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 LDENT2 = 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).

ii) If the unit does require the diversion address then:
- if it has received no previous response to its Include RQS, and has not sent the maximum number of transmissions of the RQS (see 11.2.1), it shall ignore the ACKT message;
- otherwise it shall wait for a repeat ACKT, re-enabling user transmission if a time TB elapses (in which case, it may indicate the failure to the user).

If ACK(QUAL=0) is received, the unit shall re-enable user transmission and may indicate to the user that the called party is being directed to the traffic channel.

After receiving ACKX, ACKV or ACK for its Include call, the unit shall not request on the traffic channel another transaction of any type to the same called ident (or gateway) for at least a time TB. After receiving ACKT for its Include call, the unit shall not request on the traffic channel another transaction of any type for at least a time TB.

11.2.5 Time-out after waiting for Include call

A radio unit waiting for further signalling for an Include call shall re-enable user transmission if a time TI has elapsed since the last message it sent for the transaction, viz.

RQS, requesting the Include call (see 11.2.1)
or SAMIS, providing extended address information for the call (see 11.3.1)
or ACK(QUAL=0), sent in response to an AHY message with bit POINT = 1 and IDENT1 as the called ident or gateway (see 9.2.3.2).

It may also indicate to the user that the outcome of the transaction is unknown.

11.2.6 Cancelling Include

A radio unit may cancel an Include request (after sending an RQS and while still waiting to receive ACKX, ACKV, ACKT or ACK) by transmitting a cancellation request RQX (see 5.5.3.1.3) on the traffic channel. The unit shall then wait for a response from the TSC; for timing, see 6.2.2.2. The unit shall repeat its cancellation request, each time waiting for a response from the TSC, until one of the following occurs:

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

b. It receives ACKX, ACKV, ACKT(QUAL=0) or ACK(QUAL=0) for the Include call it is attempting to cancel. See also 11.2.4.

c. It has sent the maximum number of transmissions NI. In this case, it shall return to waiting for signalling for the Include call (see 11.2.4 and 11.2.5).

In cases a. and b., the unit shall re-enable user transmission.

11.2.7 Other procedures

a. A radio unit shall not attempt an Include call if user transmission has been inhibited (by the GTC message or by a MAINT(OPER='111') message; see 9.2.2.5, 9.2.3.3 and 9.2.3.4).

b. If a radio unit requesting or attempting to cancel an Include call, or waiting for further signalling, receives a MAINT(OPER='111') message inhibiting user transmission (see 9.2.3.3), then it shall continue with the Include call but shall not re-enable user transmission at the end of the transaction.

c. If a radio unit requesting or attempting to cancel an Include call, or waiting for further signalling, receives a GTC message allocating a replacement traffic channel, it shall perform actions i) and ii) as specified in section 9.2.3.4 and shall then continue with the Include call. At the end of the transaction, the unit shall re-enable user transmission only if permitted by action iii) of 9.2.3.4.

d. If a radio unit's user goes on-hook (or equivalent) while it is requesting or attempting to cancel an Include call, or waiting for further signalling, then the unit shall abandon the Include call and shall obey the procedures specified in section 9.2.3.5.

(If the user goes on-hook (or equivalent) after an Include call, then the unit shall obey the procedures specified in section 9.2.3.5. However, see also section 11.1.9.)

e. If a radio unit requesting or attempting to cancel an Include call, or waiting for further signalling, receives a MAINT(OPER='110') or CLEAR message terminating the call in progress, then it shall abandon the Include call and shall obey the procedures specified in sections 9.2.3.7 and 9.2.3.8 respectively.

11.3 Procedures for All Radio Units on an Allocated Traffic Channel

11.3.1 Instruction to send extended address information

This procedure shall be obeyed by all radio units that are equipped to request extended addressing Include calls.

If a radio unit on a traffic channel receives an AHYC message with PFIX/IDENT2 matching its individual address then it shall either send address information or transmit ACKX(QUAL=0), as indicated below. For timing, see section 6.2.2.2.

If

the unit has sent an extended addressing Include RQS
and IDENT1 matches IDENT1 from the Include RQS
and DESC is appropriate to IDENT1 (see 5.5.3.2.8)
and SLOTS corresponds to the Include RQS
(i.e. if IDENT1=PSTNGI and FLAG1=1 then SLOTS='10' else SLOTS='01')

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

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

12. CALL DIVERSION PROCEDURES

This section defines the procedures for requesting and cancelling call diversion. Requests may apply to speech calls, data calls or both.

Two types of call diversion are provided:

i) Self-initiated diversion.
A radio unit may request that future calls addressed to it be redirected to a specified alternative destination.

ii) Third-party diversion.
A radio unit may request that future calls addressed to another subscriber unit (or group) be redirected to a specified alternative destination. For example, a despatcher unit may request diversion on behalf of a radio unit in its fleet.

In general, radio unit A (the requesting unit) may divert calls for address B (the blocked address) to alternative destination C (the diversion address); for self-initiated diversion, B = A. The procedures permit blocked address B to be a radio unit, line unit or group address. Destination C may be a radio unit, line unit or group address, a PABX extension or a PSTN number (short-form or general).

Three types of call diversion cancellation are provided:

i) Self-initiated cancellation.
A radio unit may request that its calls are no longer diverted.

ii) Third-party cancellation.
A radio unit may request that another subscriber unit's (or group's) calls are no longer diverted.

iii) General cancellation by recipient.
A radio unit may request that any existing diversions to it be cancelled. (This is a general cancellation by the recipient of diversions; specific cancellation of diversions by the recipient is covered by third-party cancellation.)

It is recommended that requests for third-party diversion or third-party cancellation are accepted only from authorised units.

Call diversion is requested or cancelled using the Request Call Diversion Message RQT (see 5.5.3.1.4). In this message:

- PFIX/IDENT2 is the address of the requesting radio unit.

- For diversion requests, IDENT1 is the diversion ident C (or IPFIXI, PABXI or PSTNGI for an interprefix address, any PABX extension or a general PSTN number respectively).

  For "self" or "third-party" cancellation of call diversion, IDENT1 specifies the unit or group whose calls should be returned (or IPFIXI for an interprefix address).

  For general cancellation by a recipient, IDENT1 is set to DIVERTI.

- Bit DIV indicates call diversion or cancellation.

- For call diversion, FLAG2 indicates "self" or "third-party" diversion.

- Field SD specifies the types of call (i.e. speech, data or both) to which the diversion or cancellation refers.

  For diversion purposes, "speech" calls are defined as calls requested using RQS(DT=0), RQE(D=0), RQQ(STATUS='00000') or RQQ(STATUS='11111'). "Data" calls are defined as calls requested using RQS(DT=1), RQE(D=1), RQQ('00001' to '11110'), RQC or RQD.

For self-initiated diversion requests or any cancellation, two addresses (plus the other parameters) specify the requirement. However, for third-party diversion requests, address B (the blocked address) must be supplied.

The TSC uses the AHYC message to demand:

a. extended address information for IDENT1
b. blocked address B

as appropriate. If both a. and b. are needed, the TSC obtains the full information in two steps, each step using the AHYC message. The AHYCs are distinguished by the setting of IDENT1 (to IPFIXI, PABXI or PSTNGI for a., or to DIVERTI for b.), and so the order in which they are sent is not prescribed.

In the procedures, a request for call diversion or cancellation is defined as an extended addressing request if IDENT1 is set to IPFIXI, PABXI or PSTNGI. A request is defined as "complex" if it requires extended addressing or if three addresses must be provided; otherwise it is "simple".

Note that extended addressing procedures are used for requesting diversion to any PABX extension (with either a "long" or "short" extension number). The radio unit sets IDENT1 in the RQT message to PABXI, and then sends the PABX address information in response to an AHYC message with IDENT1 set to PABXI and DESC set to '010'. The unit sets bit SP in the SAMIS message to indicate whether it is sending BCD digits or a 13-bit extension number (plus 2-bit exchange number). See 5.5.3.2.8 and 5.6.1.2.2.

If the TSC accepts a diversion request and then a call to the blocked address is requested by a radio unit, the TSC indicates the diversion address to the calling radio unit using the ACKT(QUAL=0) acknowledgement. The unit then either retries on the diversion address or returns to the idle state. For example, see sections 9.1.1.4 and 9.2.1.4.

12.1 TSC Procedures for Call Diversion Requests

12.1.1 Responses to a simple diversion request

A radio unit requests simple call diversion by generating an RQT message (with FLAG2 = 0 and IDENT1 set to a valid called party ident or to DIVERTI), complying with the random access protocol. On receiving a simple RQT message, the TSC shall send one of the following responses, with the same prefix and idents as the RQT:

ACKI(QUAL=1), ACKX, ACKV(QUAL=0) or ACK(QUAL=0).

For acceptable delay, see 7.2.4. See also 12.1.5.

12.1.2 Responses to a complex diversion request

A radio unit requests complex call diversion by generating an RQT message (with FLAG2 = 1 and/or IDENT1 = IPFIXI, PABXI or PSTNGI), complying with the random access protocol. On receiving a complex RQT message, the TSC shall send one of the following responses:

a. An acknowledgement ACKI(QUAL=1), ACKX or ACKV(QUAL=0), with the same prefix and idents as the RQT.

b. For an extended addressing RQT:
An AHYC message instructing the unit to send the full address information for IDENT1.

c. For a request for 3-address diversion (i.e. RQT with FLAG2=1):
An AHYC message instructing the unit to send the blocked address.

For acceptable delay, see 7.2.4. See also 12.1.3 to 12.1.5.

12.1.3 Instruction to send extended address information

After receiving an extended addressing RQT message, the TSC may demand the full address information for IDENT1 by sending the AHYC message, with:

- the same prefix and idents as the RQT
  (i.e. IDENT1 set to IPFIXI, PABXI or PSTNGI as appropriate, and
  PFIX/IDENT2 set to the requesting unit's address)
- DESC set to indicate the appropriate gateway (see 5.5.3.2.8)
- SLOTS set to correspond to the RQT
  (i.e. if IDENT1=PSTNGI and FLAG1=1 then SLOTS='10' else SLOTS='01').

The AHYC message instructs the requesting radio unit to send the full address information for IDENT1 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 transaction.

12.1.4 Instruction to send the blocked address

After receiving a request for 3-address diversion (i.e. FLAG2=1), the TSC may demand the blocked address by sending the AHYC message, with:

- IDENT1 set to DIVERTI
- PFIX/IDENT2 set to the requesting unit's address
- DESC set to '000'
- SLOTS set to '01'.

The AHYC message instructs the requesting radio unit to send the blocked address in the following slot (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 transaction.

12.1.5 Acknowledgements sent to indicate progress of RQT transaction

The TSC may send the following acknowledgement messages, with the same prefix and idents as the RQT, to indicate to a radio unit the progress of its diversion transaction. (For a complex diversion request, ACK(QUAL=0) is not appropriate until the full diversion information has been obtained.)

ACKI (QUAL=1)	-	Intermediate acknowledgement; more signalling to follow.
ACKX (QUAL=0)	-	Invalid call e.g. unauthorised diversion request, or TSC does not provide call diversion.
ACKX (QUAL=1)	-	System overload; request rejected.
ACKV (QUAL=0)	-	Transaction abandoned.
ACK (QUAL=0)	-	Call diversion or cancellation has been accepted.

For maximum acceptable delay of repeats of acknowledgements ACKX, ACKV and ACK, see time-out TB in 12.2.4.

12.1.6 Aborting the transaction

A radio unit may abort its diversion transaction by generating an RQX message (see 5.5.3.1.3), complying with the random access protocol. On receiving an RQX message aborting a diversion transaction, the TSC shall send a response: ACK(QUAL=1) with the same prefix and idents as the RQX.

12.1.7 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' (and the same prefix and idents as the RQT); 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 a diversion transaction, the TSC shall not send any further signalling for the transaction. See also 12.2.5.

12.2 Procedures for Radio Units Requesting Call Diversion

A radio unit shall make only one call attempt at a time (except in emergency); while attempting access or waiting for a terminating (i.e. end-of-transaction) acknowledgement to a diversion request, the unit shall not request another non-emergency call of any type (unless the user first aborts the original transaction).

12.2.1 Diversion request

A radio unit requests or cancels call diversion by transmitting an RQT message on a control channel, complying with the random access protocol (see 7.3). The fields in the RQT message shall be set appropriately (see 5.5.3.1.4); however, note particularly that:

a. Bit DIV specifies whether the unit is requesting call diversion or cancellation of call diversion.

b. Bit FLAG2 specifies whether or not three addresses must be provided.

c. An extended addressing diversion request is indicated by setting IDENT1 in the RQT message to the appropriate gateway ident viz. IPFIXI, PABXI or PSTNGI. (Note that extended addressing procedures are used for requesting diversion to a PABX extension with either a "short" or "long" extension number.)

The unit shall attempt access until it receives a valid response (see 12.2.2/3), or until its user aborts the transaction (see 12.2.6), 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 (and may indicate the failure to the user); otherwise, it shall wait for further signalling for the transaction - see 12.2.4 and 12.2.5.

12.2.2 Responses to simple diversion request

For a simple diversion request, the radio unit shall accept the following messages (with the same prefix and idents as the RQT) as a valid response to its RQT and send no more requests:

ACKI(QUAL=1), ACKX, ACKV(QUAL=0) or ACK(QUAL=0).

For other actions on receiving these messages, see section 12.2.4.

12.2.3 Responses to complex diversion request

For a complex diversion request, the radio unit shall accept the following messages as a valid response to its RQT and send no more requests:

a. ACKI(QUAL=1), ACKX or ACKV(QUAL=0), with the same prefix and idents as the RQT.

b. For an extended addressing RQT:
AHYC, with the same prefix and idents as the RQT.

c. For a request for 3-address diversion (i.e. RQT with FLAG2=1): AHYC, with PFIX/IDENT2 as its individual address and IDENT1 as DIVERTI.

For other actions on receiving these messages, see 12.2.4 and 9.2.2.1.

12.2.4 Acknowledgement received

If a radio unit attempting access or waiting for further signalling for a diversion transaction receives an appropriate acknowledgement (with the same prefix and idents as the RQT) then it shall take action as indicated below. For a complex diversion request, ACK(QUAL=0) is not appropriate until the full diversion information has been sent.

ACKI (QUAL=1)	-	Intermediate acknowledgement; more signalling to follow.
ACKX (QUAL=0)	-	Invalid call; request rejected.
ACKX (QUAL=1)	-	System overload; request rejected.
ACKV (QUAL=0)	-	Transaction abandoned.
ACK (QUAL=0)	-	Call diversion or cancellation has been accepted.

If ACKI(QUAL=1) is received, the unit shall wait for further signalling for the transaction.

If ACKX or ACKV(QUAL=0) is received, the unit shall return to the idle state and may indicate to the user that the transaction has failed.

If ACK(QUAL=0) is received, the unit shall return to the idle state and may indicate to the user that the request for call diversion or cancellation has been accepted.

After receiving ACKX, ACKV or ACK for its diversion request, the unit shall not request another non-emergency call of any type to the same called ident (or gateway) for at least a time TB.

12.2.5 Time-out after waiting

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

RQT, requesting the transaction (see 12.2.1)
or SAMIS, providing 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 the same prefix and idents as the RQT (see 9.2.2.3).

It may also indicate to the user that the outcome of the transaction is unknown.

13. STATUS MESSAGE PROCEDURES

This section defines the procedures for status messages. Status messages may be sent to the TSC or to a radio or line unit.

A radio unit sends status information using message RQQ - see 5.5.3.1.7. The status field in an RQQ message consists of 5 bits, allowing 32 different status values. Two of these values have been predefined.

a) For status sent to the TSC:

'00000' indicates that the unit is ready to receive a call (i.e. it indicates "off-hook" or equivalent).

'00001' to '11110' are system-defined status values.

'11111' indicates that the unit is no longer ready to receive a call (i.e. it indicates "on-hook" or equivalent).

RQQ('00000') and RQQ('11111') are used for the "Called Party Answer" mechanism - see section 9.2.2.2. If a radio unit receives AHY(CHECK=1) alerting it for an incoming call and responds with ACKI(QUAL=0), it may attempt random access with RQQ('00000') when its user/ data equipment is ready to receive the call. Then, if the user no longer wishes to receive the call, the unit may inform the TSC using RQQ('11111').

The other 30 status values may be used to send status information, as previously arranged with the system.

b) For status sent to a radio unit or line unit:

'00000' requests that the addressed unit call back with a speech call.

'00001' to '11110' are user-defined status values.

'11111' cancels a previous speech call request.

For example, RQQ('00000') may be used to request a "despatcher-queued call". In this type of call, a radio unit sends RQQ('00000') to request that the addressed despatcher be informed that the unit's user wishes the despatcher to call him (for a speech call). The TSC routes the information to the despatcher unit, which keeps a list of requested calls. The despatcher may then request each call at his convenience in the usual way; for example, if his unit is a radio unit, it sends a Simple call request RQS (see 5.5.3.1.1 and 9.2.1).

RQQ('11111') is used to withdraw a previously requested call from the addressed unit's call queue. This may be used for cancellation either:

i) after the called unit has accepted an RQQ('00000') message, or
ii) after the called unit in an RQS or RQE call has accepted the call for call-back (by sending ACKB(QUAL=0) in response to the availability check); see 9.2.1.4 and 9.2.2.2.

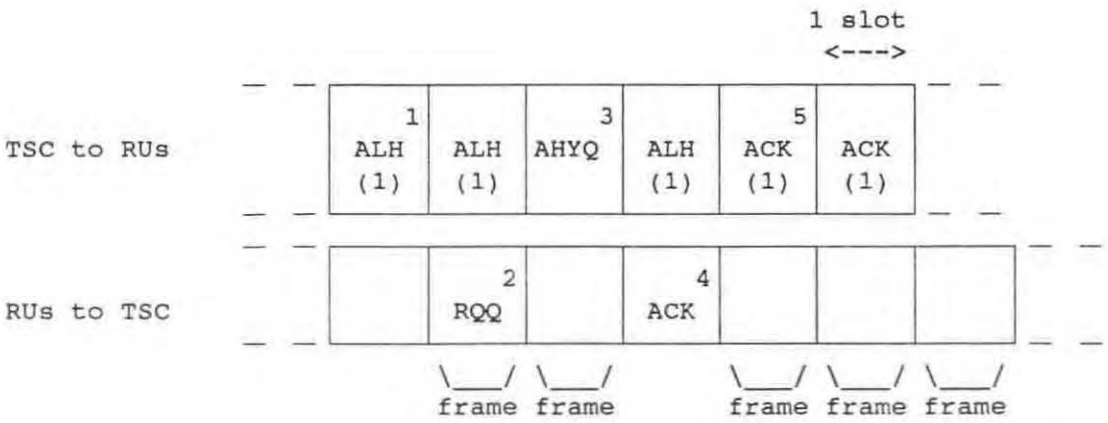
The other 30 status values may be used to send status information, as previously agreed between the requesting user and the called user.

The TSC informs a called radio unit of status information using message AHYQ - see 5.5.3.2.7. The status message may have originated from the TSC itself, from another radio unit (using RQQ etc.) or from a line unit.

