix and idents and bit D from the GTC message:

a. for a short addressing call, as in 9.2.1.2 d. and e.

b. for any extended addressing call, if PFIX/IDENT2 is its individual address and IDENT1 is the called gateway

c. for an interprefix speech call, if:
   - D=0, PFIX/IDENT1 is its individual address and IDENT2 is IPFIXI, and
   - it receives a GTC message for the caller in the next slot (see 9.2.2.5a) and PFIX/IDENT2 is the address the unit is calling.

   (Note: this is a check for call amalgamation.)

If so, it may give an indication to the user, and shall revert to the idle state at the end of the call.

9.2.1.6 Time-out after waiting

A calling radio unit waiting for further signalling for a Simple call shall return to the idle state if a time TW has elapsed since the last message it sent for the call, viz.

RQS, requesting the Simple call (see 9.2.1.1)
or SAMIS, providing extended address information for the call (see 9.2.2.1)
or ACK(QUAL=0), sent in response to an AHY message with bit POINT = 1 and IDENT1 as the called ident or gateway (see 9.2.2.3).

It may also indicate the failure to the user.

If the user tries to initiate another non-emergency call of any type or re-initiate the same call (without first cancelling it) while his unit is waiting for signalling for the call, the unit shall ignore the command.

9.2.1.7 Call cancellation

If the user wishes to cancel his Simple call and the unit has not yet sent an RQS, then it shall return immediately to the idle state. Otherwise, if the unit has sent an RQS, it shall attempt to send a call cancellation request RQX (see 5.5.3.1.3), complying with the random access protocol (see 7.3). It shall attempt access until one of the following occurs:

a. It receives ACK(QUAL=1) or AHYX, with the same prefix and idents as the RQX, confirming cancellation of the call.

b. It receives ACKX, ACKV or ACKT(QUAL=0) for the call it is attempting to cancel. See also 9.2.1.4.

c. It receives ACKB(QUAL=0) for the call it is attempting to cancel; in this case, it may indicate to the user that the call has been accepted for call-back and that the cancellation was unsuccessful. (Withdrawal of the request may then be attempted using an RQQ message with STATUS='11111', addressed to the called unit; see section 13.)

d. It receives a GTC message for the call it is attempting to cancel; in this case, it shall proceed to the designated traffic channel (see 9.2.2.5) and then revert to the idle state at the end of the call.

e. It has sent the maximum number of transmissions NR and received no response, or its access time-out TC has expired (see 7.3.8). In this case, it shall return to waiting for signalling for the Simple call (see 9.2.1.4 to 9.2.1.6).

In cases a., b. and c., the unit shall return to the idle state.

If the user tries to "cancel" a call when his unit is not attempting access or waiting for signalling for a call, the unit shall ignore the command.

9.2.2 Basic Procedures for All Radio Units on a Control Channel

These procedures shall be obeyed by all radio units on a control channel (including units making calls or requesting transactions). For other procedures for all radio units on a control channel, see sections:

6.2.1	Control channel discipline.
7.4	Individually addressed Aloha message and MOVE message.
8.	Registration procedures.
13.2.3	Receiving status message (AHYQ).
14.3	Receiving short data message (HEAD).
15.2	Data interrogation procedures.

9.2.2.1 Instruction to send address information or data message

This procedure shall be obeyed by all radio units that are equipped to request extended addressing calls, complex diversion or RQC transactions.

If a radio unit on a control channel receives an AHYC message with PFIX/IDENT2 matching its individual address then it shall either send address information or a data message in the following SLOTS slot(s), or transmit ACKX(QUAL=0), as indicated below. For timing, see 6.2.1.3.

If
the unit has sent an extended addressing non-emergency request,
or has received ACKE or AHY(E=1) for an extended addressing RQE
and IDENT1 matches IDENT1 from the request
and DESC is appropriate to IDENT1 (see 5.5.3.2.8)
and SLOTS corresponds to the request
(i.e. if IDENT1=PSTNGI and FLAG1=1 then SLOTS='10' else SLOTS='01')

then it shall transmit the full address information for IDENT1, conforming to the codeword formats defined in section 5.6.1.2.2 (SAMIS, Mode 1).

Otherwise
If
the unit has sent a request for 3-address diversion (RQT, FLAG2=1)
and IDENT1 is set to DIVERTI
and DESC is set to '000'
and SLOTS is set to '01'

then it shall transmit the "blocked address", conforming to the interprefix codeword format defined in section 5.6.1.2.2 (SAMIS, Mode 1, DESC='000').

Otherwise
If
the unit has sent an RQC message
and IDENT1 is set to SDMI
and DESC is set to '000'
and SLOTS matches SLOTS from the RQC

then it shall transmit its short data message, conforming to the codeword formats defined in section 5.6.2 (HEAD).

Otherwise
The unit shall transmit ACKX(QUAL=0), with the same prefix and idents as the AHYC.

9.2.2.2 Availability check on called radio unit

If a radio unit on a control channel receives an AHY message with PFIX/IDENT1 matching its individual address and bit POINT set to '0' then it shall respond with the appropriate acknowledgement (see below), with the same prefix and idents as the AHY. If bit AD = 0 in the AHY message, the unit shall respond in the slot following the AHY; if bit AD = 1, a data codeword is appended (containing the calling address) and the unit shall respond in the slot following the data codeword. For timing, see 6.2.1.3.

A) Incoming traffic channel call : IDENT2 = Ident (1 to 8100), Ident (8121 to 8180), INCI, IPFIXI, PSTNGI or PABXI

If bit AD = 1 in the AHY message but the appended data codeword was not decodeable and the unit requires the calling address for its operation, then it may request a retransmission by sending ACKB(QUAL=1):

ACKB (QUAL=1) - The unit requires the message to be retransmitted.

Otherwise

The unit may reject the incoming call by sending ACKX(QUAL=0) or ACKV(QUAL=1):

ACKX (QUAL=0) - The unit cannot accept the call
e.g. D = 0 in the AHY message and the unit has no speech equipment, or
D = 1 in the AHY message and the unit has no data equipment.