The procedures for status messages addressed to the TSC are similar to a subset of the procedures for status messages addressed to radio units or line units. However, for clarity, they are specified separately:

- Section 13.1 specifies the procedures for status messages addressed to the TSC.
- Section 13.2 specifies the procedures for status messages addressed to radio units or line units.

A typical message sequence for a radio unit sending a status message to another radio unit (with the same prefix) is illustrated in the example below.



Example A message sequence on a control channel for a radio unit sending a status message to a radio unit with the same prefix.

1. ALH : General Aloha invitation (single-slot frame).
2. RQQ : Random access request that status information be relayed to the called unit.
3. AHYQ : Status Ahoy message
   - acknowledges the RQQ message
   - relays the information to the called radio unit and demands a response.
4. ACK : Acknowledgement ACK(QUAL=0) from the called radio unit - information accepted.
5. ACK : Acknowledgement ACK(QUAL=0) sent to the calling unit to indicate that the called unit has accepted the information. In this example the TSC immediately repeats the ACK message, for added reliability.

13.1 Procedures for Status Messages Addressed to the TSC

13.1.1 TSC Procedures for Status Messages Addressed to It

13.1.1.1 Responses to an RQQ message addressed to the TSC

A radio unit sends status information to the TSC by generating an RQQ message (with IDENT1 = TSCI), complying with the random access protocol. On receiving an RQQ message addressed to it, the TSC shall send one of the following responses:

a. ACK(QUAL=0), ACKI(QUAL=1) or ACKX, with the same prefix and idents as the RQQ.

b. For STATUS = '00000' or STATUS = '11111':
   - an AHYX message with the same prefix and idents as the "alerting AHY"
   - a GTC message for the original call (i.e. GTC with the same prefix, idents and bit D as the alerting AHY).

For acceptable delay, see 7.2.4. See also 13.1.1.2, 9.1.1.8 and 9.1.1.12.

13.1.1.2 Acknowledgements sent to indicate progress of RQQ transaction

The TSC may send the following acknowledgement messages (with the same prefix and idents as the RQQ) to indicate to a radio unit the progress of its status transaction:

ACKI (QUAL=1)	-	Intermediate acknowledgement; more signalling to follow.
ACKX (QUAL=0)	-	Invalid call; message rejected.
ACKX (QUAL=1)	-	System overload; message rejected.
ACK (QUAL=0)	-	Transaction has been successfully completed i.e. the TSC has accepted the status information.

For maximum acceptable delay of repeats of acknowledgements ACKX and ACK, see time-out TB in 13.1.2.4.

13.1.1.3 Aborting the transaction

A radio unit may abort its status transaction by generating an RQX message (see 5.5.3.1.3), complying with the random access protocol. On receiving an RQX message aborting a status transaction, the TSC shall send a response: ACK(QUAL=1) with the same prefix and idents as the RQX.

13.1.1.4 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 TSCI; 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 status transaction, the TSC shall not send any further signalling for the transaction. See also 13.1.2.5.

See also sections 9.1.1.5, 13.1.2.7 and 13.1.2.8.

13.1.2 Procedures for Radio Units Sending Status Messages to the TSC

A radio unit shall make only one call attempt at a time (except in emergency); while attempting access or waiting for a terminating (i.e. end-of-transaction) acknowledgement to a status message addressed to the TSC, the unit shall not request another non-emergency call of any type (unless the user first aborts the original transaction).

13.1.2.1 Criteria for sending "off-hook" or "on-hook" message

If a radio unit on a control channel has been alerted for an incoming traffic channel call (see 9.2.2.2A), it may initiate the Called Party Answer mechanism, i.e. attempt random access with RQQ(STATUS='00000') addressed to the TSC, if:

- Its response to the last alerting AHY was ACKI(QUAL=0), and
- Its user/ data equipment is now ready to receive the call, and
- It is still waiting for the incoming call, i.e. the call has not taken place or been cancelled (by AHYX or by an AHY for a different call) and not more than a time TA has elapsed since receipt of the last AHY for the call; see 9.2.2.2A and 9.2.2.4.

If a radio unit has been alerted for an incoming traffic channel call and its user then indicates that he no longer wishes to receive the call (e.g. he wishes to initiate a call of his own), the unit may attempt to reject the call as follows:

a. If it is currently attempting access or waiting for signalling for an "off-hook" RQQ, it attempts to send RQX (see 13.1.2.6).

b. Otherwise, if the unit is still waiting for the incoming call, it attempts random access with RQQ(STATUS='11111') addressed to the TSC.

(Throughout these procedures, the unit responds to AHY messages and obey GTCs as specified in section 9.2.2. See also sections 13.1.2.7 and 13.1.2.8.)

13.1.2.2 Request for a status transaction to the TSC

A radio unit requests a status transaction by sending an RQQ message on a control channel, complying with the random access protocol (see 7.3). The fields in the RQQ message shall be set appropriately (see 5.5.3.1.7).

The unit shall attempt access until it receives a valid response (see 13.1.2.3), or until its user aborts the transaction (see 13.1.2.6), 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 (and may indicate the failure to the user); otherwise, it shall wait for further signalling for the transaction - see 13.1.2.4, 13.1.2.5 and 13.1.2.7.

13.1.2.3 Valid responses to an RQQ addressed to the TSC

A radio unit shall accept the following messages as a response to its RQQ to the TSC, and send no more requests:

a. An acknowledgement ACK(QUAL=0), ACKI(QUAL=1) or ACKX, with the same prefix and idents as the RQQ.

b. For STATUS = '00000' or STATUS = '11111':
- an AHYX message with the same prefix and idents as the "alerting AHY", or
- a GTC message with the same prefix, idents and bit D as the alerting AHY.

For other actions on receiving these messages, see sections 13.1.2.4 and 13.1.2.7. See also section 13.1.2.8.

13.1.2.4 Acknowledgement received

If a radio unit attempting access or waiting for further signalling for a status transaction to the TSC receives one of the following acknowledgements (with the same prefix and idents as the RQQ), then it shall take action as indicated below.

ACKI (QUAL=1)	-	Intermediate acknowledgement; more signalling to follow.
ACKX (QUAL=0)	-	Invalid call; message rejected.
ACKX (QUAL=1)	-	System overload; message rejected.
ACK (QUAL=0)	-	Transaction has been successfully completed i.e. the TSC has accepted the status information.

If ACKI(QUAL=1) is received, the unit shall wait for further signalling for the transaction.

If ACKX is received, the unit shall return to the idle state and may indicate to the user that the transaction has failed.

If ACK(QUAL=0) is received, the unit shall consider the transaction successfully completed and may indicate this to the user.

After receiving ACKX or ACK for the transaction, the unit shall not request another non-emergency call of any type to the TSC for at least a time TB.

13.1.2.5 Time-out after waiting

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

RQQ, requesting the transaction (see 13.1.2.2)
or ACK(QUAL=0), sent in response to an AHY message with bit POINT = 1 and IDENT1 set to TSCI (see 9.2.2.3).

It may also indicate to the user that the outcome of the transaction is unknown.

13.1.2.6 Aborting the transaction

If the user wishes to abort the transaction after the unit has sent an RQQ and while it is still waiting for a terminating acknowledgement, the unit shall attempt to send an abort transaction request RQX (see 5.5.3.1.3), complying with the random access protocol. It shall attempt access until one of the following occurs:

a. It receives ACK(QUAL=1) with the same prefix and idents as the RQX.

b. It receives ACK(QUAL=0) or ACKX for the transaction it is attempting to abort. See also 13.1.2.4.

c. 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 status transaction (see 13.1.2.4, 13.1.2.5 and 13.1.2.7).

d. The conditions specified in 13.1.2.7 or 13.1.2.8 occur (applicable only for STATUS = '00000' and '11111').

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

13.1.2.7 Receiving AHYX or GTC for the incoming call

If a radio unit:

a. attempting access or waiting for a terminating acknowledgement to an "off-hook" or "on-hook" RQQ message (STATUS = '00000' or '11111'), or

b. attempting to abort an "off-hook" or "on-hook" RQQ transaction

receives AHYX with the same prefix and idents as the alerting AHY, it shall respond with ACK(QUAL=1), stop its alerting signal (if appropriate) and return to the idle state; see also 9.2.2.4. If it receives a GTC message with the same prefix, idents and bit D as the alerting AHY, it shall obey the procedures in 9.2.2.5 and then revert to the idle state at the end of the call.

13.1.2.8 Receiving AHY for a different incoming call

If a radio unit:

a. attempting access or waiting for a terminating acknowledgement to an "off-hook" or "on-hook" RQQ message (STATUS = '00000' or '11111'), or

b. attempting to abort an "off-hook" or "on-hook" RQQ transaction

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 alerting AHY), then the unit shall assume that the original call will not take place and shall abandon the RQQ transaction (without sending RQX). It shall also obey the procedures in 9.2.2.2A for the new call.

13.2 Procedures for Status Messages Addressed to Radio or Line Units

13.2.1 TSC Procedures for Status Messages to Radio or Line Units

13.2.1.1 Responses to a short addressing RQQ message

A radio unit requests that status information be relayed to a unit with the same prefix by generating an RQQ message, complying with the random access protocol. On receiving a common-prefix RQQ message, the TSC shall send one of the following responses:

a. ACK(QUAL=0), ACKI(QUAL=1), ACKQ, ACKX or ACKV, with the same prefix and idents as the RQQ.

b. ACKT(QUAL=0), with PFIX/IDENT2 as the calling unit's individual address.

c. An AHYQ message for this transaction.

For acceptable delay, see 7.2.4. See also 13.2.1.4 and 13.2.1.5.

13.2.1.2 Responses to an extended addressing RQQ message

A radio unit requests that status information be relayed to a unit with a different prefix by generating an RQQ message (with IDENT1 = IPFIXI), complying with the random access protocol. On receiving an interprefix RQQ message, the TSC shall send one of the following responses, with the same prefix and idents as the RQQ:

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

b. AHYC (i.e. an instruction to send the called unit's address).

For acceptable delay, see 7.2.4. See also 13.2.1.3 and 13.2.1.4.

13.2.1.3 Instruction to send extended address information

After receiving an interprefix RQQ message, the TSC may demand the called unit's address from the calling radio unit by sending the AHYC message (with the same prefix and idents as the RQQ, field DESC set to '000' and field SLOTS set to '01').

The AHYC message instructs the calling unit to send the called address in the following slot (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 transaction.

13.2.1.4 Acknowledgements sent to indicate progress of RQQ transaction

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

ACKI (QUAL=1)	-	Intermediate acknowledgement; more signalling to follow.
ACKQ (QUAL=0)	-	System is busy. Wait for further signalling.
ACKQ (QUAL=1)	-	Called unit engaged. Wait for further signalling.
ACKX (QUAL=0)	-	Invalid call e.g. TSC does not support status messages, or called address is a group address, or called unit is not equipped to accept the information.
ACKX (QUAL=1)	-	System or called unit overload; message rejected.
ACKV (QUAL=0)	-	Called unit not in radio contact or transaction abandoned.
ACKV (QUAL=1)	-	Called unit engaged (and TSC will not hold the request), or called unit does not wish to accept the information.
ACKT (QUAL=0)	-	Called unit's calls have been diverted.
ACK (QUAL=0)	-	Transaction has been successfully completed i.e. the called unit has accepted the status information.

For maximum acceptable delay of repeats of acknowledgements ACKX, ACKV, ACKT and ACK, see time-out TB in 13.2.2.4.

13.2.1.5 Informing a called radio unit

The TSC informs a called radio unit of status information by sending the AHYQ message (see 5.5.3.2.7). The status message may have originated from the TSC itself, or from a radio unit (using RQQ etc.) or a line unit.

For an interprefix status message, IDENT2 in the AHYQ address codeword is set to IPFIXI and a data codeword is appended containing the calling unit's address.

The AHYQ message demands a response from the called unit (see 13.2.3). If the response is ACK(QUAL=0), ACKX or ACKV(QUAL=1), the TSC may send appropriate acknowledgement(s) to a calling radio unit (see 13.2.1.4). If the TSC does not successfully decode a response, or if the response is ACKB(QUAL=1), it may repeat the AHYQ message. If the called unit cannot be contacted, the TSC may indicate the failure to the calling unit by sending ACKV(QUAL=0).

13.2.1.6 Aborting the transaction

A calling radio unit may abort its status transaction by generating an RQX message (see 5.5.3.1.3), complying with the random access protocol. On receiving an RQX message aborting a status transaction, the TSC shall send a response: ACK(QUAL=1) with the same prefix and idents as the RQX.

If the RQX is aborting a speech call request (i.e. RQQ(STATUS='00000')) and the TSC has already informed the called unit of the call request, it may inform the called unit of the abortion by sending AHYQ with STATUS='11111'.

13.2.1.7 TSC time-out

The TSC may operate a time-out on the maximum time for which it holds a status message request (for example, waiting for the called unit to be free).

The TSC may instruct a calling radio unit to restart its waiting timer TW, 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 the status transaction (from the calling unit), the TSC shall not send any further signalling for the transaction. See also 13.2.2.5.

13.2.2 Procedures for Radio Units Sending Status Messages to Radio or Line Units

A radio unit shall make only one call attempt at a time (except in emergency); while attempting access or waiting for a terminating (i.e. end-of-transaction) acknowledgement to a status message request, the unit shall not request another non-emergency call of any type (unless the user first aborts the original transaction).

13.2.2.1 Request for a status transaction to a radio or line unit

A radio unit requests a status transaction by sending an RQQ message on a control channel, complying with the random access protocol (see 7.3). The fields in the RQQ message shall be set appropriately (see 5.5.3.1.7); however, note particularly that an interprefix request is indicated by setting IDENT1 to IPFIXI. (Note also that status messages cannot be sent to a group.)

The unit shall attempt access until it receives a valid response (see 13.2.2.2/3), or until its user aborts the transaction (see 13.2.2.6), 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 (and may indicate the failure to the user); otherwise, it shall wait for further signalling for the transaction - see 13.2.2.4 and 13.2.2.5.

13.2.2.2 Valid responses to a short addressing RQQ

For a common-prefix RQQ, the calling unit shall accept the following messages as a response to its RQQ and send no more requests:

a. An acknowledgement ACK(QUAL=0), ACKI(QUAL=1), ACKQ, ACKX or ACKV, with the same prefix and idents as the RQQ message.

b. An acknowledgement ACKT(QUAL=0) with PFIX/IDENT2 as its individual address. See also 13.2.2.4.

c. An AHYQ message with the same prefix, idents and STATUS field as the RQQ message.

For other actions on receiving these messages, see section 13.2.2.4.

13.2.2.3 Valid responses to an extended addressing RQQ

For an interprefix RQQ, the calling unit shall accept the following messages (with the same prefix and idents as the RQQ) as a response to its RQQ 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 called unit's address).

For other actions on receiving these messages, see 13.2.2.4 and 9.2.2.1.

13.2.2.4 Acknowledgement received

If a radio unit attempting access or waiting for further signalling for a status transaction receives an appropriate acknowledgement then it shall take action as indicated below. For interprefix RQQs, 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=1)	-	Intermediate acknowledgement; more signalling to follow.
ACKQ (QUAL=0)	-	System is busy. Wait for further signalling.
ACKQ (QUAL=1)	-	Called unit engaged. Wait for further signalling.
ACKX (QUAL=0)	-	Invalid call; message rejected.
ACKX (QUAL=1)	-	System or called unit overload; message rejected.
ACKV (QUAL=0)	-	Called unit not in radio contact or transaction abandoned.
ACKV (QUAL=1)	-	Called unit engaged (and TSC will not hold the request), or called unit does not wish to accept the information.
ACKT (QUAL=0)	-	Called unit's calls have been diverted.
ACK (QUAL=0)	-	Transaction has been successfully completed i.e. the called unit has accepted the status information.

If ACKI(QUAL=1) or ACKQ is received, the unit shall wait for further signalling and may indicate to the user the progress of the transaction.

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 transaction; it is recommended that receipt of ACKX(QUAL=0) be indicated in a distinct manner.

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 unit's calls have been diverted), or

b. attempt a new status transaction to the diversion address given in the ACKT message.
Note that, if IDENT1 = IPFIXI in the ACKT address codeword and bit GF = 1 in the appended data codeword, then the diversion address is a group address; in this case, a status transaction to the diversion address would be an invalid call.

If an incomplete ACKT(QUAL=0) message is received, 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 transaction, 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).

If ACK(QUAL=0) is received, the unit shall return to the idle state and may indicate to the user that the transaction has been successfully completed i.e. that the called unit has accepted the information. (Note that this does not imply user acceptance.)

After receiving ACKX, ACKV or ACK for the transaction, the unit shall not request another non-emergency call of any type to the same called ident (or gateway) for at least a time TB. After receiving ACKT for the transaction, the unit shall not request another non-emergency call of any type for at least a time TB.

13.2.2.5 Time-out after waiting

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

RQQ, requesting the transaction (see 13.2.2.1)
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 bit POINT = 1 and IDENT1 as the called ident or gateway (see 9.2.2.3).

It may also indicate to the user that the outcome of the transaction is unknown.

13.2.2.6 Aborting the transaction

If the user wishes to abort the transaction after the unit has sent an RQQ and while it is still waiting for a terminating acknowledgement, the unit shall attempt to send an abort transaction request RQX (see 5.5.3.1.3), complying with the random access protocol. It shall attempt access until one of the following occurs:

a. It receives ACK(QUAL=1) with the same prefix and idents as the RQX. In this case, it may indicate to the user that the outcome of the transaction is unknown.

b. It receives ACK(QUAL=0), ACKX, ACKV or ACKT(QUAL=0) for the transaction it is attempting to abort. See also 13.2.2.4.

c. 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 status transaction (see 13.2.2.4 and 13.2.2.5).

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

13.2.3 Procedures for All Radio Units on a Control Channel

The procedures in this section shall be obeyed by all radio units that are equipped to recognise a received AHYQ address codeword. (The requirement to recognise AHYQ will be system-dependent.)

13.2.3.1 Receiving status message (AHYQ)

If a radio unit on a control channel receives an AHYQ message with PFIX/IDENT1 matching its individual address then it shall respond with the appropriate acknowledgement (see below), with the same prefix and idents as the AHYQ. If IDENT2 / IPFIXI in the AHYQ message, the unit shall respond in the slot following the AHYQ; if IDENT2 = IPFIXI, 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. If the unit is not equipped to accept the information then it shall send ACKX (QUAL=0).

b. Otherwise, the unit shall send one of the following acknowledgements:

ACKB (QUAL=1) if IDENT2 = IPFIXI in the AHYQ message but the appended data codeword was not decodeable and the unit requires the message to be retransmitted.

or ACKX (QUAL=1) if it cannot accept the information at this time (e.g. STATUS = '00000' in the AHYQ message and the unit's call queue is full)

or ACKV (QUAL=1) if it does not wish to accept status information from this calling party

or ACK (QUAL=0) if it has accepted the information in the AHYQ message.

14. SHORT DATA MESSAGE PROCEDURES

This section defines the procedures for short data messages of up to 184 bits of free-format data, transmitted on a control channel. The data is contained in up to four data codewords, appended to an address codeword (HEAD).

A radio unit requests to send a short data message using the RQC message (see 5.5.3.1.8). The TSC then:

- instructs the unit to send the short data message (and extended address information if appropriate)
- forwards the message to the called party
- indicates the outcome of the transaction to the calling unit.

A radio unit may send a short data message to the TSC or to a radio unit, a line unit, a group of units, all units in the system, a PABX extension (short or extended addressing) or a PSTN number (short-form or general).

The TSC may also transmit short data messages (addressed to a radio unit, a group or all units in the system), originated from the TSC itself or from a line unit, a PABX extension or the PSTN.

For calls from radio units, the TSC uses the AHYC message to demand:

a. the called address information, for calls to:

- interprefix addresses (if appropriate: see below)
- general PSTN destinations
- "long" PABX extension numbers

b. the short data message.

If both a. and b. are needed, the TSC obtains the full information in two steps, each step using the AHYC message. The AHYCs are distinguished by the setting of IDENT1 (to IPFIXI, PSTNGI or PABXI for a., or to SDMI for b.), and so the order in which they are sent is not prescribed.

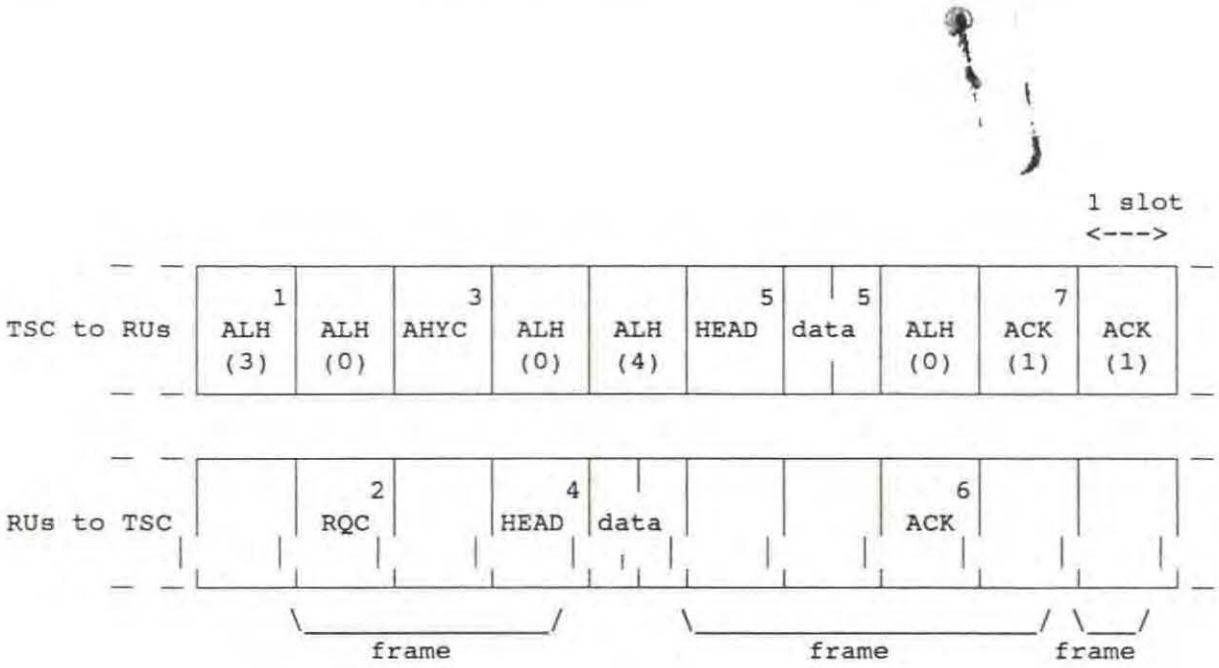
Note that, when a radio unit sends its short data message, it supplies the address (prefix/ident) of the called party in the data message header. Therefore, for an interprefix call, the TSC need not demand the called address separately unless it is required for operational convenience.

The format for data within a short data message is not prescribed. Also, further (system-dependent) specifications may be required to define:

- timings for repeat messages, and/or
- enumeration of data messages

to prevent duplicate messages (when a recipient accepts the repeat of a message as a new message).

A typical message sequence for a radio unit sending a short data message to another radio unit is illustrated in the example below.



Example A message sequence on a control channel for sending a short data message from one radio unit to another radio unit on the same site. In this example, the data message comprises an address codeword and two appended data codewords.

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

2. RQC : Random access request to transmit a short data message. (The request indicates the number of timeslots required for the data message: in this case, two slots.)

3. AHYC : Short data invitation message
   - acknowledges the RQC message
   - instructs the calling unit to send the data message in the next two slots
   - inhibits random access in the next slot.

4. HEAD + data : The calling radio unit sends its short data message to the TSC. In this example the message comprises an address codeword (HEAD) and two appended data codewords.

5. HEAD + data : The TSC forwards the short data message to the called radio unit.

   The second data codeword contains a flag (RSA) which is set to '0' to inhibit random access in the following slot, thus reserving the slot for a response from the called unit.

6. ACK : Acknowledgement ACK(QUAL=0) from the called radio unit - data message accepted.

7. ACK : Acknowledgement ACK(QUAL=0) sent to the calling unit to indicate that the called unit has accepted the data message. In this example the TSC immediately repeats the ACK message, for added reliability.

14.1 TSC Procedures for Short Data Messages

14.1.1 Responses to a short addressing RQC message

A radio unit requests to send a short data message by generating an RQC message, complying with the random access protocol. On receiving a short addressing RQC message (with EXT = 1, or with EXT = 0 and IDENT1 set to a valid called party ident), the TSC shall send one of the following responses:

a. ACKI(QUAL=1), ACKQ(QUAL=1), ACKX or ACKV, 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).

b. ACKT(QUAL=0), with PFIX/IDENT2 as the calling unit's individual address.

c. An AHYC message instructing the calling unit to send its data message.

For acceptable delay, see 7.2.4. See also 14.1.4 and 14.1.5.

14.1.2 Responses to an extended addressing RQC message

A radio unit requests to send a short data message by generating an RQC message, complying with the random access protocol. On receiving an extended addressing RQC message (with EXT = 0 and IDENT1 = IPFIXI, PSTNGI or PABXI), the TSC shall send one of the following responses:

a. ACKI(QUAL=1), ACKX or ACKV(QUAL=0), with the same prefix and idents as the RQC.

b. An AHYC message instructing the calling unit to send the full called address information.

c. An AHYC message instructing the calling unit to send its data message.

For acceptable delay, see 7.2.4. See also 14.1.3 to 14.1.5.

14.1.3 Instruction to send extended address information

After receiving an extended addressing RQC message, the TSC may demand the full called address (if appropriate), by sending the AHYC message with:

- the same prefix and idents as the RQC
  (i.e. IDENT1 set to IPFIXI, PSTNGI or PABXI as appropriate, and PFIX/IDENT2 set to the calling unit's address)
- DESC set to indicate the appropriate gateway (see 5.5.3.2.8)
- SLOTS set to correspond to the RQC
  (i.e. if IDENT1=PSTNGI and FLAG1=1 then SLOTS='10' else SLOTS='01').

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 transaction.

Note that, when the radio unit sends its short data message, it supplies the called address (prefix/ident) in the data message header. Therefore, for an interprefix call, the TSC need not demand the called address separately unless it is required for operational convenience.

14.1.4 Instruction to send the short data message

After receiving an RQC message, the TSC may demand the short data message from the calling radio unit by sending the AHYC message, with:

- IDENT1 set to SDMI
- PFIX/IDENT2 set to the calling unit's address
- DESC set to '000'
- SLOTS equal to SLOTS from the RQC.

The AHYC message instructs the calling unit to send its short data message in the following SLOTS slots (see 9.2.2.1). If the TSC does not successfully decode the short data message, it may repeat the AHYC message or transmit ACKV(QUAL=0) to indicate failure of the transaction.

Note that AHYC bars random access only in the first following return slot. When demanding a short data message, the TSC shall take appropriate action to reserve the subsequent return slot(s) if they are within a frame (e.g. by sending the AHY message with both idents set to DUMMYI).

14.1.5 Acknowledgements sent to indicate progress of RQC transaction

The TSC may send acknowledgement messages to indicate to a calling radio unit the progress of its short data transaction - for idents, see 5.5.2.1. (For an extended addressing call, acknowledgements ACKQ, ACKV(QUAL=1), ACKT(QUAL=0) and ACK(QUAL=0) are not appropriate until the called address has been obtained. Acknowledgements ACKQ(QUAL=0) and ACK(QUAL=0) are not appropriate until the short data message has been obtained.)

ACKI (QUAL=1)	-	Intermediate acknowledgement; more signalling to follow.
ACKQ (QUAL=0)	-	System is busy. Wait for further signalling.
ACKQ (QUAL=1)	-	Called party engaged. Wait for further signalling.
ACKX (QUAL=0)	-	Invalid call e.g. TSC does not support short data messages, or called party is not equipped to accept the message.
ACKX (QUAL=1)	-	System or called unit overload; message rejected.
ACKV (QUAL=0)	-	Called unit not in radio contact or transaction abandoned.
ACKV (QUAL=1)	-	Called party engaged (and TSC will not hold the request) or called unit does not wish to accept the message.
ACKT (QUAL=0)	-	Called party's data calls have been diverted.
ACK (QUAL=0)	-	Transaction has been successfully completed.

For maximum acceptable delay of repeats of acknowledgements ACKX, ACKV, ACKT and ACK, see time-out TB in 14.2.4.

14.1.6 Availability check on called radio unit

Before transmitting a short data message to a radio unit, the TSC may check that the unit is in radio contact (and suitably equipped). It uses the AHY message, with:

- bit POINT set to '0'
- bit CHECK set to '0'
- bit D set to '1'
- bit E set to '0'
- bit AD set to '0'
- PFIX/IDENT1 as the called unit's address
- IDENT2 set to SDMI.

The AHY message demands a response in the following slot from the called unit (see 9.2.2.2B).

The TSC may indicate the result of the availability check to a calling radio unit by sending appropriate acknowledgement(s) (see 14.1.5).

14.1.7 Informing called party

The TSC transmits a short data message to a radio unit, a group or all units in the system by sending the HEAD message on a control channel (see 5.6.2). The data message may have originated from the TSC itself, or from a radio unit (using RQC etc.), a line unit, a PABX extension or the PSTN.

The HEAD address codeword indicates the number of appended data codewords (up to four), and contains two 20-bit addresses: the called address and calling address (or gateway). The user data is contained in the data codewords. For an individually addressed short data message sent within a frame, the TSC shall set the RSA flag in the last data codeword (or in the "filler" data codeword) to '0', to inhibit random access in the next slot.

For an individually addressed short data message, the HEAD message demands a response from the called unit (see 14.3.1.1). If the response is ACK(QUAL=0), ACKX or ACKV(QUAL=1), the TSC may send appropriate acknowledgement(s) to a calling radio unit (see 14.1.5). If the TSC does not successfully decode a response, or if the response is ACKB(QUAL=1), it may repeat the HEAD message. If the called unit cannot be contacted, the TSC may indicate the failure to the calling unit by sending ACKV(QUAL=0).

For a short data message addressed to a group (or system-wide), the called units do not respond; the TSC may repeat the data message, to increase the probability of successful receipt. After transmitting the short data message, the TSC may send ACK(QUAL=0) to a calling radio unit.

14.1.8 Aborting the transaction

A calling radio unit may abort its short data transaction by generating an RQX message (see 5.5.3.1.3), complying with the random access protocol. On receiving an RQX message aborting a short data transaction, the TSC shall send a response: ACK(QUAL=1) with the same prefix and idents as the RQX.

14.1.9 TSC time-out

The TSC may operate a time-out on the maximum time for which it holds a short data message (for example, waiting for the called party to be free).

The TSC may instruct a calling radio unit to restart its waiting timer TJ or TW, by sending the AHY message with bit POINT set to '1'; see 9.1.1.7 and 9.2.2.3. If a time TJ or TW, minus the tolerance on the radio unit's timer, elapses since the last message it received for a short data transaction (from the calling unit), the TSC shall not send any further signalling for the transaction. See also 14.2.6.

14.2 Procedures for Radio Units Sending Short Data Messages

A radio unit shall make only one call attempt at a time (except in emergency); while attempting access or waiting for a terminating (i.e. end-of-transaction) acknowledgement to a short data message request, the unit shall not request another non-emergency call of any type (unless the user first aborts the original transaction).

14.2.1 Request for a short data transaction

A radio unit requests to transmit a short data message by sending an RQC message on a control channel, complying with the random access protocol (see 7.3). The fields in the RQC message shall be set appropriately (see 5.5.3.1.8); however, note particularly that:

a. Field SLOTS specifies the number of timeslots required for the data message (minimum two slots, maximum three slots).
b. An extended addressing request is indicated by setting IDENT1 in the RQC message to the appropriate gateway (viz. IPFIXI, PSTNGI or PABXI).

The unit shall attempt access until it receives a valid response (see 14.2.2/3), or until its user aborts the transaction (see 14.2.7), 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 (and may indicate the failure to the user); otherwise, it shall wait for further signalling for the transaction - see 14.2.4 to 14.2.6.

14.2.2 Valid responses to a short addressing RQC

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

a. ACKI(QUAL=1), ACKQ(QUAL=1), ACKX or ACKV, 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.

c. AHYC, with PFIX/IDENT2 as its individual address and IDENT1 as SDMI.

For other actions on receiving these messages, see 14.2.4 and 9.2.2.1.

14.2.3 Valid responses to an extended addressing RQC

For an extended addressing RQC, the calling unit shall accept the following messages as a response to its RQC and send no more requests:

a. ACKI(QUAL=1), ACKX or ACKV(QUAL=0), with the same prefix and idents as the RQC.

b. AHYC, with the same prefix and idents as the RQC.

c. AHYC, with PFIX/IDENT2 as its individual address and IDENT1 as SDMI.

For other actions on receiving these messages, see 14.2.4 and 9.2.2.1.

14.2.4 Acknowledgement received

If a radio unit attempting access or waiting for further signalling for a short data transaction receives an appropriate acknowledgement then it shall take action as indicated below. (ACKQ, ACKV(QUAL=1), ACKT(QUAL=0) and ACK(QUAL=0) are not appropriate until the called address information has been sent - in the RQC, as extended address information or in the short data message. ACKQ(QUAL=0) and ACK(QUAL=0) are not appropriate until the short data message has been sent.) For idents, see 5.5.2.1.

ACKI (QUAL=1)	-	Intermediate acknowledgement; more signalling to follow.
ACKQ (QUAL=0)	-	System is busy. Wait for further signalling.
ACKQ (QUAL=1)	-	Called party engaged. Wait for further signalling.
ACKX (QUAL=0)	-	Invalid call; message rejected.
ACKX (QUAL=1)	-	System or called unit overload; message rejected.
ACKV (QUAL=0)	-	Called unit not in radio contact or transaction abandoned.
ACKV (QUAL=1)	-	Called party engaged (and TSC will not hold the request) or called unit does not wish to accept the message.
ACKT (QUAL=0)	-	Called party's data calls have been diverted.
ACK (QUAL=0)	-	Transaction has been successfully completed.

If ACKI(QUAL=1) or ACKQ is received, the unit shall wait for further signalling and may indicate to the user the progress of the transaction.

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 transaction; it is recommended that receipt of ACKX(QUAL=0) be indicated in a distinct manner.

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 data calls have been diverted), or
b. attempt a new short data transaction to the diversion address given in the ACKT message.

If an incomplete ACKT(QUAL=0) message is received, 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 transaction, 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).

If ACK(QUAL=0) is received, the unit shall return to the idle state and may indicate to the user that the transaction has been successfully completed i.e. that:

- for an individual call, the called unit has accepted the short data message; (note that this does not imply user acceptance);

- for a group (or system-wide) call, the short data message has been sent to the group.

After receiving ACKX, ACKV or ACK for the transaction, the unit shall not request another non-emergency call of any type to the same called ident (or gateway) for at least a time TB. After receiving ACKT for the transaction, the unit shall not request another non-emergency call of any type for at least a time TB.

14.2.5 Sending the short data message

The calling unit shall transmit its short data message (a HEAD address codeword and appended data codeword(s) - see 5.6.2) on receipt of an appropriate AHYC from the TSC; see section 9.2.2.1.

14.2.6 Time-out after waiting

A calling radio unit waiting for further signalling for a short data transaction shall return to the idle state if a time TJ (for a data message addressed to the TSC) or TW (for other destinations) has elapsed since the last signalling message it sent for the transaction, viz.

RQC, requesting the transaction (see 14.2.1)
or SAMIS, providing extended address information for the call (see 9.2.2.1)
or HEAD, containing the short data message (see 14.2.5 and 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 to the user that the outcome of the transaction is unknown.

14.2.7 Aborting the transaction

A radio unit may abort a short data transaction (after sending an RQC and while still waiting to receive ACKX, ACKV, ACKT or ACK) by transmitting an abort transaction request RQX (see 5.5.3.1.3), complying with the random access protocol. It shall attempt access until one of the following occurs:

a. It receives ACK(QUAL=1) with the same prefix and idents as the RQX. In this case, it may indicate to the user that the outcome of the transaction is unknown.

b. It receives ACK(QUAL=0), ACKX, ACKV or ACKT(QUAL=0) for the transaction it is attempting to abort. See also 14.2.4.

c. 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 short data transaction (see 14.2.4 to 14.2.6).

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

14.3 Procedures for All Radio Units on a Control Channel

The procedures in this section shall be obeyed by all radio units that are equipped to recognise a received HEAD address codeword. (The requirement to recognise HEAD will be system-dependent.)

14.3.1 Receiving short data message (HEAD)

14.3.1.1 Individually addressed HEAD message

If a radio unit on a control channel receives a HEAD message with PFIX1/IDENT1 matching its individual address then it shall respond with the appropriate acknowledgement (see below), with PFIX/IDENT1 as its individual address and IDENT2 set to IDENT2 from the HEAD. The HEAD address codeword contains a field (LEN) which indicates the number of appended data codewords; the unit shall respond in the slot following the last data codeword. For timing, see 6.2.1.3.

a. If the unit is not equipped to accept the data message then it shall send ACKX (QUAL=0).

b. Otherwise, the unit shall send one of the following acknowledgements:

ACKB (QUAL=1) if not all the appended data codewords were decodeable and the unit requires the message to be retransmitted

or ACKX (QUAL=1) if it cannot accept the message at this time (e.g. its data store is full)

or ACKV (QUAL=1) if it does not wish to accept a data message from this calling party

or ACK (QUAL=0) if it has accepted the data message.

14.3.1.2 HEAD message addressed to a group

If a radio unit on a control channel receives a HEAD message with PFIX2/IDENT2 not matching its individual address, and

PFIX1/IDENT1 matching one of its group addresses for this system or

IDENT1 set to the system-wide all-call ident ALLI,

then it may accept the information contained in the HEAD address codeword and the appended data codewords, but shall transmit no response.

15. DATA INTERROGATION PROCEDURES

This section defines data interrogation procedures, which allow the TSC to demand that an addressed radio unit transmits a data message of a prescribed type. This demand is an interrogation by the TSC, not part of the signalling for a call requested by the radio unit. It may be sent on either a control channel or an allocated traffic channel.