ACKV (QUAL=1) - The user has indicated that he does not wish to receive this call (e.g. using the "Busy control").

Otherwise

If bit D = 0 in the AHY message and IDENT2 is not set to INCI, the unit may accept the call for call-back by sending ACKB(QUAL=0):

ACKB (QUAL=0) - The unit has accepted the call for call-back.

Otherwise

i) If bit CHECK = 0 in the AHY message, then the unit shall send ACK(QUAL=0):

ACK (QUAL=0) - Unit is available for the call.

ii) If bit CHECK = 1 in the AHY message, then the unit shall send either ACKI(QUAL=0) or ACK(QUAL=0), to indicate its state of readiness so far as it is able. For ACKI(QUAL=0), the unit shall alert the user or take action to prepare the data equipment.

ACKI (QUAL=0) - Unit alerting but user/ data equipment not ready
e.g. D = 0 in the AHY message and the unit's RFCC is not currently active, or
D = 1 in the AHY message and the unit's data equipment is not ready.

ACK (QUAL=0) - User/ data equipment is available for the call.

The unit may indicate the caller (by reference to PFIX/IDENT2 from the AHY message or PFIX2/IDENT2 from the data codeword), and may indicate whether the incoming call is an emergency call (by reference to bit E from the AHY).

After receiving an AHY message for an incoming traffic channel call and responding with ACK(QUAL=0) or ACKI(QUAL=0), the unit shall ignore group call GTC messages as specified in section 9.2.2.5 rule 2 or 3, until either:

a. it receives channel allocation signalling for the incoming call (i.e. a GTC message with the same prefix, idents and bit D as the AHY), or
b. it assumes that the call will not take place; see 9.2.2.4.

If a radio unit receives AHY(CHECK=1) alerting it for an incoming call and responds with ACKI(QUAL=0), it may attempt to send RQQ(STATUS='00000') to the TSC when its user/ data equipment is ready to receive the call. After responding with ACKI(QUAL=0) or ACK(QUAL=0), it may send RQQ(STATUS='11111') if the user no longer wishes to receive the call; in this case, it shall respond to any further AHY messages with ACKV(QUAL=1). See also 13.1.2.1.

If, while waiting for an incoming traffic channel call, a radio unit receives a repeat AHY, it shall send the appropriate acknowledgement and continue with any "off-hook" or "on-hook" signalling in progress; also, for ACK(QUAL=0) or ACKI(QUAL=0), it shall restart its timer TA (see 9.2.2.4). If the unit receives an AHY for a different incoming traffic channel call, it shall abandon any signalling for the old call and obey the new AHY; see also 9.2.2.4 and 13.1.2.8.

B) Availability check for short data message : IDENT2 = SDMI

The unit may reject the short data message by sending ACKX(QUAL=0) or ACKV(QUAL=1). Otherwise it shall send ACK(QUAL=0).

ACKX (QUAL=0) - The unit cannot accept the short data message e.g. it has no data equipment.
ACKV (QUAL=1) - The user has indicated that he does not wish to receive short data messages.
ACK (QUAL=0) - Unit is available to receive a short data message.

C) "No-call" test availability check : IDENT2 = DUMMYI

The unit may indicate that it is not suitably equipped by sending ACKX(QUAL=0). Otherwise it shall send ACK(QUAL=0).

ACKX (QUAL=0) - The unit could not accept a call of this type
e.g. D = 0 in the AHY message and the unit has no speech equipment, or
D = 1 in the AHY message and the unit has no data equipment.
ACK (QUAL=0) - Unit is in radio contact and is suitably equipped.

D) Invalid availability check : IDENT2 / Ident (1 to 8100), IDENT2=Ident(8121 to 8180), INCI, IPFIXI, PSTNGI, PABXI, SDMI or DUMMYI

The unit shall send ACKX(QUAL=0), to reject the availability check.

9.2.2.3 Availability check on requesting radio unit

If a radio unit on a control channel receives an AHY message with PFIX/IDENT2 matching its individual address and bit POINT set to '1' then it shall respond with the appropriate acknowledgement (see below), with the same prefix and idents as the AHY. If bit AD = 0 in the AHY message, the unit shall respond in the slot following the AHY; if bit AD = 1, a data codeword is appended and the unit shall respond in the slot following the data codeword. For timing, see 6.2.1.3.

ACK (QUAL=0) - The unit is waiting for signalling for a call or transaction appropriate to IDENT1 and bit E i.e.
a. IDENT1 is the called ident or gateway (or REGI for a registration request)
b. E is '1' for an emergency call, otherwise '0'; see section 5.5.3.2.1.
See also sections 8.2.2.4, 9.2.1.6, 10.2.7, 12.2.5, 13.1.2.5, 13.2.2.5 and 14.2.6.

ACKX (QUAL=0) - The unit is not waiting for signalling for a call or transaction appropriate to IDENT1 and bit E.

9.2.2.4 Cancelling alert/waiting state of called unit

If a radio unit on a control channel receives an AHYX message with PFIX/IDENT1 matching its individual address then it shall respond in the next slot with ACK(QUAL=1), with the same prefix and idents as the AHYX.

A unit that has received an AHY message for an incoming traffic channel call (see 9.2.2.2A), and responded with ACK(QUAL=0) or ACKI(QUAL=0), shall assume that the call will not take place if one of the following occurs:

a. It has not received channel allocation signalling for the call at a time TA after the last ACK(QUAL=0) or ACKI(QUAL=0) it sent in response to an AHY for the call.

b. It receives an AHYX message with the same prefix and idents as the AHY. In this case, if currently attempting an "off-hook" or "on-hook" RQQ transaction for the incoming call, it shall return to the idle state - see 13.1.2.7.

c. It receives an AHY message checking its availability for a different incoming traffic channel call (i.e. bit D and/or bit E and/or the calling address is different from the original AHY). In this case, if currently attempting an "off-hook" or "on-hook" RQQ transaction for the original call, it shall abandon the transaction - see 13.1.2.8.