The TSC interrogates the radio unit by sending message AHYC, Mode 2 (see 5.5.3.2.8). In this message, PFIX/IDENT1 is set to the radio unit's individual address and IDENT2 is the ident of the interrogator (a non-radio-unit ident). The type of data to be transmitted by the radio unit is indicated by the descriptor field DESC and the non-radio-unit ident.

The TSC does not acknowledge receipt of the radio unit's data message (though it may take appropriate action as a result of the received data).

Currently, for data interrogation, only one value of the data message descriptor field DESC has been assigned. This value is used for implementing serial number checks: the TSC may at any time, on a control channel or traffic channel, instruct a radio unit to send its 38-bit serial number. Comparison of the received serial number with the expected value (held in store at the TSC) will assist in the detection of fraudulent users.

15.1 Data Interrogation Procedures for TSC

15.1.1 Data interrogation on a control channel

The TSC may demand that a radio unit on a control channel transmits a data message of a prescribed type, by sending the AHYC message with:

- PFIX/IDENT1 set to the individual address of the radio unit
- IDENT2 set to the ident of the interrogator
  (for example, for a serial number check, IDENT2 = TSCI)
- DESC set to indicate the type of data message required; see 5.5.3.2.8
  (for example, for a serial number check, DESC = '000')
- SLOTS set appropriately; see 5.5.3.2.8
  (for example, for a serial number check, SLOTS = '01').

The AHYC message instructs the addressed radio unit to transmit a data message in the following SLOTS slot(s) (see 15.2.1). If the TSC does not successfully decode a reply, it may repeat the AHYC message when convenient. (The TSC does not acknowledge receipt of the data message).

Note that AHYC bars random access only in the first following return slot. When demanding a multi-codeword data message, the TSC shall take appropriate action to reserve the subsequent return slot(s) if they are within a frame (e.g. by sending the AHY message with both idents set to DUMMYI).

15.1.2 Data interrogation on a traffic channel

The TSC may demand that a radio unit on an allocated traffic channel transmits a data message of a prescribed type, by sending the AHYC message with:

- PFIX/IDENT1 set to the individual address of the radio unit
- IDENT2 set to the ident of the interrogator
- DESC set to indicate the type of data message required; see 5.5.3.2.8
- SLOTS set appropriately; see 5.5.3.2.8.

The AHYC message instructs the addressed radio unit to transmit a data message (see 15.2.2). If the TSC does not successfully decode a reply, it may repeat the AHYC message.

15.2 Procedures for All Radio Units

The procedures in this section shall be obeyed by all radio units that are equipped to recognise a received Mode 2 AHYC message. (The requirement to recognise AHYC, Mode 2 will be system-dependent.)

15.2.1 Data interrogation message (AHYC, Mode 2) on a control channel

If a radio unit on a control channel receives an AHYC message with PFIX/IDENT1 matching its individual address then it shall either send a data message in the following SLOTS slot(s), or transmit ACKX(QUAL=0), as indicated below. For timing, see section 6.2.1.3.

If
IDENT2 is set to TSCI
and DESC is set to '000'
and SLOTS is set to '01'
and the unit is equipped to transmit its serial number on interrogation

then it shall transmit its serial number, conforming to the codeword format defined in section 5.6.1.2.2 (SAMIS, Mode 2, DESC='000'). (The form of the serial number is system-dependent.)

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

15.2.2 Data interrogation message (AHYC, Mode 2) on an allocated traffic channel

If a radio unit on a traffic channel receives an AHYC message with PFIX/IDENT1 matching its individual address then it shall either send a data message or transmit ACKX(QUAL=0), as indicated below. For timing, see section 6.2.2.2.

If
IDENT2 is set to TSCI
and DESC is set to '000'
and SLOTS is set to '01'
and the unit is equipped to transmit its serial number on interrogation

then it shall transmit its serial number, conforming to the codeword format defined in section 5.6.1.2.2 (SAMIS, Mode 2, DESC='000').

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

16. ADDITIONAL SHORT DATA PROCEDURES e.g. SAMs

Additional short data procedures are not included in this issue.

17 STANDARD DATA PROCEDURES

17.0 Introduction

This section defines the procedures for setting up data calls and then transmitting Tmessages (see 2) in a standard manner on a standard data traffic channel (the data channel). A base station may include several data channels.

Data may be transferred between the following parties:

radio unit ---> TSC, line unit, radio unit or group
radio unit ---> all standard data equipped (SDE) units in system
radio unit ---> PABX extension (short or long extension number)
radio unit ---> PSTN destination (prearranged or general)
radio unit ---> Public Data Network (PDN) subscriber
TSC ---> radio unit, group or all SDE units in system
line unit ---> radio unit, group or all SDE units in system
PABX extn. ---> radio unit, group or all SDE units in system
PSTN terminal-> radio unit, group or all SDE units in system
PDN user ---> radio unit, group or all SDE units in system

Set-up of a new data call is initiated by the RQD request transmitted on either the control or data channel. For this and other purposes the data channel has random access frames interspersed with the user data being conveyed.

The data channel provides a link between the TSC and radio unit for the purposes of a data call. For an individual link with the TSC, errors on the data channel are corrected as necessary by automatic request for repetition (ARQ) before the data is passed on to any other data link or equipment, i.e. operation is "store and forward". The TSC may limit the time for which it will store a call if it finds difficulty in forwarding it. For a call between radio units at least two links are necessary.

One data channel at a base station may be shared at one time by up to 1023 links, several of which may be concurrently active, although the mean data transfer rate experienced by each active radio unit is liable to reduce as the total activity increases. The TSC is the master station and controls all transmissions on the data channel so as to avoid any simultaneous transmissions (except random access ones) from radio units on the return channel.

17.0.1 Facilities offered by the Standard Data Procedures

Facilities offered by these procedures are:

a) radio units operate in a half-duplex mode with bidirectional Tmessage transmission facility,

b) for group calls the data in the link from the TSC to the group is not corrected by automatic request for repetition but may be repeated up to a prearranged number of times to increase the probability of successful reception by all group members,

c) a data call may be conducted with an individual radio unit or transmitted to a group of radio units, and in the latter case responses may be obtained either by separate polling of each radio unit in the group or by inviting random access from group members,

d) the calling party may request that a call shall be directed to any one of 8 sub-addresses (PORTs), e.g. to call a particular receiving terminal configuration,

e) an end-to-end high accuracy data transfer (HADT) mode may be invoked,

f) a calling radio unit may request priority for resources for a data call,

g) a calling radio unit may make a request for an interactive data exchange with the called party so that the TSC will test whether a suitable radio channel is available and the called party is ready to exchange data,

h) urgent calls may be requested,

j) a suitably equipped radio unit may engage in more than one data call concurrently,

k) any called party can be informed of the identity of the calling party,

l) the calling party is given a reason for any call set-up failure,

m) a data call may consist of a single Tmessage (see NOTE 1), or may include a response or a number of data interchanges with pauses between the various Tmessages,

n) each link provided via a data channel is bit-transparent (see NOTE 2),

p) the standard data signalling rate is 1200 bit/s, with provision for a customised rate (see NOTE 3), and

q) radio units may be transferred individually or in groups from one data channel to another so that relief data channels may be created and brought into use when a data traffic overload occurs and can be taken out of use when the overload subsides. Also a radio unit on a data channel may be transferred collectively to another data channel.

NOTE 1. No specific "mail-box" facility is listed but all the ingredients necessary to provide that facility are available.

NOTE 2. Users concerned about unauthorised reception may wish to take advantage of this facility by encrypting their data.

NOTE 3. The individual links of a call may transmit at different rates because of the storage provided by the TSC. No customised rate is prescribed by this standard.

17.0.2 Guide to Some Key Protocol Aspects

17.0.2.1 Data Channel Addressing

On the data channel it would be wasteful of time always to use address codewords including the full identity of both the sender and recipient of a transmission dataitem. Moreover, if two radio units are involved they each have their own link with the TSC(s), and these links often act at different times because of the store and forward nature of the facility. Therefore on the data channel, instead of Prefixes and Identities, each radio unit uses a 10-bit transaction number termed a "TRANS" which identifies that link during that call and is assigned by the TSC in a "Go-to-TRANS" (GTT) message sent during the call set-up phase. The TRANS validity ceases when the link closes, and the TRANS value may then be reused for a new link. A dummy TRANS value '0000000000' is reserved for use in messages whenever no allocated value is appropriate.

Apart from the use of TRANS, the use of certain addresswords containing a PFIX and IDENT(s) also is valid on a data channel in appropriate circumstances.

17.0.2.2 Data channel format

All messages on the data channel conform to the traffic channel format described in section 3. On the forward channel preamble and SYNT are found in the last half of a Data Channel System Codeword (DCSC), equivalent to the CCSC of a control channel but with SYNC replaced by SYNT, see 5.1.

The standard allows for two possible transmission rates, viz 1200 bit/s and a customised one. Only one rate is used on any one channel. All stations must be able to utilize the 1200 bit/s rate, but use of the customised one is optional. A calling or individually called radio unit states whether it could operate at the customised rate in its respective RQD or acknowledgement message. The TSC specifies the rate for each TRANS in the relevant GTT message, but must not specify the customised rate unless both TSC and radio unit can use it. At 1200 bit/s the timing of a radio unit message relative to the TSC "invoking message" is as described in 6.2.1.3, but for any customised rate this timing is specified elsewhere. Some timing criteria are outlined in Appendix 6.

The data channel format is similar to a control channel in some ways, consisting of random and non-random transactions with radio units. However, because the transactions are often lengthy, differences between data and control channel are:

a) because of the long messages a TSC may transmit, on the forward channel DCSCs are infrequent compared to CCSCs,

b) the concept of time-slots only applies within random access frames,

c) the Aloha function which introduces a random access frame does not require a whole codeword and frequently shares a codeword with another function,

d) the list of codewords on the forward channel which withdraw slots from a random access frame is different,

e) the WAIT parameter is replaced by a 3-bit frame count parameter, WF. If a random access attempt has not been acknowledged before WF frames have been received then the access attempt may be repeated,

f) in the Aloha function there is a frame length (slots) field ND which has 5 bits to give a wide range of frame lengths,

g) a 10-bit TRANS field replaces the PFIX and IDENT fields found in frame marking codewords, and

h) there is no equivalent of the modifier M field in frame marking codewords (a TRANS value of '0000000000' permits any radio unit to attempt access, otherwise only the radio unit(s) assigned to the specified TRANS can attempt access).

17.0.2.3 Access on the data channel

Random access opportunities are provided on the data channel for radio units to make various data service requests. A frame marking function states the number of slots in an access frame, and radio units attempt access by transmitting a one-codeword message in a random slot within that frame. At 1200 bit/s each slot consists of two codewords, but slots at the customised rate may differ. The access frame has a maximum length of 31 slots. The frame marking function occupies half a codeword, the other half often being used for an acknowledgement.

Three types of frame marking function are provided, viz:

- DAL, a general Aloha,

- DALG, which limits requests to urgent calls or those for repeat of a group Tmessage, and

- DALN, which invites any requests except those for a repeat of a non-urgent group Tmessage.

Five types of request may be sent by radio units, viz:

- RQD to request a data call (which may be a concurrent call), (RQD with urgency bit E set to '1' is sent in any random access frame)

- DRUGI to request resumption of data transmission or reception in a given TRANS after a period of inactivity,

- DRQG to request repeat of the whole of a group Tmessage,

- DRQZ to request transmission of expedited data, and

- DRQX to request that a TRANS be closed. If the TRANS value in DRQX is the dummy, '0000000000', then it requests that all TRANS assigned to that radio unit be closed.

Permitted responses to these requests are detailed in 17.2.2.

A parameter, NDR, limits the number of random access tries in any one access attempt, and a time-out, TDC, limits the duration of a random access attempt. These parameters are pre-set. If either is exceeded then the

random access attempt is abandoned.

The AHYD message contains bit E to signal an urgent call. As well as the AHYD message, the TSC may send other data ahoy type messages to addressed radio units, viz:

- DAHY to check whether a particular TRANS is still active,

- DAHYZ to inform a radio unit of expedited data, e.g. to reset the link to a known state, and

- DAHYX to demand that a specific (or all) TRANS are closed.

17.0.2.4 Call Set-up

The call set-up procedures are similar whether initiated on the control or data channel.

To make a data call the radio unit transmits an RQD message. This includes PFIX and IDENT information and the called PORT, priority or urgency required, whether real-time data exchange with the recipient is required, whether high accuracy data transfer (HADT) is required, and whether the customised transmission rate can be used. The TSC grants the Request by sending a GTT message which includes the calling identity, the designation of the data channel to be used, the TRANS to be used for that call (or TRANS can be allocated on the data channel), and the designated link transmission rate.

To call a radio unit(s) the TSC sends an AHYD (POINT=0) message containing calling and called identities, whether HADT will be used, and the called PORT. In an individual call, if the radio unit can satisfy the call requirements it acknowledges this with a message which includes an indication of whether the customised rate can be used. A GTT message from the TSC, including the called identity, channel number, TRANS for that link (usually), and transmission rate, then instructs the radio unit to go to the data channel.

A call to or from a prearranged destination on any network can be set up using a special Ident, e.g. NETSIj or one of the spare Ident's. Calls to general PSTN and PABX destinations require extended addressing which is achieved in the normal manner. General calls to or from a PDN destination use the gateway "DNI", and then are switched to the data channel so that the addressing can be completed in gateway dependent format.

For a group call no response is made to the AHYD message. The group link then is announced by a GTT message. Usually the group transmission rate is prearranged. Any unit which cannot cope with the announced transmission rate or HADT, or accept the PORT ignores that message (but radio units may use a fall-back PORT). Although no reply to the Tmessage is possible within the call, a radio unit may note the caller's address in the AHYD, and, after the call, if it wishes to respond it sets up (e.g. on the data channel) a new call to the noted originator's address. The amount of data which can be conveyed in one group call is limited to a maximum of 11994 bits.

17.0.2.5 The ARQ scheme and related matters

Apart from the above, as well as the forward error correction possibilities offered by each codeword, an ARQ scheme is included in links with individual radio units. The descriptions given in this subsection apply only to individual links.

ARQ is not provided for a transmission to a group but, by prearrangement, the Tmessage may be transmitted automatically more than once, and individual radio units can request a repeat.

On any link no dataitem may contain more user data than that found in the address word plus 62 data codewords. Tmessages needing more than this are sent by dividing them into a number of dataitems. The maximum number of data codewords in any dataitem is controlled by the receiving station (or the TSC for a first dataitem) and in no case exceeds 62. Initially a dataitem is sent in one user data message but a fragment of a dataitem can also constitute a user data message.

The number of data codewords in any user data message is stated in a FRAGL field in its address codeword (SITH, see 5.8.12), and the position of the last bit of user data in the final codeword is given in the LASTBIT field of SITH. In a dataitem, user data starts in the 10-bit USER DATA field of SITH and continues with 47 bits of user data in every appended data codeword until the final codeword in the dataitem. In the user data field of that codeword (including SITH if it has no appended data codeword) the end of the user data is followed by a '1' to confirm the end of the user data. Any space left in the field is filled with '0's (unless HADT is used, see below). If it happens that the last user data bit occupies the final bit in the user data field of a codeword the end of user data is still confirmed, which gives rise to an appended data codeword containing a '1' and 46 '0's in its information field.

If HADT is invoked, the last 15 information bits in the message are a checksum on the data in the dataitem, and may replace 15 filler '0's. See 17.2.3.1.4.2.

In response to a faulty user data message the receiver may send a selective acknowledgement (SACK) to request retransmission of a fragment of a dataitem. Alternatively the receiver may request complete retransmission of the dataitem by sending a negative acknowledgement (NACK).

If HADT is invoked, when an apparently entire dataitem has been received the checksum is used to decide whether the dataitem is incorrect, and if so a NACK message is sent.

When the entire dataitem has been correctly received, a positive acknowledgement (PACK) is sent. Only then may the next dataitem be embarked upon. PACK and NACK only differ in 1 bit, and are known collectively as DACK.

As a precaution against lost or duplicated messages every header and acknowledgement contain the TRANS and a 1-bit dataitem number (ITENUM). The dataitem number remains constant for one dataitem and any repeat fragments but differs between any two adjacent dataitems.

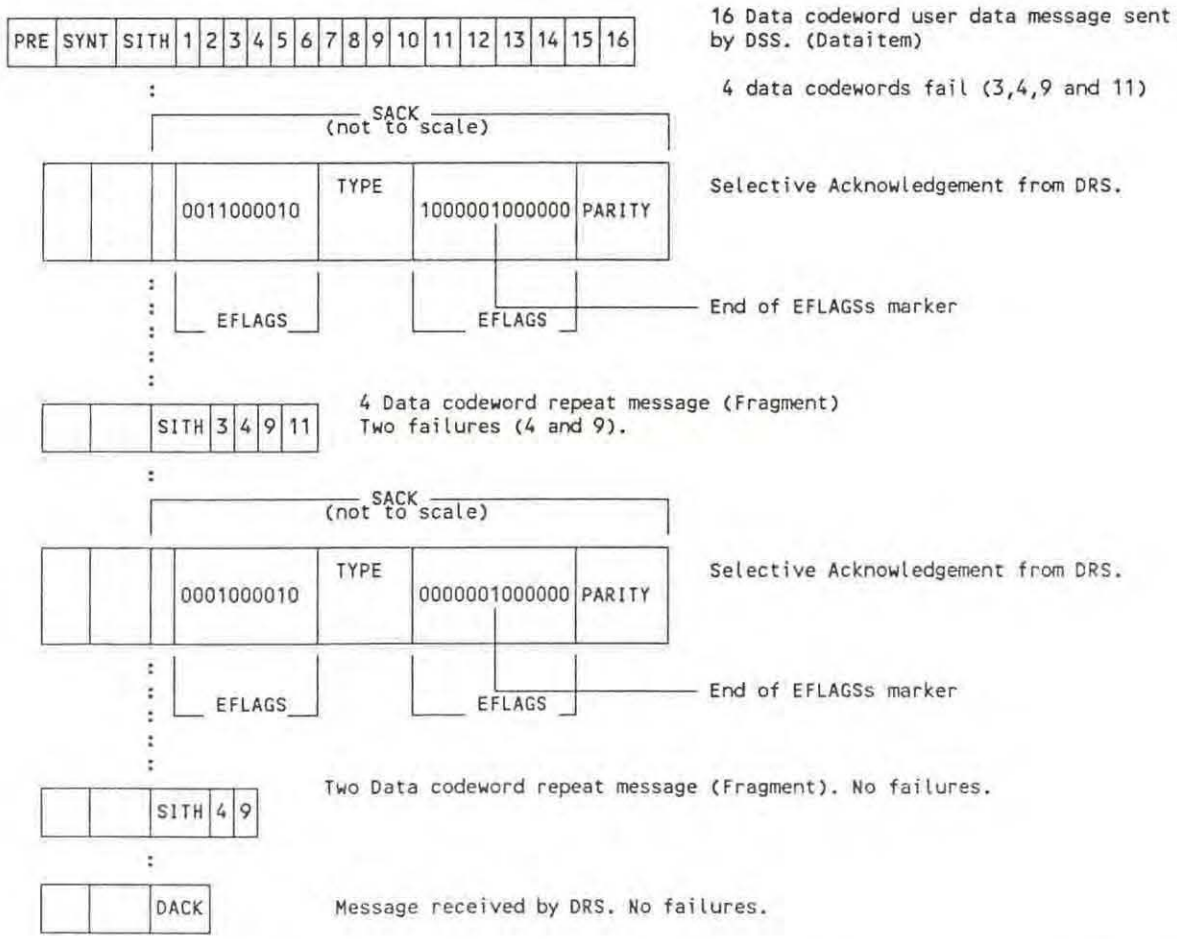
DACK occupies only about half a codeword (a submessage) and the remaining submessage is used for data channel access (see 17.0.2.3 and

17.0.2.6). In contrast a SACK message includes one assigned EFLAG bit for every dataword in the dataitem. An assigned EFLAG which is set to '1' indicates that the relevant data codeword must be repeated. The leading EFLAG represents the leading data codeword in the dataitem, and so on (see 5.8.11 for rules governing the use of the EFLAGS' field).

In order to mark the last assigned data codeword in the SACK message the first non-assigned EFLAG is set to '1' and any remaining non-assigned EFLAGs are set to '0'. There are 23 EFLAGs in the SACK addressword. If the dataitem has more than 22 datawords the SACK has an appended data codeword with a 40-bit EFLAG field, as confirmed by an address codeword flag "AD". Security of the EFLAG information is enhanced by a 4-bit 'ONES' field in each SACK codeword. The value of ONES is set to the modulo-16 number of EFLAGs set to 1 in that codeword.

In response to a SACK message containing assigned EFLAGs which are set to '1' the data transmitter sends a fragment of the dataitem which consists of a new header and only the repeated relevant data codewords in the same order as in the dataitem. A radio unit sends this response immediately (see Figure 17.1 below). For procedures for the data sending station (DSS) see 17.2.3.1.

FIGURE 17.1 Use of EFLAGS in Selective Repeat of a user data message



After sending a user data message, if, within a set time limit, the sender does not recognize an acknowledgement then it may infer that either

the recipient failed to decode the SITH (and hence any appended datawords) or that an acknowledgement was sent but not decoded. If only the addressword of a two-word SACK is decoded then clearly the user data message was received but the SACK cannot be acted upon. The acknowledgement loss situation can be rectified by repeating the message, but this is wasteful if the message is a long one and only acknowledgement information has been lost. To reduce waste a Repeat Last Acknowledgement (RLA) message is specified so that a sending station can demand acknowledgement repetition instead of sending a message repetition. The sending station acts upon the information in the repeated acknowledgement.

An acknowledgement from a radio unit follows substantially immediately after the end of the message transmitted by the TSC but the acknowledgement sent by the TSC in response to a message from a radio unit may be delayed by up to a pre-set time limit after the end of the message. If the time limit is exceeded the radio unit may use random access to send a query to the TSC.

17.0.2.6 Data Traffic and Flow Control

The TSC controls all data traffic on the data channel either by using a GO submessage to grant a dataitem transmission to the addressed radio unit or by using an aloha marker submessage to give a random access opportunity to radio units (see 5.8.2). A radio unit may indicate to the TSC in a GO submessage the length of the next dataitem it proposes to send. The TSC may grant a shorter dataitem length.

A field found both in SITH and DACK is "TNITEL" which informs the receiver of the proposed number of data codewords (0 to 62) in the next dataitem. The GO submessage (sent by a data receiving station) includes a 6-bit field, RNITEL, which defines the maximum number of data codewords that can be accepted in the next user data message.

Flow control at a link level is achieved by using the TNITEL and RNITEL fields. A data sending station must not send more data than is acceptable to the receiving station, as expressed in RNITEL. The TNITEL value found in SITH is advisory so that the receiver can check that it has sufficient storage.

When transmitted in a DACK submessage, if TNITEL has any value except the null value, '111111', that means the the acknowledging station intends or wishes to send user data, and hence bidirectional transmission is implied. If sent by a radio unit, TNITEL < '111111' can be acted upon by the TSC to invite user data. For example, bidirectional data flow in a TRANS may occur in the following recurrent order:

F'w'd Chan DACK+TNITEL+GO Message DACK+TNITEL+GO
Ret'n " Message DACK+TNITEL+GO
etc.

A radio unit which finds it necessary to stop data reception completely for some time may cease to be offered more data by the TSC. In that case, when it is ready the radio unit may request resumption of data flow by using a random access opportunity.

17.0.2.7 RESET

The RESET function is employed by a receiving or sending station or by the TSC to reset the data to a known state. The RESET operated by the end users is usually combined with synchronisation points so that after a RESET operation data communication can restart from a known synchronisation mark. The synchronisation marking techniques of the network service user are not specified in this standard. Generally this involves more than one link but of course comprises a single link if the radio unit and TSC happen to be the two end parties.

The RESET operation discards all that data transmitted before initiation of the RESET but not yet delivered to the network service user.

If the TSC receives the RESET message (which may be sent in a random access frame or in place of an acknowledgement or instead of invited data) it firstly acknowledges the message and also transmits RESET to the other correspondent at the earliest opportunity, e.g. before sending a 'GO' message or other which would permit the correspondent to send or repeat data. If necessary the TSC repeats the RESET until it is acknowledged by the radio unit. The TSC sends no more data to the originator of the RESET until this acknowledgement has been received.

A data receiving or sending radio unit which receives a RESET message firstly removes all data from its receiving and sending buffers and acknowledges the (received) RESET and then sends a RESET to (its) data terminal equipment (DTE) and waits for DTE acknowledgement before resuming any data sending or receiving.

17.0.2.8 Demarcation of a Tmessage

A "MORE" bit is found in each SITH, "MORE" is used to indicate the conclusion of each Tmessage. It is the duty of each node in the communication chain to interpret the "MORE" bit in this protocol or its equivalent in any other protocol and pass its meaning on to the dependant link in the appropriate format and position within the data stream.

17.0.2.9 Closing a TRANS and Moving to another channel

A TRANS may be closed either by TSC demand (which may or may not also demand an acknowledgement) or by radio unit request or by expiry of the radio unit inactivity timer TDX or TDN for an individual or group call respectively. When all TRANS of a radio unit have been closed it returns to the control channel.

If a TSC finds it desirable to move a radio unit to another data channel, e.g. because the data channel it is on has become overloaded, it may do so without breaking down a data call. To do this the TSC first demands closure of any calls concurrent with the one to be preserved. Then, at a time when neither radio unit nor TSC are attempting to send a message it sends the radio unit a GTT message including a new channel and a new TRANS. The radio unit moves to the new channel and notes that the new TRANS replaces the preserved one for the continued call.

The TSC may simultaneously move all the radio units to a new data channel by addressing them with the ALLI ident.

17.1 Procedures for Setting Up Standard Data Calls

This section contains the procedures for setting up standard data call links on either a control channel or a data channel. The procedures cover the following aspects:

a) Link with calling party

- call request procedures for standard data calls
- instruction to send extended address information
- call cancellation while waiting for a call
- establishment of calling party data link.

b) Link with called party

- availability/rate check on called radio units
- establishment of called party data link.

Standard data calls from radio units are requested using the Standard Data Communication Request Message RQD (see 5.7.1). For an emergency standard data call, bit E in the RQD is set to '1'.

The RQD message contains all the information necessary to request a common-prefix call, a system-wide call or a call to a prearranged PSTN or PDN destination.

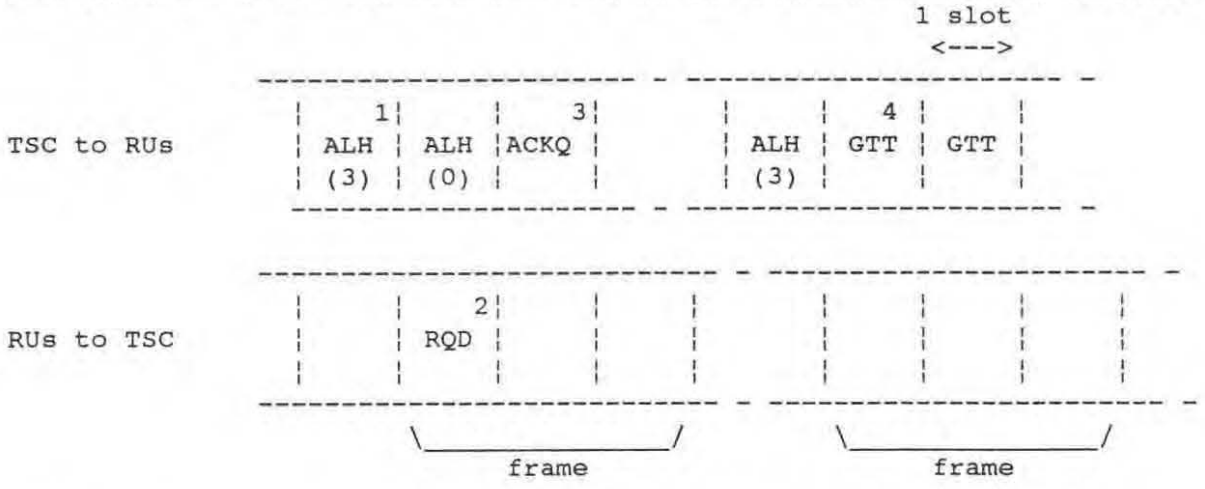
For an interprefix call, a general call to the PSTN or a call to any PABX extension, the call details cannot be accommodated in a single address codeword. For these calls, the RQD message requests entry into the extended addressing mode; the radio unit sets IDENT1 in the RQD to the appropriate gateway ident (viz. IPFIXI, DNI, PSTNGI or PABXI), and the TSC then demands the full called party information using the AHYC message.

Usually, if the TSC has a direct entry point to a data network then for a general call to a data network destination, the radio unit sets IDENT1 in the RQD message to DNI. After setting up the link, the radio unit is invited to supply the full destination address on the data channel using network layer procedures. Alternatively a radio unit may contact a distant data network entry point via the PSTN or a PABX, and when that contact has been established the full destination address is provided on the data channel as described above.

Note that extended addressing procedures are used for requesting a standard data call to any PABX extension (with either a long or short extension number). The unit sets IDENT1 in the RQD message to PABXI, and then sends the PABX address information in response to an AHYC message with IDENT1 set to PABXI and DESC set to '010'. The unit sets bit SP in the SAMIS message to indicate whether it is sending BCD digits or a 13-bit extension number (plus 2-bit exchange number). See 5.5.3.2.8 and 5.6.1.2.2.

Radio units requesting a 'general' PSTN call use the gateway ident, PSTNGI. In this case, units are requested to provide the full dialling information for the PSTN destination using extended addressing procedures. The FAD field in the RQD message performs the same function as FLAG1 in an RQC message.

The call set-up procedures are outlined in section 17.0.2, and typical message sequences for establishing standard data links are illustrated in the example below. The call shown is a common-prefix non-emergency call between two radio units, both of which are currently tuned to controlchannels. In this example, the calling unit is queued (to wait for a data channel or for the called party in an interactive call) - otherwise the TSC could have sent the Go To Transaction message directly.



Example 1A A message sequence on a control channel for a calling radio unit requesting a common-prefix standard data call.

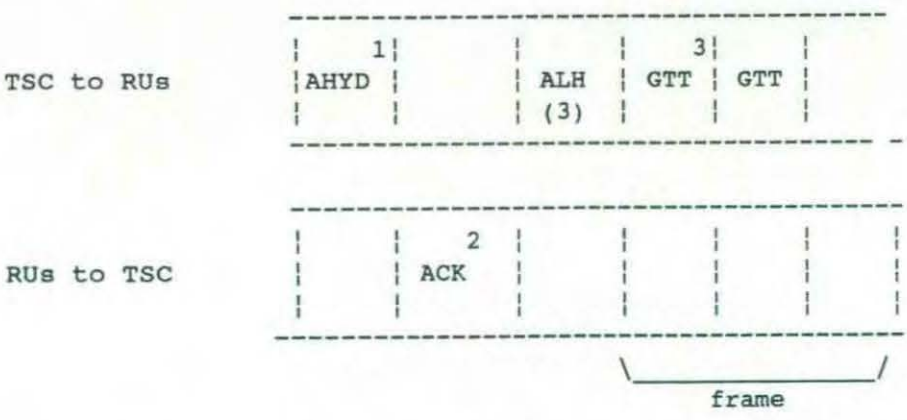
1. ALH : General Aloha invitation (three-slot frame).

2. RQD : Random access request for a Standard Data call.

3. ACKQ : The TSC acknowledges the RQD message, informing the calling unit that the call has been queued.

4. GTT : Go To Transaction message instructing the calling unit to switch to a designated data channel for the transaction. In this example, the GTT message is repeated, for added reliability.

(Note that the GTT message cannot mark an Aloha frame, but does not withdraw slots from an ongoing frame.)



Example 1B A message sequence on a control channel for a called radio unit in a common-prefix standard data call.

1. AHYD : Availability/rate check message sent to called unit. Demands a response from the called unit.

2. ACK : Acknowledgement that the radio unit is available and indicates whether it can operate at the customised rate.

3. GTT : Go To Transaction message instructing the called unit to switch to a designated data channel for the transaction. In this example, the GTT message is repeated, for added reliability.

As shown in the example, data links are established using the Go To Transaction message GTT. Note that the GTT message instructs only one radio unit or group. GTT messages are sent independently to establish links, for a particular call, between:

a) calling radio unit and TSC,
b) TSC and called radio unit (or group), as required. Note that:

- these GTT messages may be sent on different sites;
- they may designate different data channels;
- the specified transmission rates may be different;
- there is no relationship between the transaction numbers (which will be different if both parties are directed to use the same data channel).

Also, since all data is transferred via the TSC, it may not be necessary for the two parties to be on their data channels at the same time. Bit INTER in RQD indicates whether the calling party requires that the called party should be available to receive the data immediately (enabling a call where the parties appear to have interactive contact, achieved via the TSC's store-and-forward mechanism).

In the example, both radio units started the exchange tuned to control channels. More generally:

a) The call request (and following message sequence) may be sent on either a control or data channel, as appropriate.

b) The message sequence with the called party may take place on either a control or data channel, depending on where the called party is currently tuned.

The message sequences are similar whether they take place on a control or data channel. Where there are differences (for example, in the random access method) these are indicated in the procedures.

Note that high accuracy data transfer (HADT) may be invoked by setting the HADT bit of an RQD or AHYD message to '1'. When HADT is used in a call, it shall be applied to all links within the call which conform to this standard and, in an individual call, to both possible user data transmission directions. Parts of the call chain which do not conform to this standard are assumed here to be of adequate data transfer accuracy and are excluded from the rules laid down here. It is the user's responsibility to assure himself of the data transfer accuracy of these non-MPT 1327 parts of the chain.

17.1.1 TSC Procedures for Setting Up Standard Data Calls

This section describes 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.

Section 17.1.1.1 defines the basic procedures for setting up non-emergency standard data call links. Section 17.1.1.2 defines the procedures for emergency standard data calls.

17.1.1.1 TSC Procedures for Setting Up Non-Emergency Standard Data Call Links

17.1.1.1.1 Responses to a short addressing RQD(E=0) message

A radio unit requests a short addressing non-emergency standard data call by generating an RQD message (with E = 0 and IDENT1 set to a valid called party ident or short-form ident), on a control channel or data channel, complying with the appropriate random access protocol. On receiving a short addressing RQD(E=0) message, the TSC shall send one of the following responses (on the channel on which the RQD was received):
(For acceptable delay, see 7.2.4 or 17.1.4.)

- SLOTS set to correspond to the request as follows:

  For an interprefix or PABX call, SLOTS = '01' or
  For a general PSTN call, SLOTS = '01' or '10'

  (The FAD field in the RQD message indicates if the number of dialled digits exceeds 9).

The AHYC message instructs the calling radio unit to send the called party address information in the following SLOTS slot(s) (see 17.1.2.1.5). 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 17.1.1.1.4).

Note that AHYC bars random access only in the first following return slot. For SLOTS = '01', this is sufficient for the radio 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).

17.1.1.1.4 Acknowledgements sent to indicate progress of a call set-up attempt

The TSC may send acknowledgement messages at appropriate times to indicate to a calling radio unit the progress of its standard data call. For idents, see 5.5.2.1. (For extended addressing calls, only ACKI(QUAL=1), ACKV(QUAL=0) and ACKX 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 and ACKT should take account of time-out TDB (described in 17.1.2.1.4).

The TSC may send ACKI(QUAL=1) or ACKQ to indicate to a calling radio unit the progress of the signalling for its data call:

ACKI (QUAL=1)	-	Intermediate acknowledgement; more signalling to follow.
ACKQ (QUAL=0)	-	All data channels are busy. Wait for further signalling.
ACKQ (QUAL=1)	-	Called party is engaged (and calling party requires interactive contact). Wait for further signalling.

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

ACKX (QUAL=0)	-	Invalid call e.g. TSC or called party does not support standard data at least from this caller, or the radio unit is blacklisted, or called address is unobtainable.

ACKX (QUAL=1) - System overload, or for INTER='1' the called party is engaged or will not interact at this time and the TSC has not queued the call; request rejected.

ACKV (QUAL=0) - Called unit not in radio contact or call set-up abandoned.

ACKV (QUAL=1) - Call not queued because the called party is unable to receive a call with the required facilities, e.g. the called radio unit does not support HADT or interaction or cannot accept the requested PORT.

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); see 5.5.2.1.

(On receiving ACKT, the radio unit will either return to the idle state or re-attempt access by calling the diversion address - see 17.1.2.1.4.)

17.1.1.1.5 Call cancellation by calling party

A calling radio unit may cancel a requested standard data call by generating an RQX message (see 5.5.3.1.3), complying with the appropriate random access protocol. On receiving an RQX message cancelling a standard data call, the TSC shall send a response: ACK(QUAL=1), with the same prefix and idents as the RQX.

17.1.1.1.6 Queue time-out

The TSC may order its queue of standard data 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 standard data call. See also 17.1.2.1.7.

The TSC may instruct a calling radio unit to restart its waiting timer, by sending the AHY message with bit POINT set to '1'. If a time TW,(control channel) or TDW (data channel), minus the tolerance on the radio unit's timer, elapses since the last call set-up message it received for a standard data call (from the calling unit), the TSC shall not send on this channel any further call set-up messages to the calling unit for this call. (It may send AHYX to inform a called radio unit that the call will not take place - see 17.1.1.1.9.)

17.1.1.1.7 Establishing a data link with a calling party

A calling radio unit's request message indicates whether it is able to operate at the customised transmission rate. If the customised rate is not acceptable to both the calling unit and the TSC, then the TSC shall default to the standard rate. The TSC shall not specify a rate which is different from one in current use on the allocated channel.

For an interactive call, the TSC may establish the data link with the calling party only when it has ascertained that the called party or network gateway can accept the call (see 17.1.1.1.8 for checking call acceptance by a radio unit).

The TSC sends the Go To Transaction message GTT (on the channel on which the RQD was received). The TSC may repeat the GTT command.

The GTT message specifies:

i) The data channel number for the transaction.