In cases a. and b., the unit shall stop the alerting signal (if appropriate) and may indicate to the user/ data equipment that the call will not take place; it shall also note that rule 2 or 3 of section 9.2.2.5 (requiring it to ignore GTC messages for incoming group calls) no longer applies. In case c., the unit shall obey the procedures in 9.2.2.2A for the new call.

9.2.2.5 Traffic channel allocation

A radio unit on a control channel shall check all GTC messages it receives to see whether the message is addressed to it, that is, whether:

PFIX/IDENT2 from the GTC message matches its individual address
or PFIX/IDENT1 matches any of its designated addresses for this system
or IDENT1 is the system-wide all-call ident ALLI.

If the GTC message is addressed to it, the unit shall use the appropriate rule below to decide whether to obey the command:

1. If the unit is making an emergency (RQE) call and has not received ACKE(QUAL=0) or AHY(E=1) for its call, it shall obey the GTC message if and only if its emergency call is a short addressing non-PABX call and the GTC message is for the requested call (see 10.2.2 and 10.2.6).

   If the unit is waiting for further signalling for its emergency call, after receiving ACKE(QUAL=0) or AHY(E=1) for the call, it shall obey the GTC message if and only if it is individually addressed by the GTC (i.e. its individual address is PFIX/IDENT1 or PFIX/IDENT2).

2. Otherwise
   If the unit is waiting for an incoming emergency call (see 9.2.2.2A), it shall obey the GTC message if and only if it is individually addressed by the GTC.

3. Otherwise
   If the unit is waiting for an incoming non-emergency traffic channel call (see 9.2.2.2A), it shall obey the GTC message if and only if it is individually addressed by the GTC or IDENT1 is set to ALLI.

4. Otherwise
   If the unit is attempting access or waiting for further signalling for a non-emergency call or transaction, it shall obey the GTC message if and only if:

   it is individually addressed by the GTC message,
   or IDENT1 is set to ALLI,
   or PFIX/IDENT1 is one of the unit's group addresses, and
   the unit is attempting to call that group, and
   the user wishes to receive group calls, and
   the unit knows that it is not the calling unit (see below).

   (Thus, if making an interprefix group call, a radio unit shall ignore GTC messages containing the requested group address and the requested bit D unless it receives a GTC message for the calling unit in the next slot (see a. below) and finds that it is not the calling unit. If it is the calling unit, it obeys the individually addressed GTC message.)

5. Otherwise (i.e. if not waiting for any call or transaction)
   The unit shall obey the GTC message if:

   it is individually addressed by the GTC message,
   or IDENT1 is set to ALLI,
   or PFIX/IDENT1 is one of the unit's group addresses
   and the user wishes to receive group calls.

If the unit is required to obey the GTC command, it shall perform the following actions:

a. It shall tune to the designated forward traffic channel, obeying the following timings:

   - If IDENT2 / IPFIXI, the unit shall be able to receive on the traffic channel within 35 ms after the end of the GTC message.

   - If IDENT2 = IPFIXI, the unit shall be able to receive on the traffic channel within 142 ms after the end of the GTC message; (this allows a called radio unit in an interprefix call to remain on the control channel for one timeslot after receiving GTC, to extract the caller's address if the next message is a GTC for the calling unit).

b. It shall note PFIX, IDENT1 and IDENT2 from the GTC message and also the channel number of the control channel (for use in obeying the procedures in sections 9.2.3.1, 9.2.3.3, 9.2.3.5, 9.2.3.6 and 9.2.3.7).

c. If bit D from the GTC message is '0', then the unit shall unmute the audio (for speech communication). If bit D is '1', the unit shall mute the audio (for data communication) and shall note that it need not send call maintenance messages within items (unless required by the system by prearrangement).

d. If IDENT1 from the GTC message is ALLI and PFIX/IDENT2 from the GTC message is not its individual address, then the unit shall inhibit user transmission on the traffic channel. Otherwise it shall enable user transmission on the traffic channel.

It may also give an indication to the user. This may include an indication of the caller on the called party's unit. Such an indication should be derived from any availability check performed for the call. However if the contents of IDENT2 of the GTC message differ from the contents of IDENT2 in the AHY availability check and are not DUMMYI, the indication should be derived from IDENT2 of the GTC message.

If the unit does not obey a GTC message (or, for IDENT2 = IPFIXI, a GTC message in the next slot), and the designated traffic channel is the control channel on which the message was received, then the unit shall return to the control channel acquisition procedures (see 6.2.1.1).

9.2.2.6 Storing call maintenance parameters

A radio unit shall store the call maintenance parameters specified by the most recent broadcast message BCAST, SYSDEF='00010' it has received referring to the system it is currently using. These parameters indicate:

a. whether the system requires that a radio unit on an allocated traffic channel shall send Pressel On messages at the start of each speech item it transmits (the number of messages is specified in 9.2.3.1);

b. whether radio units shall send messages periodically within speech items and, if so, the maximum interval (in seconds) between the start

of the item and the first periodic message, and then between subsequent periodic messages;

c. whether a called unit in a group shall set PFIX/IDENT1 in MAINT messages it sends to its individual address or to the group address from the GTC message.

See also 5.5.4.2, 5.5.4.5c and 9.2.3.1. At the start of a session, until it receives a BCAST, SYSDEF='00010' message, the unit shall:

- send Pressel On messages
- send periodic messages with a maximum interval TP
- set PFIX/IDENT1 to the group address (when it is a called unit in a group).

9.2.3 Procedures for All Radio Units on an Allocated Traffic Channel

These procedures shall be obeyed by all radio units on an allocated traffic channel (except when exempted by emergency call procedures agreed with the system - see 10.2.8). For other procedures for all radio units on a traffic channel, see sections:

6.2.2	Traffic channel discipline.
11.3	Instruction to send extended address information.
15.2	Data interrogation procedures.

9.2.3.1 Call maintenance messages

During a speech call (see 9.2.2.5 and 9.2.3.4), a radio unit shall send the following call maintenance messages within speech items:

a. If required by the system (see 9.2.2.5 and 9.2.3.4), the radio unit shall send a minimum of one Pressel On message (MAINT, OPER='000') at the start of each speech item it transmits. If defined by the system the radio unit may send NPON messages. When NPON is not defined it shall default to the value 1. Where more than one message is sent the form of transmission specified in 3.3.2 shall be used.

b. If required by the system, the radio unit shall send periodic messages (MAINT, OPER='010') within each speech item it transmits. See 9.2.2.6 for the maximum interval between periodic messages.

c. The radio unit shall send a minimum of one Pressel Off message (MAINT, OPER='001') at the end of each speech item it transmits, as the last signal before retuning to the forward traffic channel. If defined by the system the radio unit may send NPOFF messages. Where NPOFF is not defined it shall default to the value 1. Where more than one message is sent the form of transmission specified in 3.3.2 shall be used.

PFIX/IDENT1 in MAINT messages sent by a radio unit is the unit's individual address if it was individually addressed by the GTC message; otherwise (i.e. for a called unit in a group), PFIX/IDENT1 shall be set to either the unit's individual address or to the group address (PFIX/IDENT1) from the GTC message, as required by the system - see 9.2.2.5 and 9.2.2.6.

(During a data call, a radio unit need not send the above messages, unless required by the system by prearrangement.)

9.2.3.2 Availability check on a traffic channel

If a radio unit on a traffic channel receives an AHY message with:

PFIX/IDENT1 matching its individual address and POINT = 0
or PFIX/IDENT2 matching its individual address and POINT = 1

then it shall respond with the appropriate acknowledgement (see below), with the same prefix and idents as the AHY. If bit AD = 0 in the AHY message, the unit shall time its response from the end of the AHY address codeword; if bit AD = 1, a data codeword is appended and the unit shall time its response from the end of the data codeword. For timing, see 6.2.2.2.

a. If POINT = 0, the unit shall send ACK(QUAL=0).

ACK (QUAL=0) - The unit is in radio contact.

b. If POINT = 1, the unit shall send ACK(QUAL=0) or ACKX(QUAL=0):

ACK (QUAL=0) - The unit is waiting for signalling for an Include call appropriate to IDENT1 (i.e. IDENT1 is the called ident or gateway). See also section 11.2.5.

ACKX (QUAL=0) - The unit is not waiting for signalling for an Include call appropriate to IDENT1.

9.2.3.3 Disabling user transmission

If a radio unit on a traffic channel receives a call maintenance message MAINT, OPER='111' with channel number (CHAN) equal to the number of the traffic channel and an applicable address, then it shall inhibit user transmission while it is tuned to this traffic channel (i.e. it shall disable the pressel for a speech call or inhibit user data for a data call).

The address (PFIX/IDENT1) from the MAINT message is applicable if:

a. PFIX/IDENT1 matches the unit's individual address, or
b. PFIX/IDENT1 is equal to PFIX/IDENT1 from the GTC message and the unit is not the calling party, or
c. IDENT1 is equal to ALLI.

9.2.3.4 Replacement of traffic channel

If a radio unit on a traffic channel receives a GTC message with:

PFIX/IDENT2 from the GTC message matching its individual address
or PFIX/IDENT1 matching any of its designated addresses for this system
or IDENT1 set to the system-wide all-call ident ALLI

then it shall perform the following actions:

i) It shall tune to the designated forward traffic channel and shall be able to receive within 35 ms after the end of the GTC message.

ii) If bit D from the GTC message is '0', then the unit shall unmute the audio (for speech communication). If bit D is '1', the unit shall mute the audio (for data communication) and shall note that it need not send call maintenance messages within items (unless required by the system by prearrangement).

iii) If IDENT1 from the GTC message is ALLI and PFIX/IDENT2 from the GTC message is not its individual address, then the unit shall inhibit user transmission. Otherwise it shall enable user transmission. (See also 11.2.7c.)

When the unit has tuned to the designated traffic channel, it may continue communication.

(Note that the unit continues to use PFIX, IDENT1 and IDENT2 from the original GTC message (see 9.2.2.5) in obeying the procedures in sections 9.2.3.1, 9.2.3.3, 9.2.3.5, 9.2.3.6 and 9.2.3.7).

9.2.3.5 Going "on-hook" on traffic channel

If a radio unit's user goes on-hook or equivalent (or if its data equipment indicates that a data call has ended) while it is tuned to the traffic channel, and if its individual address is either PFIX/IDENT1 or PFIX/IDENT2 from the GTC message, then the unit shall send a number of Disconnect messages (MAINT, OPER='011') on the traffic channel. It shall send ND1 Disconnect messages if its individual address is PFIX/IDENT1 from the GTC, or ND2 if its individual address is PFIX/IDENT2 from the GTC. The unit shall send the messages continuously (see 3.3.2 and 6.2.2.2) and mute the audio, and shall then return to the control channel acquisition procedures (see 6.2.1.1).

A radio unit whose individual address is neither PFIX/IDENT1 nor PFIX/IDENT2 from the GTC message (i.e. a called unit in a group call) may leave the call at any time when the user goes on-hook or equivalent; it shall mute the audio and return to the control channel acquisition procedures (without signalling). However, the calling unit sends ND2 Disconnect messages for a group call (see above), and so the caller should be advised to remain with a group call until its completion.

9.2.3.6 Time-outs on traffic channel

A radio unit on a traffic channel shall time the length of a period during which it detects no activity (e.g. fails to receive adequate signal strength) and shall also time the length of each item it transmits.

If the unit detects no activity on the forward traffic channel for a time TN then it shall assume that the call is terminated: it shall mute the audio and return to the control channel acquisition procedures (without signalling), and may indicate to the user that the call has ended.

If the unit transmits an item that reaches the maximum permitted duration TT then it shall mute the audio and shall:

i) send NPON Pressel Off messages (for a speech item);
ii) send ND1 or ND2 Disconnect messages if its individual address is PFIX/IDENT1 or PFIX/IDENT2 from the GTC (as in section 9.2.3.5).

It shall then cease transmission on the traffic channel and return to the control channel acquisition procedures, and may indicate to the user that the call has ended.