For a call set-up GTT sent on a data channel, this shall be the number of that same data channel. (Whereas the TSC procedures for in-call transfer are specified in section 17.2.5.1.)

ii) The transmission rate to be used.

For a call set-up GTT sent on data channel, this shall specify the rate currently used on that channel.

iii) A transaction number TRANS for use on that data channel.

For GTT sent on a control channel, the TSC may set TRANS to a dummy value '0000000000'. In this case, it shall send further GTT message(s) on the specified data channel to designate a valid transaction number. The calling party will wait for a time TDG for a data channel GTT - see 17.1.2.3.4c. Accordingly, it is recommended that the TSC sends any data channel GTTs for the call within a period TDG (minus the tolerance on the radio unit's timer) following the first control channel GTT.

When establishing a data link with a calling radio unit, the TSC shall set bit O/R in the GTT message to '1'.

17.1.1.1.8 Availability/rate check on individually called radio unit

A TSC which wishes to set up a standard data call to a radio unit shall, before establishing the called party link, check whether the called unit can accept the call.

The TSC checks availability of a called radio unit for standard data, and asks whether the unit can accept the customised transmission rate, by sending the AHYD message. This message may be sent on either a control channel or data channel as appropriate. In the AHYD message:

- INTER indicates whether interactive contact is required,

- bit E indicates whether the call is urgent,

- PORT is the called port,

- PFIX/IDENT1 is the called unit's individual address,

- IDENT2 is the calling ident or short-form ident appropriate to the calling terminal or gateway, and

- HADT is set as appropriate.

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 AHYD to '1'.

The AHYD message demands a response from the called unit (see 17.1.2.3.1 or 17.1.2.4.3). If the response is ACKX or ACKV(QUAL=1), the TSC may send appropriate acknowledgement(s) to a calling radio unit (if the calling unit is still in the state of waiting for call set-up signalling for this call). If the TSC does not successfully decode a response, or if the response is ACKB(QUAL=1), it may repeat the AHYD message. If the called unit cannot be contacted, the TSC may indicate the failure to a waiting calling unit by sending ACKV(QUAL=0).

Acknowledgement ACK(QUAL=0) contains a bit, MODEM, which indicates whether the customised transmission rate is acceptable to the unit (see 5.5.2.2).

17.1.1.1.9 Informing called party of call cancellation

If an individual call is cancelled 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 17.1.2.3.2 or 17.1.2.4.4).

17.1.1.1.10 Sending AHYD to a group or ALLI

After receiving a request for a standard data call to a group (or to all units in the system), the TSC may send the AHYD message to announce:

- whether it is an emergency call (bit E),

- the called PORT,

- the calling or short-form ident or gateway (IDENT2), and

- whether HADT will be used.

For a request for a group call with INTER set to '1', or if PORT information is needed by called radio units, use of this message is recommended.

The AHYD message may be sent on either a control channel or data channel as appropriate. It may be repeated.

For an interprefix call, the TSC may append a data codeword containing the calling unit's address; if so, it shall set bit AD in the AHYD to '1'.

On receipt of the AHYD message, group members do not respond but may wait for a time TA (on a control channel) or TDA (on a data channel) for the corresponding GTT message (see 17.1.2.3.3 or 17.1.2.4.5). Accordingly, it is recommended that, on this channel:

a) The TSC sends any GTT messages for the call within a period TA/TDA (less the tolerance on the radio unit's timer) following the first transmitted AHYD message.

b) The TSC does not send any GTT messages for a different call to the same group address within a period TA/TDA (plus tolerance) following the last AHYD for this call. (Note that some radio units may miss the GTT messages for this call.)

17.1.1.1.11 Establishing data link with called party

The TSC establishes a data call link with a called radio unit or group by sending the Go To Transaction message GTT with bit O/R set to '0'. It may repeat the GTT command.

The GTT message specifies:

i) The data channel number for the transaction.

For a call set-up GTT sent on a data channel, this shall be the number of that same data channel.

ii) The transmission rate to be used.

For a call set-up GTT sent on a data channel, this shall specify the rate currently used on that channel.

For GTT sent on a control channel to a group, the method for the TSC to choose an appropriate transmission rate is system-dependent.

iii) A transaction number TRANS for use on the data channel.

For GTT sent on a control channel, the TSC may set TRANS to a dummy value '0000000000'. In this case, it shall send further GTT message(s) on the specified data channel to designate a valid transaction number. Called party(ies) will wait for a time TDG for a data channel GTT (or for an AHYD for another call) - see 17.1.2.3.4c. Accordingly, it is recommended that the TSC sends any data channel GTTs for the call within a period TDG (minus tolerance) following the first control channel GTT; and does not send any data channel GTT messages for a different call to the same group address within a period TDG (plus tolerance) following the last control channel GTT.

17.1.1.2 TSC Procedures for Setting Up Emergency Standard DataCall Links

17.1.1.2.1 Response to an emergency standard data request

A radio unit requests an emergency standard data call by generating an RQD(E=1) message, on a control channel or data channel, complying with the appropriate normal random access protocol (unless it has other arrangements with the system). On receiving an RQD(E=1) message, the TSC shall send a response: ACKE(QUAL=0) with the same prefix and idents as the RQD. For maximum permissible delay, see 7.2.4 or 17.2.1.1.4.

ACKE(QUAL=0) is sent only as a response to an RQE or RQD(E=1) message; it is an intermediate acknowledgement, indicating that further signalling will follow.

17.1.1.2.2 Signalling for previous call

After receiving an RQD(E=1) message, the TSC shall not send any further call set-up messages to the calling unit for any previous call requested by that unit (though, for a traffic channel or standard data call, it may send AHYX to inform a called radio unit that the call will not take place).

17.1.1.2.3 Obtaining extended address information

After receiving and responding to an extended addressing RQD(E=1) message, the TSC may demand the full called address information from the calling radio unit by sending the AHYC message (as in 17.1.1.1.3).

17.1.1.2.4 Acknowledgements sent to indicate progress of call

After receiving and responding to an RQD(E=1) message, the TSC may send acknowledgements ACKI(QUAL=1), ACKQ, ACKX, ACKV or ACKT(QUAL=0) to the waiting calling unit to indicate the progress of the call (as in 17.1.1.1.4).

17.1.1.2.5 Call cancellation by calling party

A calling radio unit may send an RQX message to cancel its emergency standard data call. The TSC procedures are as defined in 17.1.1.1.5.

17.1.1.2.6 TSC time-out

The TSC may instruct a calling radio unit to restart its waiting timer by sending the AHY message with bit POINT set to '1' (and bit E set to '1'). If a time TW/TDW, minus the tolerance on the radio unit's timer, elapses since the last call set-up message it received for an emergency data call (from the calling unit), the TSC shall not send on this channel any further call set-up messages to the calling unit for this call. (It may send AHYX to inform a called radio unit that the call will not take place.) See also 17.1.2.2.6.

17.1.1.2.7 Availability/rate check on individually called radio unit

This check shall be made as specified in 17.1.1.1.8.

17.1.1.2.8 Establishing data links

If all standard data channels (or transaction numbers) are fully occupied then the TSC may terminate another data call prematurely in order to establish an emergency call.

The procedures for establishing data links are as detailed in sections 17.1.1.1.7 and 17.1.1.1.11.

17.1.2 Radio Unit Procedures for Establishing Standard Data Calls

Section 17.1.2.1 defines the procedures for requesting non-emergency standard data calls and section 17.1.2.2 defines the procedures for emergency standard data calls. Sections 17.1.2.3 and 17.1.2.4 define related procedures for all radio units on control and data channels.

17.1.2.1 Procedures for Radio Units Requesting Standard Data Calls

A radio unit shall use short addressing for calls to other radio units with the same prefix, or, by prearrangement with the system, to a limited number of PSTN and PDN destinations. A radio unit also shall use short addressing for general calls via any PDN gateway offered by the TSC, in which case the full addressing is then accomplished on the allotted data channel in the format appropriate to that gateway.

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

17.1.2.1.1 Request for a non-emergency standard data call

A radio unit requests a non-emergency standard data call by sending an RQD(E=0) message, on a control channel or data channel, complying with the appropriate random access protocol (see 7.3 or 17.2.1.2). The fields in the RQD message shall be set appropriately (see 5.7.1); however, note particularly that:

a. An extended addressing request is indicated by setting IDENT1 in the RQD message to the appropriate gateway viz. IPFIXI, PSTNGI, and PABXI.

Note that:

extended addressing procedures are used for a call to a PABX extension. 'Short' PABX procedures are not supported for standard data calls, and

if a PDN entry point is to be reached via an intermediate network then the appropriate intermediate gateway is set in IDENT1 and further addressing is accomplished on the data channel in the format appropriate to that gateway.

b. The FAD field shall be set to '0' unless the PABX/PSTN destination address contains more than 9 digits.

c. Field PORT indicates the required called port.

d. Bit INTER is set to '1' if the calling party requires interactive contact with the called party.

e. Bit LEVEL indicates whether the calling party is requesting high priority for resources. For INTER = '1', this requests high priority for the complete path to the called party; for INTER = '0', it requests high priority only for the calling unit's link to the TSC.

f. Bit MODEM indicates whether the unit is able to operate at the customised transmission rate.

g. Bit HADT shall be set to '1' if high accuracy data transfer is thought to be supported by the TSC and is required.

The radio unit shall attempt access until:

i) it receives a valid response (see 17.1.2.1.2/3), or

ii) its user cancels the call (see 17.1.2.1.8), or

iii) the access attempt fails (i.e. the unit has sent the maximum number of transmissions NR/NDR and received no response, or its access time-out TC/TDC has expired (see 7.3.8 or 17.2.1.2.7)).

In this case:

- If the unit has not sent a request, it shall return to the state previous to the access attempt (and may indicate the failure to the service user).

- Otherwise, the unit shall wait for further call set-up signalling for the call; see 17.1.2.1.4 to 17.1.2.1.7.

17.1.2.1.2 Valid responses to short addressing RQD(E=0)

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

a. An acknowledgement ACKI(QUAL=1), ACKQ, ACKX or ACKV, with the same prefix and idents as the RQD.

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

c. A Go To Transaction message GTT with PFIX/IDENT as its individual address, bit O/R set to '1', an acceptable RATE and, for a request on a data channel, CHAN set to the number of that data channel.

For other actions on receiving these messages, see sections 17.1.2.1.4 and 17.1.2.1.6, and 17.1.2.3.4 or 17.1.2.4.6.

17.1.2.1.3 Valid responses to extended addressing RQD(E=0)

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

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

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

For other actions on receiving these messages, see sections 17.1.2.1.4 and 17.1.2.1.5.

17.1.2.1.4 Acknowledgement received

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

ACKI (QUAL=1)	-	Intermediate acknowledgement; more signalling to follow.
ACKQ (QUAL=0)	-	All data channels are busy. Wait for further signalling.
ACKQ (QUAL=1)	-	Called party engaged. Wait for further signalling.
ACKX (QUAL=0)	-	Call adjudged to be invalid by TSC or called party; request rejected.
ACKX (QUAL=1)	-	System overload, or for INTER='1' the called party is engaged or will not interact at this time, and the TSC has not queued the call; request rejected.
ACKV (QUAL=0)	-	Called unit not in radio contact or call set-up abandoned.
ACKV (QUAL=1)	-	Call not queued because the called party is unable to receive a call with the required facilities, e.g. the radio unit does not support HADT or interaction or cannot accept the requested PORT.
ACKT (QUAL=0)	-	Called party's calls have been diverted.

If ACKI(QUAL=1) or ACKQ is received, the unit shall wait for further signalling and may indicate to the service user the progress of the call.

If ACKX or ACKV is received, the unit shall return to the state previous to the call request and may indicate to the service user the reason for the failure of the call; it is recommended that receipt of ACKV(QUAL=0), ACKV(QUAL=1), ACKX(QUAL=0), and ACKX(QUAL=1) each be indicated in its own distinct manner.

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

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

b. wait for a time (TB on the control channel, TDB on the data channel) (see below), and then attempt a new call to the diversion address given in the ACKT message:

- if IDENT1 does not equal IPFIXI or PSTNGI or PABXI, try on IDENT1;

- if IDENT1 = IPFIXI or 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 previous state (and may give an indication to the service 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 previous state if a time TB/TDB elapses (in which case, it may indicate the failure to the service user).

After receiving ACKX or ACKV for the call, the unit shall not request another non-emergency call of any type to the same called ident (or gateway) for at least a time TB/TDB. After receiving ACKT for the call, the unit shall not request another non-emergency call of any type for at least a time TB/TDB.

17.1.2.1.5 Instruction to send address information

A radio unit that is requesting an extended addressing standard data call on a control channel shall follow the procedure in 9.2.2.1 for sending the full address information, but with a revised check on the SLOTS field from the AHYC. The check that "SLOTS corresponds to the request", for an extended addressing data call, shall be taken as:

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If IDENT1 = PSTNGI and unit's call requires > 9 PSTN digits
                          then SLOTS = '10'.
If IDENT1 = PSTNGI and unit's call requires < 10 PSTN digits
                          then SLOTS = '01' or '10'.
If IDENT1 not equal to PSTNGI
                          then SLOTS = '01'.
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The procedure for sending extended addressing information for a data call requested on a data channel is specified in section 17.1.2.4.1.

17.1.2.1.6 Availability check and channel command for own call

A calling radio unit attempting access or waiting for further call set-up signalling for a standard data call shall obey the appropriate availability check and channel command procedures (see 9.2.2.2 to 9.2.2.5 and 17.1.2.3.1 to 17.1.2.3.4, or 17.1.2.4.2 to 17.1.2.4.6).

It shall assume that a GTT message it receives is for its requested standard data call if PFIX/IDENT is its individual address, bit O/R is set to '1', RATE is acceptable and, for a GTT on a data channel, CHAN is set to the number of that data channel. If also TRANS > '0000000000' then the unit shall regard the call link as established and may give an indication to the service user.

17.1.2.1.7 Time-out after waiting

A calling radio unit waiting for further call set-up signalling on the channel on which it attempted access for a standard data call shall return to the previous state if a time TW/TDW has elapsed since the last message it sent for the call, viz.

RQD, requesting the standard data call (see 17.1.2.1.1)

or SAMIS, providing extended address information for the call (see 17.1.2.1.5)

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 or 17.1.2.4.2).

It may also indicate the failure to the service user.

17.1.2.1.8 Call cancellation

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

a. It receives ACK(QUAL=1), 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 17.1.2.1.4.

c. It receives a GTT message for the call it is attempting to cancel; in this case, it shall obey the GTT procedure (see 17.1.2.3.4 or 17.1.2.4.6), though it may then terminate the transaction.

d. It has sent the maximum number of transmissions NR/NDR and received no response, or it's access time-out TC/TDC has expired. In this case, it shall return to waiting for signalling for the standard data call (see 17.1.2.1.4 to 17.1.2.1.7).

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

17.1.2.2 Procedures for Radio Units Requesting Emergency Standard Data Calls

A radio unit shall make only one emergency call set-up attempt at a time. While attempting access or waiting for further call set-up 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 set-up attempt to request an emergency call; in this case it shall abandon the previous call attempt (without sending RQX).

17.1.2.2.1 Request for an emergency standard data call

A radio unit requests an emergency standard data call by sending an RQD(E=1) message on a control channel or data channel. The fields in the RQD message shall be set appropriately (see 5.7.1). 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 appropriate normal random access protocol - see 7.3 or 17.2.1.2.

The unit shall attempt access until it receives a valid response (see 17.1.2.2.2), or until its user cancels the call (see 17.1.2.2.7), or until the access attempt fails (i.e. the unit has sent the maximum number of transmissions (NE for the control channel, NDE for the data channel) and received no response, or its access time-out TC/TDC has expired). In the case of access failure, if the unit has not sent a request, it shall return to the previous state (and may indicate the failure to the service user); otherwise, it shall wait for further call set-up signalling for the call - see 17.1.2.2.3 to 17.1.2.2.6.

17.1.2.2.2 Responses to RQD(E=1)

The calling unit shall accept the following messages (with the same prefix and idents as the RQD) as a valid response to its emergency RQD and send no more requests:

a. An acknowledgement ACKE(QUAL=0).

b. An AHYD message with bits POINT and E set to '1'.

It shall then wait for further signalling for the call. See also section 9.2.2.3 or 17.1.2.4.2.

17.1.2.2.3 Sending extended address information

For an extended addressing emergency standard data call, after receiving ACKE(QUAL=0) or AHY(POINT=1,E=1) for its call, the calling unit shall send the full called address information on receipt of an appropriate AHYC; see section 17.1.2.1.5.

Until it receives ACKE(QUAL=0) or AHY(POINT=1,E=1), the unit shall respond to Mode 1 AHYC messages with ACKX(QUAL=0).

17.1.2.2.4 Acknowledgements indicating progress of call

After receiving ACKE(QUAL=0) or AHY(POINT=1,E=1) for its emergency standard data call, the waiting calling unit shall take appropriate action on receiving further acknowledgements -ACKI(QUAL=1), ACKQ, ACKX, ACKV or ACKT(QUAL=0) - as detailed in section 17.1.2.1.4.

Until it receives ACKE(QUAL=0) or AHY(POINT=1,E=1), the unit shall ignore other acknowledgements.

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

17.1.2.2.5 Availability check and channel command for own call

A calling radio unit attempting access or waiting for further call set-up signalling for an emergency standard data call shall obey the availability check procedures (see 9.2.2.2 to 9.2.2.4, 17.1.2.3.1 and 17.1.2.3.2, or 17.1.2.4.2 to 17.1.2.4.4).

The unit shall also obey the channel allocation procedures (see 9.2.2.5 and 17.1.2.3.4 or 17.1.2.4.6). Note particularly that:

i) On a control channel:

a. If the unit has not received ACKE(QUAL=0) or AHY(POINT=1,E=1) for its emergency call, it shall ignore all GTT and GTC messages.

b. After receiving ACKE(QUAL=0) or AHY(POINT=1,E=1) for its emergency call, the unit shall obey a GTT or GTC message only if it is individually addressed by the GTT or GTC.

ii) On a data channel:

If the unit has not received ACKE(QUAL=0) or AHY(POINT=1,E=1) for its emergency call, it shall ignore individually addressed GTT messages with bit O/R set to '1'.

See rule 1 of sections 9.2.2.5 and 17.1.2.3.4, or section 17.1.2.4.6b.

After receiving ACKE(QUAL=0) or AHY(POINT=1,E=1) for a short addressing call or after sending the full address information for an extended addressing call, the unit shall assume that a GTT message it receives is for its requested call if PFIX/IDENT is its individual address, bit O/R is set to '1', RATE is acceptable and, for a GTT on a data channel, CHAN is set to the number of that data channel. If also TRANS > '0000000000' then the unit shall regard the call link as established and may give an indication to the service user.

17.1.2.2.6 Time-out after waiting

A calling radio unit waiting for further call set-up signalling on the channel on which it attempted access for an emergency standard data call shall return to the previous state if a time TW/TDW has elapsed since the last message it sent for the call, viz.

RQD(E=1), requesting the emergency call (see 17.1.2.2.1)
or SAMIS, providing extended address information for the call
or ACK(QUAL=0), sent in response to an AHY message with POINT = 1, E = 1 and IDENT1 as the called ident or gateway. It may also indicate the failure to the service user.