9.2.3.7 "Selective" clear-down message : MAINT with OPER='110'

If a radio unit on a traffic channel receives a call maintenance message MAINT, OPER='110' with:

channel number (CHAN) equal to the number of the traffic channel
and PFIX/IDENT1 not equal to PFIX/IDENT1 from the GTC message
and PFIX/IDENT1 not equal to PFIX/IDENT2 from the GTC message

then immediately it shall mute the audio and return to the control channel acquisition procedures, and may indicate to the user that the call has ended.

9.2.3.8 CLEAR message

If a radio unit on a traffic channel receives a clear-down message CLEAR with:

channel number (CHAN) equal to the number of the traffic channel
and field REVS equal to '101010101010'

then it shall immediately mute the audio and move to the forward control channel indicated by field CONT in the CLEAR message (to be capable of receiving within 35 ms after the end of the CLEAR address codeword), and may indicate to the user that the call has ended.

Note: If field CONT in the CLEAR message is equal to '0000000000', then the channel movement is system-dependent.

10. EMERGENCY CALL PROCEDURES

This section defines standardised procedures for emergency calls. (Note that systems may have alternative emergency procedures employing customised messages, and radio units which have suitable arrangements with the system may use these.)

Standard emergency calls from radio units may be requested to:

- a radio unit, line unit or group
- all units in the system
- a PABX extension (short or extended addressing)
- a PSTN destination (prearranged or general).

Emergency calls from radio units are requested using the Emergency Call Request Message RQE (see 5.5.3.1.5). Bit D in the RQE message specifies whether the unit is requesting speech or data communication. An extended addressing request is indicated by setting IDENT1 in the RQE message to the appropriate gateway ident.

A radio unit may interrupt a non-emergency call attempt to request an emergency call; in this case it abandons the previous call attempt. Messages ACKE(QUAL=0) and AHY(E=1) are responses unique to RQE calls; they indicate positively that the TSC has received the RQE and that any further signalling sent to the unit is for the emergency call. Until it receives ACKE(QUAL=0) or AHY(E=1), the unit ignores other acknowledgements and rejects Mode 1 AHYC messages.

Usually emergency calls will take precedence over all other calls. Emergency calls may be pre-emptive, that is, another call may be terminated prematurely to free a channel for an emergency call.

If bit EXT is set to '0' in the RQE message (i.e. if the RQE is not for a short addressing PABX call) then FLAG2 may be set to '1' to indicate that the calling radio unit is requesting a special mode of emergency service previously arranged with the system; the TSC determines the required action by reference to the calling unit's address, and the TSC and radio unit follow appropriate (non-standardised) procedures. In this case, the meanings of fields IDENT1, D and FLAG1 in the RQE message may be redefined. For example, EXT=0/FLAG2=1 could indicate that field IDENT1 contains a special 13-bit message to be acted upon by the TSC; these special messages could have any prearranged meaning (such as the nature of the emergency, the required service or the unit's geographical position). See also the introductions to sections 10.1 and 10.2.

10.1 Standard Emergency Call Procedures for TSC

If the TSC offers an emergency service then it shall be prepared to accept an RQE message in any random access slot.

The TSC procedures detailed in the following subsections are for standard emergency calls. If, owing to incorrect operation of a radio unit, the TSC receives an RQE message requesting a special mode of service (i.e. EXT=0/FLAG2=1) from a radio unit with which it has no previous arrangements then it may reject the request by responding with ACKE(QUAL=0) and then sending ACKX(QUAL=0), where both ACKE and ACKX contain the same PFIX, IDENT1 and IDENT2 as the RQE message.

10.1.1 Responses to a short addressing standard emergency request

A radio unit requests an emergency call by generating an RQE message, complying with the random access protocol (unless it has other arrangements with the system). On receiving a short addressing RQE message, the TSC shall send a response as soon as possible; for maximum permissible delay, see 7.2.4. Valid responses are:

a. ACKE(QUAL=0); see 5.5.2.1 and 10.2.2.

b. An availability check for the call (AHY with bit E set to '1'); see 9.1.1.5, 9.1.1.7 and 10.2.2.

c. For a non-PABX call (i.e. EXT=0 in the RQE message):
   - A Go To Channel message GTC for the call; see 9.1.1.12 and 10.2.2. (This is the recommended response if the TSC does not make any availability checks for the call - see 10.1.6.)

ACKE(QUAL=0) is sent only as a response to an RQE message; it is an intermediate acknowledgement, indicating that further signalling will follow. The TSC may then send other acknowledgements (e.g. ACKI, ACKX) to the waiting calling unit at appropriate times to indicate the progress of the call set-up; see section 10.1.5.

10.1.2 Response to an extended addressing standard emergency request

A radio unit requests an emergency call by generating an RQE message, complying with the random access protocol (unless it has other arrangements with the system). On receiving an extended addressing RQE message, the TSC shall send a response: ACKE(QUAL=0) with the same prefix and idents as the RQE. For maximum permissible delay, see 7.2.4.

10.1.3 Signalling for previous call

After receiving an RQE message, the TSC shall not send any further signalling messages to the calling unit for any previous call requested by that unit (though, for a traffic channel call, it may send AHYX to inform a called radio unit that the call will not take place).

10.1.4 Obtaining extended address information

After receiving an extended addressing RQE message and responding with ACKE(QUAL=0), the TSC may demand the full called address information from the calling radio unit by sending the AHYC message (as in section 9.1.1.3).

10.1.5 Acknowledgements sent to indicate progress of emergency call

After sending ACKE(QUAL=0) or an availability check AHY with E=1 as a response to an emergency call request, the TSC may send acknowledgements ACKI, ACKQ, ACKX, ACKV, ACKB(QUAL=0) or ACKT(QUAL=0) to the calling unit to indicate the progress of the call (as in section 9.1.1.4).

10.1.6 Availability checks before allocating traffic channel

For emergency calls, the mandatory availability check detailed in section 9.1.1.5 may be dispensed with. (For emergency calls, availability checks on radio units are made using the AHY message with bit E set to '1'.)

10.1.7 TSC time-out

The TSC may instruct the calling unit to restart its waiting timer TW, by sending the AHY message with bit POINT set to '1' (and bit E set to '1'); see 9.1.1.7 and 9.2.2.3. If a time TW, minus the tolerance on the radio unit's timer, elapses since the last message it received for an emergency call (from the calling unit), the TSC shall not send any further signalling for the call, except that it may send AHYX to inform a called radio unit that the call will not take place. See also 10.2.7.

10.1.8 Other procedures

a. A calling radio unit may send an RQX message to cancel its emergency call. The TSC procedures are as defined in 9.1.1.8 for Simple calls.

b. It is recommended that the TSC does not amalgamate an emergency call with any other call in its queues.

c. If all traffic channels are in use then the TSC may terminate another call prematurely (with or without warning to the correspondents using it), in order to free the channel for an emergency call.

d. The procedures for traffic channel allocation and call maintenance and clear-down are as detailed in 9.1.1.12 and 9.1.2.

10.2 Standard Emergency Call Procedures for Radio Units

A radio unit shall make only one emergency call attempt at a time. While attempting access or waiting for further signalling for an emergency request, the unit shall not request another call of any type (unless the user first cancels the original call). It may make an emergency call at any other time. For example, it may interrupt a non-emergency call attempt to request an emergency call; in this case it shall abandon the previous call attempt (without sending RQX).

The radio unit procedures detailed in the following subsections are for standard emergency calls. If a radio unit sends an RQE message with EXT=0/FLAG2=1 then it is requesting a special mode of emergency service previously arranged with the system and generally follows non-standardised procedures; however, if it receives ACKE(QUAL=0) and subsequently receives ACKX(QUAL=0) - both with the same PFIX, IDENT1 and IDENT2 as its RQE - then it shall return to the idle state (and may indicate to the user that the call attempt has failed).

10.2.1 Request for a standard emergency call

A radio unit requests a standard emergency call by sending an RQE message on a control channel; the fields in the RQE message shall be set appropriately (see 5.5.3.1.5). Some TSCs may permit more than one emergency random access transmission in a frame; however, unless the radio unit knows the retry rate permitted by the TSC, it shall comply with the normal random access protocol - see 7.3. (Note that a radio unit requesting an emergency call ignores all values of the address qualifier except M=20 - see 7.3.1.)

The unit shall attempt access until it receives a valid response (see 10.2.2/3), or until its user cancels the call (see 10.2.8), or until the access attempt fails (i.e. the unit has sent the maximum number of transmissions NE and received no response, or its access time-out TC has expired (see 7.3.8)). In the case of access failure, if the unit has not sent a request, it shall return to the idle state (and may indicate the failure to the user); otherwise, it shall wait for further signalling for the call - see 10.2.4 to 10.2.7.

10.2.2 Responses to short addressing RQE

For a short addressing call, the calling unit shall accept the following messages (with PFIX/IDENT2 as its individual address and IDENT1 as the called ident (or PABXI for a PABX call)) as a valid response to its RQE and send no more requests:

a. An acknowledgement ACKE(QUAL=0).

b. An AHY message with bit E set to '1'.

c. For a non-PABX call (i.e. EXT=0 in the RQE message):
   - a Go To Channel message GTC with bit D equal to bit D from the RQE message.

In cases a. and b., the unit shall then wait for further signalling for the call. See also sections 10.2.6, 9.2.2.3 and 9.2.2.5.

10.2.3 Responses to extended addressing RQE

For an extended addressing call, the calling unit shall accept an acknowledgement ACKE(QUAL=0) or an AHY(E=1) message (with the same prefix and idents as the RQE) as a response to its RQE and send no more requests; it shall then wait for further signalling for the call. See also 9.2.2.3.

10.2.4 Sending extended address information

For an extended addressing emergency call, after receiving ACKE(QUAL=0) or an AHY(E=1) message for its call, the calling unit shall send the full called address information on receipt of an appropriate AHYC; see section 9.2.2.1. Until it receives ACKE(QUAL=0) or AHY(E=1), the unit shall respond to Mode 1 AHYC messages with ACKX(QUAL=0).

10.2.5 Acknowledgements indicating progress of emergency call

After receiving ACKE(QUAL=0) or an AHY(E=1) message for its emergency call, the waiting calling unit shall take appropriate action on receiving further acknowledgements - ACKI, ACKQ, ACKX, ACKV, ACKB(QUAL=0) or ACKT(QUAL=0) - as detailed in section 9.2.1.4.

If it receives ACKE(QUAL=0) for the call then the unit shall wait for further signalling.

10.2.6 Availability check and channel allocation for own call

A calling radio unit attempting access or waiting for further signalling for an emergency call shall obey the availability check procedures (see 9.2.2.2 to 9.2.2.4).

The unit shall also obey the traffic channel allocation procedures (see 9.2.2.5). Note particularly that:

a. If the unit has not received ACKE(QUAL=0) or AHY(E=1) for its emergency call, it shall obey a GTC message only if its call is a short addressing non-PABX call and the GTC message is for the requested call (see below).

b. After receiving ACKE(QUAL=0) or AHY(E=1) for its emergency call, the unit shall obey a GTC message only if it is individually addressed by the GTC (i.e. if its individual address is PFIX/IDENT1 or PFIX/IDENT2).

See section 9.2.2.5, rule 1.

For a short addressing non-PABX call or after receiving ACKE(QUAL=0) or AHY(E=1) for a short addressing PABX call or after sending the full address information for an extended addressing call, the unit shall assume that a GTC message it receives is for its requested call if PFIX/IDENT2 is its individual address, IDENT1 is the called ident (or gateway) and bit D is the same as in the RQE. If so, it may give an indication to the user, and shall revert to the idle state at the end of the call.

10.2.7 Time-out after waiting

A calling radio unit waiting for further signalling for an emergency call shall return to the idle state if a time TW has elapsed since the last message it sent for the call, viz.

RQE, requesting the emergency call (see 10.2.1)
or SAMIS, providing extended address information for the call (see 9.2.2.1)
or ACK(QUAL=0), sent in response to an AHY message with POINT = 1, E = 1 and IDENT1 as the called ident or gateway (see 9.2.2.3).