17.1.2.2.7 Other procedures

a. A calling radio unit waiting for an emergency standard data call may attempt to cancel the call by sending a call cancellation request RQX. The procedures are as defined in 17.1.2.1.8 for cancelling non-emergency data calls.

b. The procedures on the data channel are as defined in 17.2.

17.1.2.3 Related Procedures for All Radio Units on a Control Channel

These procedures shall be obeyed by all radio units that are equipped to send or receive standard data.

A radio unit attempting access or waiting for further signalling for a call may be sent a data availability check message AHYD or Go To Transaction message GTT for an incoming call (see 17.1.2.3.1A and 17.1.2.3.4). Note that:

i) The unit can reject an incoming individual standard data call by sending ACKV(QUAL=1) in response to the AHYD message.

ii) A radio unit is required to obey individually addressed GTT messages and system-wide calls (except in emergency), though it may ignore group call GTTs. However, if making a call of its own, the unit is required to ignore GTT messages for incoming group calls; see 17.1.2.3.4. This rule applies also to a unit that has received an AHY or AHYD message for an incoming individual traffic channel or data call and responded with ACK(QUAL=0) or ACKI(QUAL=0).

iii) If a unit receives and obeys a GTT 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 TDW) on the previous state has expired.

17.1.2.3.1 Data availability/rate check on individually called radio unit

If a radio unit on a control channel receives an AHYD message with PFIX/IDENT1 matching its individual address then it shall respond with the appropriate acknowledgement (see below), with the same prefix and idents as the AHYD. If bit AD = 0 in the AHYD message, the unit shall respond in the slot following the AHYD address codeword; 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 standard data call : IDENT2 not equal to DUMMYI

The unit shall send one of the following acknowledgements:

ACKX (QUAL=0) if it is not equipped to accept standard data calls at least from this calling party.

ACKX (QUAL=1) if it cannot accept this standard data call at this time (e.g. its data store is full or interaction has been requested but is not immediately possible).

ACKV (QUAL=1) if it does not support one or more of the requested facilities, i.e. does not support HADT or interaction or cannot accept the wanted PORT.

ACKB (QUAL=1) if AD = 1 in the AHYD message but the appended data codeword was not decodeable and the unit requires the message to be retransmitted.

ACK (QUAL=0) if it is available for a standard data call of this type; in this case, the unit shall set bit MODEM to indicate whether it is able to operate at the customised transmission rate; see 5.5.2.2.

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

Note that, unlike AHY for traffic channel calls, there is no option for the radio unit to respond to AHYD with an intermediate acknowledgement ACKI(QUAL=0), followed by use of a called party answer mechanism; the unit must either accept or reject the data call. (If the data equipment is not ready immediately, the radio unit could receive and buffer the first data

transmission(s), and then introduce a pause using the Flow Control mechanisms on the data channel.)

After receiving an AHYD message for an incoming individual standard data call and responding with ACK(QUAL=0), the unit shall ignore:

- group call GTC messages as specified in section 9.2.2.5 rule 2 or 3,

- group call GTT messages as specified in section 17.1.2.3.4 rule 2 or 4,

until either:

a. it receives a channel command for the incoming data call (i.e. a GTT message with PFIX/IDENT as its individual address, bit O/R set to '0' and an acceptable RATE), or

b. it assumes that the call will not take place; see 17.1.2.3.2.

If, while waiting for an incoming individual standard data call, a radio unit receives a repeat AHYD then it shall send the appropriate acknowledgement; also, for ACK(QUAL=0), it shall restart its timer TA/TDA (see 17.1.2.3.2).

If, while waiting for an incoming traffic channel call (having sent ACK(QUAL=0) or ACKI(QUAL=0) in response to an AHY message), a radio unit receives an AHYD for an incoming individual standard data call, the unit shall abandon the old call and obey the AHYD; also, if currently attempting an "off-hook" or "on-hook" RQQ transaction for the original call, it shall abandon the RQQ transaction - see 13.1.2.

B) "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 at any time accept a standard data call with all the specified facilities.

ACK (QUAL=0) - Unit is in radio contact and is suitably equipped to support the particular parameter settings in the AHYD. Bit MODEM indicates whether it is able to operate at the customised transmission rate.

17.1.2.3.2 Cancelling waiting state of individually called radio unit

A radio unit that has received an AHYD message for an incoming individual standard data call (see 17.1.2.3.1A), and responded with ACK(QUAL=0), shall assume that the call will not take place if one of the following occurs:

a. It has not received a GTT message for the call at a time TA/TDA after the last ACK(QUAL=0) it sent in response to an AHYD for the call.

b. It receives an AHYX message with the same prefix and idents as the AHYD. (The unit shall respond in the next slot with ACK(QUAL=1), as required by section 9.2.2.4.)

c. It receives an AHYD message checking its availability for a different incoming individual standard data call (i.e. bit E and/or the calling address and/or the PORT is different from the original AHYD).

d. It receives an AHY message checking its availability for an incoming traffic channel call.

The unit may indicate to the service user that the expected data call will not take place. In cases a. and b., the unit shall note that:

- rule 2 or 3 of section 9.2.2.5, and

- rule 2 or 4 of section 17.1.2.3.4

(requiring the unit to ignore GTC/GTT messages for incoming group calls) no longer apply. In case c., the unit shall obey the procedures in 17.1.2.3.1A for the new call. In case d., the unit shall obey the procedures in 9.2.2.2A for the new call.

17.1.2.3.3 Receiving AHYD message addressed to a group or ALLI

If a radio unit on a control channel receives an AHYD message with

PFIX/IDENT1 matching any of its group addresses for this system or

IDENT1 set to the system-wide all-call ident ALLI

then it may accept the call information contained in the AHYD codeword, but shall transmit no response. The unit may then assume that the next GTT(O/R=0) message for this respective group or ALLI address received on this channel within the following time TA/TDA corresponds to the:

i) calling address
(PFIX/IDENT2 or PFIX2/IDENT2 from an appended data codeword)

ii) E bit

iii) PORT

announced by the AHYD message.

If the unit has not received a GTT(O/R=0) message at a time TA/TDA after the last received AHYD for the call, or if it receives an AHYD message for different call to this address, then it may assume that the expected call will not take place.

17.1.2.3.4 Data channel assignment

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

PFIX/IDENT from the GTT message matches its individual address or

PFIX/IDENT matches any of its group addresses for this system or

IDENT is the system-wide all-call ident ALLI.

If the GTT message is addressed to it, and it is able to receive standard data at the transmission rate specified by field RATE, the unit shall use the appropriate rule below to decide whether to obey the command:

1. If the unit is making an emergency call (RQE or RQD(E=1)) and has not received ACKE(QUAL=0) or AHY(E=1) for its call, it shall ignore the GTT message.

   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 GTT message if and only if it is individually addressed by the GTT (i.e. its individual address is PFIX/IDENT).

2. Otherwise:
   If the unit is waiting for an incoming individual emergency call (see 9.2.2.2A and 17.1.2.3.1A), it shall obey the GTT message if and only if it is individually addressed by the GTT.

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

   it is individually addressed by the GTT,

   or IDENT is set to ALLI and the unit knows that it is not the calling unit (i.e. it is not making a system-wide standard data call or has received an AHYD message indicating another caller - see 17.1.2.3.3).

4. Otherwise:
   If the unit is waiting for an incoming non-emergency individual traffic channel or data call (see 9.2.2.2A and 17.1.2.3.1A), it shall obey the GTT message if and only if:

   it is individually addressed by the GTT,

   or IDENT is set to ALLI (unless the unit has received an AHYD message indicating that it was the calling party in the call).

5. Otherwise (i.e. if not waiting for any call or transaction):

The unit shall obey the GTT message, unless:

IDENT is set to ALLI and the unit has received an AHYD message indicating that it was the calling party in the call

or PFIX/IDENT is one of the unit's group addresses and the unit cannot or does not wish to accept this call, for example:

- the service user does not wish to receive group calls, or
- the unit has received an AHYD message for this group address indicating that it was the calling party in the call, or
- the unit has received an AHYD message for this group address indicating an unacceptable calling party or PORT, or
- the unit has not received an AHYD message for this group address and it needs the AHYD information for reliable operation (e.g. some calls to this address are of normal accuracy whilst others employ HADT).

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

a. The unit shall tune to the designated forward channel and shall be able to receive on the data channel within 35 ms after the end of the GTT message.

It shall be prepared to receive signalling at the transmission rate specified by field RATE in the GTT message.

b. If bit O/R from the GTT message is set to '1', the unit shall note that it is the calling party. Otherwise it is a called party.

Note that, if the unit is a called party and is waiting for an incoming standard data call for this address (see 17.1.2.3.1 and 17.1.2.3.3), then it may take the PORT and the calling address (if fully supplied) from the AHYD message.

c. The unit shall note PFIX, IDENT and TRANS from the GTT message.

i) For TRANS > '0000000000', the unit shall expect to receive signalling on the data channel for this transaction number.

ii) For TRANS = '0000000000', the unit shall expect to receive a further GTT message on the data channel to assign a transaction number for the link. The unit shall assume that the next GTT message, containing this address, bit O/R and bit RATE, and with CHAN equal to the number of the data channel, received within the following time TDG, corresponds to this call - see 17.1.2.4.6a.

If a calling unit has not received the expected GTT(O/R=1) message on the data channel at a time TDG after the control channel GTT, then it shall return to the idle state on the control channel and may indicate the call failure to the service user.

If a called unit has not received the expected GTT(O/R=0) message on the data channel at a time TDG after the control channel GTT, or if it receives an individually addressed AHYD message for a different call to this address, then it shall assume that the expected call will not be received and may give an indication to the service user.

d. The unit shall note the channel number of the control channel.

It may also give an indication of the event to the service user.

If the unit does not obey a GTT message, and the designated data channel is the control channel on which the message was received, then the unit shall enter the control channel acquisition procedures.

17.1.2.4 Related Procedures for All Radio Units on a Data Channel

These procedures shall be obeyed by all radio units which are equipped to request or receive calls on a data channel. (Other procedures for radio units on a data channel are included in sections 17.2.)

17.1.2.4.1 Instruction to send extended address information

This procedure shall be obeyed by all radio units that are equipped to request extended addressing standard data calls.

If a radio unit on a data channel receives an AHYC message with PFIX/IDENT2 matching its individual address then it shall either send address information or transmit ACKX(QUAL=0), as indicated below. For timing on a 1200 bit/s data channel, see section 6.2.1.3.

If the unit has sent an extended addressing RQD(E=0) request, or has received ACKE or AHY(E=1) for an extended addressing RQD(E=1)

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 unit's call requires > 9 PSTN digits then SLOTS = '10'

if IDENT1 = PSTNGI and unit's call requires < 10 PSTN digits then SLOTS = '01' or '10'

if IDENT1 is not equal to PSTNGI then SLOTS = '01')

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

Otherwise

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

17.1.2.4.2 Data availability/rate check on individually called radio unit

If a radio unit on a data channel receives an AHYD message with PFIX/IDENT1 matching its individual address then it shall respond with the appropriate acknowledgement (see below), with the same prefix and idents as the AHYD. If bit AD = 0 in the AHYD message, the unit shall respond in the slot following the AHYD address codeword; 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 on a 1200 bit/s data channel, see 6.2.1.3.

A) Incoming standard data call : IDENT2 not equal to DUMMYI

The unit shall send one of the following acknowledgements:

ACKX (QUAL=0) if it is not equipped to accept standard data calls from this calling party.

ACKX (QUAL=1) if it cannot accept this standard data call at this time (e.g. it cannot process concurrent calls or its data store is full or interaction has been requested but is not immediately possible).

ACKV (QUAL=1) if it does not support one or more of the requested facilities, i.e. does not support HADT or interaction or cannot accept the wanted PORT.

ACKB (QUAL=1) if AD = 1 in the AHYD message but the appended data codeword was not decodeable and the unit requires the message to be retransmitted.

ACK (QUAL=0) if it is available for a standard data call of this type; i.e. it can support the particular parameter settings of the AHYD. In this case, the unit shall set bit MODEM to the value appropriate for that channel; see 5.5.2.2.

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

After receiving an AHYD message for an incoming individual standard data call and responding with ACK(QUAL=0), the unit shall wait for a GTT message for the call (i.e. a GTT message with PFIX/IDENT as its individual address,

bit O/R set to '0', an acceptable RATE and CHAN set to the number of this data channel), or until it assumes that the call will not take place (see 17.1.2.4.4).

If, while waiting for an incoming individual standard data call, a radio unit receives a repeat AHYD then it shall send the appropriate acknowledgement; also, for ACK(QUAL=0), it shall restart its timer TA/TDA.

B) "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 at any time accept a standard data call with the parameter settings of the AHYD.

ACK (QUAL=0) - Unit is in radio contact and could at times accept a data call with the parameter settings of the AHYD.

This availability check does not start or restart any timer.

17.1.2.4.3 Cancelling waiting state of individually called radio unit

If a radio unit on a data 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 radio unit that has received an AHYD message for an incoming individual standard data call (see 17.1.2.4.2A), and responded with ACK(QUAL=0), shall assume that the call will not take place if one of the following occurs:

a. It has not received a GTT message for the call at a time TDA after the last ACK(QUAL=0) it sent in response to an AHYD for the call.

b. It receives an AHYX message with the same prefix and idents as AHYD.

c. It receives an AHYD message checking its availability for a different incoming individual standard data call (i.e. bit E and/or the calling address and/or the PORT is different from the original AHYD).

The unit may indicate to the service user that the expected data call will not take place. In case c., the unit shall obey the procedures in 17.1.2.4.2A for the new call.

17.1.2.4.4 Receiving AHYD message addressed to a group or ALLI

If a radio unit on a data channel receives an AHYD message with

PFIX/IDENT1 matching any of its group addresses for this system

or IDENT1 set to the system-wide all-call ident ALLI

then it may accept the call information contained in the AHYD codeword and indicate it, but shall transmit no response. The unit may then assume that the next GTT(O/R=0) message, for this group or ALLI address and with CHAN equal to the number of this data channel, received within the following time TDA corresponds to the:

i) calling address
(PFIX/IDENT2 or PFIX2/IDENT2 from an appended data codeword)

ii) E bit

iii) PORT

announced by the AHYD message.

If the unit has not received a GTT(O/R=0) message at a time TDA after the last received AHYD for the call, or if it receives an AHYD message for a different call to this address, then it may assume that the expected call will not take place.

17.1.2.4.5 Receiving GTT message for same data channel

If a radio unit on a data channel receives a GTT message with channel number CHAN equal to the number of the data channel then it shall obey the procedure in this section. The procedure if CHAN is not equal to the number of the data channel is specified in section 17.2.6.2 (In-call transfer).

A radio unit on a data channel shall check all GTT messages it receives to see whether the channel number CHAN is equal to the number of this data channel and whether the message is addressed to it, that is, whether:

PFIX/IDENT from the GTT message matches its individual address

or PFIX/IDENT matches any of its group addresses for this system

or IDENT is the system-wide all-call ident ALLI.

If the GTT message is addressed to it, and TRANS >'0000000000', and it is able to receive on this data channel at the specified RATE, then the unit shall use the appropriate rule below to decide whether to accept the GTT:

a. If the unit is currently waiting for a transaction number for this address and bit O/R, having received a GTT message on a control channel with TRANS = '0000000000' (see 17.1.2.3.4c.), then it shall accept the GTT message as applying to that call.

b. If bit O/R is set to '1' and PFIX/IDENT from the GTT message matches its individual address, then:

- If the unit is making an emergency call RQD(E=1) and has not received ACKE(QUAL=0) or AHY(E=1), then it shall ignore the GTT.
- Otherwise, a unit making a data call RQD(E=0/1) shall accept the GTT message.

c. If bit O/R is set to '0' and PFIX/IDENT from the GTT message matches its individual address, and the unit is waiting for an incoming individual data call, having received an AHYD message and responded with ACK(QUAL=0), then it shall accept the GTT message.

d. Otherwise, the unit may accept the GTT message.

If the unit accepts the GTT message, it shall perform the following actions:

i) It shall be prepared to receive signalling for this transaction number.

ii) If bit O/R from the GTT message is set to '1', the unit shall note that it is the calling party. Otherwise it is a called party.

If the unit is a called party and is waiting for an incoming standard data call for this address (see 17.1.2.4.3 and 17.1.2.4.5) then it may take the PORT and the calling address (if fully supplied) from the AHYD message.

It may also give an indication to the service user.

17.2 Behaviour on the Data Channel

17.2.0 General

These procedures shall be obeyed by all stations on an allocated data channel. More than one data channel may be operated at a base station and radio units may be transferred between channels, for example to provide an even load sharing.

17.2.0.1 Signalling Formats

The signalling format shall conform to Sections 3.1 and 3.2 (but see transmission rate below).

The Data Channel codeword synchronisation sequence shall always be SYNT.

In addition to the 1200 bit/s standard transmission rate a network may offer or a radio unit may be equipped for a customised rate.

17.2.0.2 General behaviour of a TSC on a data channel

Every message transmitted by a TSC shall start with SYNT. Except for the first message in a transmission, SYNT shall be contained in a DCSC codeword.

The TSC shall monitor the return channel and shall be prepared to receive messages with timing according to 17.2.0.3 below.

Many messages require or invite individual response transmissions from radio units with timing according to 17.2.0.3. The TSC shall not transmit any combination of messages which could result in any of these required responses coinciding to produce channel interference.

It is not necessary to provide synchronisation between the Control Channel and the Data Channel.

17.2.0.3 General behaviour of a radio unit on a data channel

Whilst on a data channel a radio unit shall not indicate to its user or any attached equipment any information relating to the address or data codewords of any message except those pertinent to that radio unit. However, the radio unit itself may use the information in non-pertinent address codewords to enhance its performance, e.g. to save energy or optimise random access.

A radio unit may support more than one concurrent standard data call.

A radio unit shall start a system dependant timer, TDX or TDN, for an individual or group call respectively, for the TRANS when it receives the GTT message. Timer TDX shall be restarted whenever the radio unit receives any message relevant to the TRANS except DAHYX. If timer TDX or TDN expires the radio unit shall deem the TRANS to be closed.

If at any time a radio unit deems that it no longer has any open TRANS it shall leave the data channel and return to control channel acquisition procedures.

A radio unit shall attempt to decode DCSC codewords whilst receiving on the forward data channel. If a time TDL elapses without being able to decode any DCSC codeword the radio unit shall assume that it is out of range and shall enter channel acquisition procedures.

A radio unit shall not transmit on the return channel unless it is either to make random access within an appropriate random access frame in an unwithdrawn slot or is invited to transmit on an individual basis, which latter opportunity may be specified by either the radio unit's individual address or an individual TRANS (see below).

Every message transmitted by a radio unit shall start with SYNT. Radio unit transmission timing shall conform either to the requirements of 6.2.1.3 but with timing starting from the end of the last codeword of any invoking message from the TSC or to the timing rules specified for the particular customised transmission rate for that data call (see Appendix 6).

17.2.1 Random Access Protocol for the Data Channel

A Random Access protocol is used on the data channel which is based on that found on the control channel but differing considerably in detail.