It may also indicate the failure to the user.

10.2.8 Other procedures

a. A calling radio unit waiting for an emergency call may attempt to cancel the call by sending a call cancellation request RQX. The procedures are as defined in 9.2.1.7 for cancelling Simple calls.

b. The procedures on an allocated traffic channel are as defined in 9.2.3 (unless other arrangements have been made with the system).

11. INCLUDE CALL PROCEDURES

During an RQS or RQE call, a radio unit on its allocated traffic channel may send a request message RQS to the TSC, to ask for a party to join the call in progress. This facility may be used to implement:

a) a Conference Call - a user on channel may ask for the call to be expanded to include another party;

b) Call Transfer - a user may include another party in the call, and then leave the call to proceed without him;

c) a Repeat Call - a user may ask for the channel assignment signalling for the call to be retransmitted.

The Included party may be a radio unit, a line unit, a group of units, a PABX extension (short or extended addressing) or a PSTN number (short-form or general).

A radio unit requests an Include call by transmitting a request message RQS on the allocated traffic channel. (An extended addressing request is indicated by setting IDENT1 in the RQS message to the appropriate gateway ident.) The TSC responds and, for an extended addressing request, instructs the Including unit to transmit the full called party details. It then checks the availability of the called party (if appropriate) and directs the called party to the traffic channel. Throughout the transaction, the TSC may send acknowledgements to the Including unit to indicate the progress and the success/failure of the transaction.

When a user initiates an Include call, his pressel is disabled until the radio unit receives an acknowledgement other than ACKI(QUAL=1) or until it times out.

After a party has been included in a call, the TSC may allow units to leave the call, without terminating the call, provided that the number of parties that will indicate the "on-hook" condition is not reduced below the normal number for the type of call.

The timing constraints for messages transmitted on a traffic channel are specified in sections 6.1.2.2 and 6.2.2.2.

11.1 TSC Procedures for Include Calls

This subsection defines procedures for TSCs that offer the Include facility.

11.1.1 Responses to a short addressing Include request

A radio unit requests a short addressing Include call by transmitting an RQS message (with EXT = 1, or with EXT = 0 and IDENT1 set to a valid called party ident) on the traffic channel. On receiving a short addressing Include RQS, the TSC shall send a response:

ACKI, ACKQ(QUAL=0), ACKX, ACKV, ACKT(QUAL=0) or ACK(QUAL=0).

For idents, see section 5.5.2.1; for acceptable delay, see 6.1.2.2.

These acknowledgement messages may also be sent to the unit to indicate the progress of its Include call - see section 11.1.4.

11.1.2 Responses to an extended addressing Include request

A radio unit requests an extended addressing Include call by transmitting an RQS message (with EXT = 0 and IDENT1 = IPFIXI, PABXI or PSTNGI) on the traffic channel. On receiving an extended addressing Include RQS, the TSC shall send one of the following responses, with the same prefix and idents as the Include RQS:

a. An acknowledgement ACKI(QUAL=1), ACKX or ACKV(QUAL=0).

b. AHYC (i.e. an instruction to send the full called address information).

For acceptable delay, see 6.1.2.2. See also 11.1.3 and 11.1.4.

11.1.3 Instruction to send extended address information

After receiving an extended addressing Include RQS, the TSC may demand the full called address by sending the AHYC message, with:

- the same prefix and idents as the Include RQS
- DESC set to indicate the appropriate gateway (see 5.5.3.2.8)
- SLOTS set to correspond to the Include RQS (i.e. if IDENT1=PSTNGI and FLAG1=1 then SLOTS='10' else SLOTS='01').

The AHYC message instructs the Including radio unit to send the called party address information (see 11.3.1). If the TSC does not successfully decode the address information, it may repeat the AHYC message or transmit ACKV(QUAL=0) to indicate failure of the Include call.

After decoding the full address information successfully, the TSC may send appropriate acknowledgements to the Including unit (see 11.1.4).

11.1.4 Acknowledgements sent to indicate progress of Include call

The TSC may send acknowledgement messages to indicate to a radio unit the progress of its Include call - for idents, see 5.5.2.1. (For extended addressing Include calls, only ACKI(QUAL=1), ACKX and ACKV(QUAL=0) are appropriate until the full address information has been obtained.)

ACKI (QUAL=0)	-	Called party alerting but not yet ready.
ACKI (QUAL=1)	-	Intermediate acknowledgement; more signalling to follow.
ACKQ (QUAL=0)	-	All traffic channels in use on called site; more signalling to follow.
ACKX (QUAL=0)	-	Invalid call; request rejected.
ACKX (QUAL=1)	-	System overload e.g. all channels in use on called site, and call has not been queued.
ACKV (QUAL=0)	-	Called unit not in radio contact or Include call abandoned.
ACKV (QUAL=1)	-	Conflicting call in progress (e.g. called party engaged) or called user does not wish to receive this call.
ACKT (QUAL=0)	-	Called party's calls have been diverted.
ACK (QUAL=0)	-	Include request accepted; availability check successful (if performed); called party will be directed to the traffic channel.

For maximum acceptable delay of repeats of acknowledgements ACKX, ACKV, ACKT and ACK, see time-out TB in section 11.2.4.

11.1.5 Availability check on called radio unit

If an Include request specified an individual radio unit to be Included, the TSC may check the availability of the called unit before instructing it to join the call in progress.

The TSC checks availability of a called radio unit by sending the AHY message on a control channel (see 5.5.3.2.1 and 9.2.2.2A). For an Include call availability check, IDENT2 in the AHY address codeword is set to INCI (to prohibit the called unit from responding with ACKB(QUAL=0)) and a data codeword may be appended containing the Including unit's address.

The TSC may indicate the result of the availability check to an Including radio unit by sending appropriate acknowledgement(s) (see 11.1.4) on the traffic channel.

11.1.6 Call cancellation

A radio unit may cancel its requested Include call by transmitting an RQX message (see 5.5.3.1.3) on the traffic channel. On receiving an RQX message cancelling an Include call, the TSC shall respond with ACK(QUAL=0) or ACK(QUAL=1), with the same prefix and idents as the RQX; see also 11.1.4 and 11.2.6.

If an Include call is cancelled, the TSC may inform a called radio unit by sending the AHYX message (with IDENT2 set to INCI) on the control channel. The AHYX message may be repeated if it is not acknowledged by an ACK(QUAL=1) message from the called unit (see 9.2.2.4).

11.1.7 TSC time-out

The TSC may instruct an Including radio unit to restart its waiting timer TI, by sending the AHY message with:

- bit POINT set to '1'
- PFIX/IDENT2 set to the unit's individual address
- IDENT1 set to the called ident or gateway.

See 9.1.2.2 and 9.2.3.2. If a time TI, minus the tolerance on the radio unit's timer, elapses since the last message it received for an Include call (from the Including unit), the TSC shall not send any further signalling for the transaction, except that it may send AHYX on the control channel to inform a called radio unit. See also 11.2.5.

11.1.8 Traffic channel allocation

The TSC shall direct a called radio unit or group of radio units to the appropriate traffic channel using the Go To Channel message GTC (with IDENT2 set to INCI); see section 5.4.

11.1.9 Call clear-down

After an Include call, the TSC may allow parties to leave the call in progress, without terminating the call, as follows:

i) For a group call or a call in which a group has been included, the TSC may allow radio units to signal on-hook (or line/PABX/PSTN users to leave the call), without terminating the call, provided that at least one party that will indicate end-of-channel-use remains in the call.

ii) For a call comprising only individually addressed parties, the TSC may allow radio units to signal on-hook (or line/PABX/PSTN users to leave the call), without terminating the call, provided that at least two parties remain in the call.

In this way, at least the normal number of parties that will indicate end-of-channel-use remains in a call (barring corruption of signalling messages). See also section 9.1.2.6.

11.2 Procedures for Radio Units Requesting Include

A radio unit on a traffic channel shall request only one transaction at a time; while requesting an Include call or waiting for further signalling, the unit shall not request another transaction of any type (unless the user first cancels the Include call).

11.2.1 Include request

When a user initiates an Include call (indicating that he wishes another party to join the call in progress), the radio unit shall inhibit user transmission i.e.

- disable the pressel for a speech call, or
- inhibit user data for a data call.

The radio unit requests an Include call by transmitting RQS on the allocated traffic channel. The fields in the RQS message shall be set appropriately (see 5.5.3.1.1); however, note particularly that:

a. If the call in progress is a speech call (see 9.2.2.5 and 9.2.3.4), bit DT shall be set to '0'; for a data call, DT shall be set to '1'.
b. Bit LEVEL shall be set to '1'.
(This constraint is imposed to prevent the RQS being interpreted as an AHY to the called party).
c. An extended addressing request is indicated by setting IDENT1 in the RQS message to the appropriate gateway (viz. IPFIXI, PABXI or PSTNGI).

After transmitting an Include request message on a traffic channel, the unit shall wait to receive a response from the TSC. If a response is not received within the timing constraints defined in section 6.2.2.2, the unit shall assume that the message was unsuccessful and may retransmit its request. It shall repeat its Include request, each time waiting for a response from the TSC, until:

i) it receives a valid response (see 11.2.2/3), or

ii) its user cancels the Include call (see 11.2.6), or

iii) it has sent the maximum number of transmissions NI.
In this case, it shall wait for further signalling for the Include call (see 11.2.4 and 11.2.5).

11.2.2 Responses to short addressing Include request

For a short addressing Include RQS, the radio unit shall accept the following messages as a valid response to its RQS and send no more requests:

a. ACKI, ACKQ(QUAL=0), ACKX, ACKV or ACK(QUAL=0), with PFIX/IDENT2 as its individual address and IDENT1 as the called ident (or PABXI for a PABX call).

b. ACKT(QUAL=0) with PFIX/IDENT2 as its individual address.

For other actions on receiving these messages, see section 11.2.4.

11.2.3 Responses to extended addressing Include request

For an extended addressing Include RQS, the radio unit shall accept the following messages (with the same prefix and idents as the RQS) as a valid response to its RQS and send no more requests:

a. An acknowledgement ACKI(QUAL=1), ACKX or ACKV(QUAL=0).

b. AHYC (i.e. an instruction to send the full called address information).

For other actions on receiving these messages, see 11.2.4 and 11.3.1.

11.2.4 Acknowledgement received

If a radio unit waiting for a response to an Include RQS, or for further signalling for an Include call, receives an appropriate acknowledgement then it shall take action as indicated below. For extended addressing Include calls, only ACKI(QUAL=1), ACKX and ACKV(QUAL=0) are appropriate until the full address information has been sent. For idents, see 5.5.2.1.

ACKI (QUAL=0)	-	Called party alerting but not yet ready.
ACKI (QUAL=1)	-	Intermediate acknowledgement; more signalling to follow.
ACKQ (QUAL=0)	-	All traffic channels in use on called site; more signalling to follow.
ACKX (QUAL=0)	-	Invalid call; request rejected.
ACKX (QUAL=1)	-	System overload; request rejected.
ACKV (QUAL=0)	-	Called unit not in radio contact or Include call abandoned.
ACKV (QUAL=1)	-	Conflicting call in progress (e.g. called party engaged) or called user does not wish to receive this call.
ACKT (QUAL=0)	-	Called party's calls have been diverted.
ACK (QUAL=0)	-	Include request accepted; called party will be directed to the traffic channel.

If ACKI or ACKQ(QUAL=0) is received, the unit shall wait for further signalling. However, for a speech call, it may re-enable the pressel on receiving ACKI(QUAL=0) or ACKQ(QUAL=0).

If ACKX or ACKV is received, the unit shall re-enable user transmission and may indicate to the user that the Include call has failed.

If a complete ACKT(QUAL=0) message is received, the unit shall either:

a. re-enable user transmission (and may indicate to the user that the called party's calls have been diverted), or

b. attempt a new Include call to the diversion address.

If an incomplete ACKT(QUAL=0) message is received, then:

i) If the unit does not require the diversion address, it shall re-enable user transmission (and may give an indication to the user).