Random access on a data channel is used by radio units to:

a) query an unexpected delay in user data transfer, or

b) send expedited data such as RESET, or

c) close one or all of its TRANS, or

d) attempt to set up a concurrent call.

17.2.1.1 TSC Random Access Facilities

17.2.1.1.1 Marking Random Access Frames

The TSC shall designate sections of a return data channel as random access frames, each containing a whole number of timeslots. Every frame is marked by a codeword which contains an Aloha submessage and an ND parameter indicating the frame size.

The zero aloha number (ND=0) is a special value indicating "this is not the beginning of a frame". Filler messages each consisting of a DCSC codeword and a codeword containing an aloha submessage with ND='0' may be used.

17.2.1.1.2 Addressing the radio unit population

The TSC may invite random access responses from all radio units, or may restrict access to a specific individual or group of units using the TRANS parameter in the data-aloha codeword.

For TRANS='0000000000', there is no restriction, i.e. all radio units may attempt access subject to the other random access rules specified in this section. For all other values of TRANS, access is restricted to the one or more units corresponding to that TRANS. This will typically be used for a group TRANS to restrict a frame for use by one particular group only. Note that unlike the control channel random access mechanism, a response is never demanded, even when an individual TRANS is specified.

17.2.1.1.3 Inviting specific types of random access message

The TSC may limit random access to particular types of message by means of specific data-aloha submessages: DAL, DALG, DALN (see 5.8.2.).

17.2.1.1.4 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 WF field in the data-aloha submessage, the number of frames that a radio unit must wait for before attempting a further random access transmission of the message (see 17.2.1.2.6).

17.2.1.1.5 Withdrawing slots from frames

The TSC shall ensure that slot synchronism is maintained within any random access frame, e.g. at 1200 bit/s if an AHYD message within the frame contains an appended data codeword the TSC shall add an appropriate filler data codeword.

The only invoking messages the TSC may transmit within the random access frames are:

- DAHYX, DAHYZ, DAHY, AHYD, and AHYC

(Random access is inhibited in the first following return slot after the messages.)

- SITH (individual or group) such that the user data message extends at least to the end of the return channel random access frame.

17.2.1.2 Radio Unit Random Access Protocol

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

The various criteria given below must all be satisfied before a random access transmission is made.

17.2.1.2.1 Checking for TRANS restriction

A radio unit is permitted to transmit a non-emergency random access message only if the related transaction is invited by the TSC, by means of the TRANS parameter in the data-aloha submessage. Thus access is permitted by the radio unit if either

- RTRANS = '0000000000', or

- The specified RTRANS in the data-aloha submessage matches any of the radio unit's currently active TRANS' to be transmitted.

An emergency request, RQD(E=1), can be transmitted regardless of any TRANS restrictions.

17.2.1.2.2 Checking the Aloha function

A radio unit shall note the function from each data-aloha submessage it receives. The requests invited (subject to other restrictions) by each function are as follows:

DAL invites DRQX, DRQZ, DRUGI, DRQG, RQD(E=1), RQD(E=0), RQX

DALG invites DRQG, RQD(E=1)

DALN invites DRQX, DRQZ, DRUGI, RQD(E=1), RQD(E=0), RQX

17.2.1.2.3 Frames defined by Aloha numbers

The number of slots in a frame is equal to the aloha number within the frame marking data-aloha submessage, and can take any value in the range 1-31.

The radio unit shall monitor the forward data channel and shall note which sections of the return data channel are designated as random access frames. The first access slot in a frame starts at the end of a codeword containing a data aloha submessage with a non-zero aloha number, and respective coincidence is maintained for subsequent slots.

17.2.1.2.4 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; it shall then choose a slot randomly from the specified frame length, using a uniform distribution. The unit shall transmit its message in the chosen slot, provided that the slot
is not withdrawn (see 17.2.1.2.5). For access timing see section 6.2.1.3 or as specified for the customised rate in use.

A radio unit shall not chose more than one slot from a frame.

17.2.1.2.5 Check for withdrawn slot

Before transmitting its random access message in a chosen slot, except for case (a) below, a radio unit shall check whether the slot is still available for random access by attempting to decode the final codeword in the slot immediately preceding the chosen slot. If any of the following is received then random access is permitted:

a) reception of a SITH address codeword as the last codeword in any slot of that frame before the chosen access slot, and

b) any address codeword containing an Aloha number DN, and RTRANS = '0000000000' or any currently active TRANS for this RU, and

c) the following address codewords:

AHYD or AHYC, either only with AD = '1'
(unless the AHYD or AHYC is addressed to the unit)

GTT

Note that, unless covered by rule (a), all received codewords which are spare, reserved or undecodeable do not permit random access in the next slot.

17.2.1.2.6 Noting the response delay

A radio unit shall note the delay parameter WF from each data-aloha submessage it receives.

If a random access attempt has not been acknowledged (see 17.2.2 for listed acknowledgements) before WF frames have been received, then the random access attempt may be repeated if the time-out or allowable number of tries permits.

17.2.1.2.7 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 and summarised in 17.2.2).

If the radio unit does not receive a response before WF subsequent frames have been received, it shall assume that the message was unsuccessful.

Then it shall either:

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

b. attempt a further random access transmission. 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, NDR, and received no valid response.

The unit shall also operate a time-out, TDC, 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 to close all its TRANS fails then it shall deem them all to be closed and shall relinquish the data channel and attempt to return to the control channel. If the unit's access attempt to progress or close one TRANS {see 17.2.1 (a, b, or c)} fails then it shall deem the TRANS to be closed. If the attempt to set up a concurrent call fails then it shall abandon the attempt.

17.2.2. Messages, Submessages, and Responses on the data channel

Data channel procedures are ranked from highest to lowest as:

a) closure of all or one TRANS,
b) transfer to another data channel,
c) transfer of expedited data, and
d) transfer of user data and call set-up.

A current procedure of one rank may be interrupted or aborted by the TSC or radio unit at any opportunity by using an appropriate message to enter a procedure of a higher rank.

This subsection lists all the various messages and submessages that can be transmitted on a data channel, together with the appropriate responses in their ranking order. Descriptions of the messages are found in section 5, and their uses follow from this. A Submessage is preceded by "(S)".

All random access attempts are subject to the time-outs and re-try limits given in 17.2.1.2.7. Additionally some random access attempts are prohibited before time-outs have expired; and these accesses are marked "(L)"

All messages from the TSC are to individual radio units except those specifically indicated for groups.

LIST OF MESSAGES, SUBMESSAGES AND RESPONSES

Message	Receiver	Response(s)
CLEAR	RU	None, but deem all TRANS closed.
RQD	TSC	See 17.1
AHYD	RU	" "
AHYC	RU	SAMIS Extended address message
GTT	RU	No transmitted response. See 17.1 and 17.2.6
DRUGI (TNITEL < 63)	TSC	DAHYX, DAHYZ, (S)GO
DRUGI (RNITEL < 63)	TSC	DAHYX, DAHYZ, DACKD(REASON='001'), SITH
DRUGI(T'L =R'L = 63)	TSC	DAHYX, DAHYZ, None (await developments)
DRQG	TSC	Ignore, DAHYX (GROUP), SITH group
DRQZ	TSC	DAHYX, DACKZ
DRQX	TSC	DACKD(REASON='000)
DAHY	RU	DRQX, DRQZ(REASON='000), DRUGI
DAHYZ	RU	DRQX, DACKZ
DAHYX (TRANS > 0)	RU	DACKD(REASON = '000')
(S)DAL	RU	DRQX, DRQZ, RQD, DRQG, DRUGI, RLA (L)
(S)DALG	RU	DRQX, DRQG, RQD(E='1')
(S)DALN	RU	DRQX, DRQZ, RQD, DRUGI, RLA (L)
(S)GO after (S)DACK	RU	DRQX, DRQZ, DACKD(REASON = '001'), SITH
(S)GO (no (S)DACK)	RU	DRQX, DRQZ, RLA
(S)GO (+ (S)DACK)	TSC	DAHYX, DAHYZ, DACKD(REASON = '001'), SITH
SACK	Either	DAHYX or DRQX, DAHYZ or DRQZ, SITH
SACK (incomplete)	Either	DAHYX or DRQX, DAHYZ or DRQZ, RLA
RLA	Either	DAHYX or DRQX, DAHYZ or DRQZ, (S)DACK(P/N), and SACK
SITH	Either	DAHYX or DRQX, DAHYZ or DRQZ, (S)DACK(P/N), and SACK

17.2.3 Transmission and correction of user's data

In this sub-section there are major differences between the actions required of a station sending user data and one receiving it. These stations are referred to as data sending and data receiving stations (DSS and DRS) respectively. There are only minor differences between the actions to be taken by TSCs and radio units. For this reason, except where noted the procedures described here apply to both TSCs and radio units, although each shall always conform to the appropriate transmission timing requirements.

Due to the bidirectional facilities provided by this standard a data sending station may also be a data receiving station at the same time. Such a station shall conform to the appropriate procedures according to the particular direction of data transmission under immediate consideration at any instant.

All the procedures specified here shall be understood to refer only to the one TRANS under consideration. Every message not bearing that TRANS in its appropriate field(s) shall be deemed irrelevant. Every TRANS being processed by any station shall be treated as a separate entity, and interleaving of messages relevant to various radio units and TRANS may take place. Such interleaving is not mentioned further in this section.

17.2.3.1 Procedures for Data Sending Stations (DSS)

17.2.3.1.0 Tmessages and dataitems

User data consists of one or more Tmessages. A Tmessage consists of one or more dataitems. No dataitem shall contain data from more than one Tmessage. The last dataitem of one Tmessage may be adjacent to the first dataitem of a following Tmessage. See 17.2.3.1.4.1 for use of the MORE bit for marking the end of a Tmessage.

17.2.3.1.1 Sending a User Data Message to a Group

A group link may convey only one Tmessage in a single dataitem which may not include more user data (including any HADT checksum) than that which can be accommodated in the user data field of its address codeword plus NG data codewords, where NG = 1, 3, 7, 15, 31, 63, 127, or 255 as prearranged.

Within the link the group dataitem may be repeated a prearranged number of times. It is permitted to transmit other messages between these dataitems providing the total time between the GTT message and the end of the last codeword of the final transmission of the dataitem does not exceed TDN seconds. For example, a message with DALG submessage bearing the group TRANS to mark a random access frame could be sent after transmission of a group message. Lack of any random access attempt in that frame might then be taken by the TSC to mean that no following repeat of the dataitem is required.

17.2.3.1.2 Maximum Length of a dataitem in an Individual Link

For an individual link no dataitem may include more data than that which can be accommodated in the user data field of its address codeword plus 62 data codewords. The RNITEL field in the GO submessage indicates to a DSS how much data the data receiving station (DRS) can receive. A DSS shall not transmit any quantity of user data unless the DRS has previously indicated that it can accept at least that quantity, but a lesser quantity may be sent.

17.2.3.1.3 Responding to a GO Submessage in an individual link

Upon receiving a data acknowledgement (DACK) submessage followed by a GO submessage (which may be in the same message) a DSS shall decide whether a higher ranking message (see 17.2.2) or an old or new dataitem should be sent, and if the last, what user data will compose the new dataitem (if any) which will be sent. Once a dataitem has been sent then all or parts of that data shall be repeated as required by the DRS but no other user data shall be sent until the DRS indicates by a positive submessage (PACK) that the dataitem has been completely received. If a DSS receives a data acknowledgement and GO submessage and the limit of resp

TNITEL - shall be set to indicate the maximum number of data codewords proposed for the next dataitem. Its null value is '111111' and is used if no further dataitem is immediately proposed.

LASTBIT - shall be set to indicate the codeword bit number, see 17.0.2.5, of the last bit of user data in the dataitem unless modified by the HADT coding rules, see 17.2.3.1.4.2.

In a dataitem (i.e. the initial fragment) user data shall start in the first bit of the USER DATA field and continue in bit order through this field and through any appended data codewords until all user data in the dataitem have been included. A further information bit following the last user data in the dataitem shall be a marker bit, '1'. The marker bit shall always be provided even if that requires addition of an extra data codeword. All remaining bits in the user data field of the last codeword shall be '0's unless subsequently altered by HADT coding, see below.

17.2.3.1.4.2 HADT Coding

The SITH codeword and the user data in it is not included in HADT coding.

If HADT is invoked then the last 15 bits of appended data in each dataitem shall consist of a dataitem checksum of all the other user information bits in appended data codewords in the dataitem (see Figure 17.2). The 15 bits of the checksum are calculated as follows:

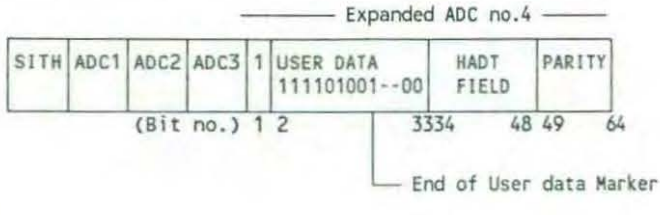
The information field of each appended data codeword containing user data or the end of data marker shall be considered to be the co-efficients of a polynomial having terms x^{61} down to x^{15}. This polynomial shall be divided modulo-2 by the generating polynomial;

$$x^{15} + x^{14} + x^{11} + x^{10} + x^9 + x^6 + x^5 + x^4 + x + 1.$$

The co-efficients of the terms x^{14} down to x^0 found at the completion of the division are termed the HADT remainder.

All the HADT remainders for the dataitem shall be modulo-2 added to form a 15-bit dataitem checksum. If bit positions 34-48 in the final user data codeword are all '0's then the dataitem checksum shall replace these '0's; otherwise a further data codeword shall be appended with bits 1-33 = '0' and the dataitem checksum shall occupy the bits 34-48 and 16 shall be added to the value of the LASTBIT field in SITH. The value in the FRAGL field of SITH shall include the added codeword.

FIG 17.2. SITH plus 4 Additional Data Codewords (ADC)



17.2.3.1.5 Actions after sending a Fragment or RLA Message

Within subsection 17.2.3.1.5 and dependant subsections the specified actions only apply if the DSS decides not to close the TRANS or send expedited data.

After sending a fragment or a "Repeat Last Acknowledgement" (RLA) message,

- a radio unit shall immediately restart its timer TDH. If no acknowledgement is received before timer TDH expires and a suitable random access frame occurs the radio unit may attempt random access with a RLA message.

- if a TSC receives a partial or no acknowledgement from the radio unit it shall either repeat the fragment or send an RLA message. The TSC shall only repeat that fragment to which it was expecting an acknowledgement.

- if a radio unit receives no acknowledgement from the TSC but receives a GO submessage it shall send an RLA message,

- if a radio unit receives a partial acknowledgement it shall send an RLA message.

17.2.3.1.5.1 After sending an RLA message

- if the acknowledgement received is the same as the last complete acknowledgement received then the DSS shall, at the next GO submessage, repeat the last fragment sent,

- if the acknowledgement received is appropriate to the last fragment sent then the DSS shall act on that acknowledgement according to the rules specified below.

17.2.3.1.5.2 After sending a fragment

- if a DSS receives a NACK submessage in acknowledgement it shall repeat the whole dataitem when it receives an appropriate GO submessage.

- if the DSS receives a SACK message in acknowledgement it shall send a fragment consisting of a SITH address codeword and ONLY the data codewords corresponding to the assigned EFLAGs set to '1' in the SACK message. This is irrespective of the setting of EFLAGs in any previous SACK message relevant to that dataitem. (If no assigned EFLAGs are set in a SACK message the DSS shall repeat the whole fragment or send an RLA message). Note that in a dataitem the user data in the SITH is repeated in all fragments of that dataitem,

- if the DSS receives a PACK submessage, it shall proceed to the next dataitem, if any. If it receives a relevant GO submessage before it has a complete Tmessage ready for transmission then it shall transmit a DACKD(REASON = '001') message.

If a DSS sends a fragment with more than 22 included data codewords or an RLA message after having last sent such a fragment it shall prepare to receive an acknowledgement with appended codeword.

17.2.3.2 Procedures for Data Receiving Stations (DRS)

17.2.3.2.1 Minimum Reception Storage when Starting a Call

A DRS shall indicate to the DSS how much data it can receive initially. Compliance with a GTT message is one method of giving this indication. Otherwise a DRS shall give the indication in the RNITEL field of a GO submessage.

For an individual link a radio unit shall disregard a GTT message unless it can receive a message with at least 22 fully used data codewords. For a group link a radio unit shall disregard a GTT message unless it can receive a message with at least a preset number, NG, of data codewords,see 17.2.3.1.1.

17.2.3.2.2 Receiving a Group Message

A radio unit which receives a SITH codeword of a group message shall count the number of times that SITH has been received within the group link, and shall also attempt to decode the message. If the group message has been repeated then amalgamation of the various decoding attempts is permitted. HADT decoding shall be used when appropriate. The radio unit shall then decide whether to accept the message, and if so it may consider the call to be complete and the TRANS to be closed. If it does not accept the message and timer TDN has not expired and the relevant SITH count is less than NDN and an appropriate random access frame is marked then the RU may attempt random access with the DRQG(TRANS=group) message to request a message repetition. If either timer TDN expires or the SITH count equals NDN then the RU shall consider the call to be complete and its TRANS closed.

17.2.3.2.3 Decoding an Individual Fragment

After decoding a SITH address codeword and attempting to decode every following data codeword in a fragment as determined by the received value of FRAGL, a DRS in an individual TRANS shall decide whether to send a higher ranking message or shall choose the appropiate acknowledgement to send. A radio unit shall also restart its timer TDE:

- if the DRS finds any inconsistency in a fragment when compared to prior states, fragments or acknowledgements, e.g. FRAGL exceeding the previous RNITEL value or an unexpected ITENUM value, etc., according to the severity or persistence of the condition it may demand closure of the TRANS or send a RESET request or request repeat of the dataitem or fragment,

- if the DRS decides to ask for the entire dataitem to be repeated it shall send a NACK submessage,

- if the DRS decides to ask for any selection of data codewords to be repeated, it shall send a SACK message.

- if the HADT mode was invoked by the call set up procedures and the entire dataitem has been decoded the DRS shall modulo-2 divide the data in each data codeword by the generator polynomial given in 17.2.3.1 above to yield HADT remainders and shall modulo-2 add these

HADT remainders together to form a dataitem checksum. If this checksum does not equal the final 15 data bits of the received dataitem then the DRS shall send a NACK message.

- if the HADT mode was invoked and LASTBIT value is larger than 48 then the last codeword contains only HADT check sum and the user data ends in the previous codeword at the point of LASTBIT-16 (see 17.2.3.1.4.2)

- if the LASTBIT value is 48 then the last additional data codeword does not contain any user data (see 17.2.3.1.4.1).

- if the DRS is satisfied that the entire dataitem can be accepted then it shall send a PACK submessage. The RNITEL field shall be set either to the value of the TNITEL field in the SITH codeword heading the accepted dataitem or to a lower value if the DRS is unable to accept that amount of data.

If the DRS receives an RLA message instead of a fragment then it shall repeat the last acknowledgement sent.

If a radio unit, after sending a GO submessage with RNITEL not equal to '111111', does not receive another relevant message before timer TDE expires and then a suitable random access frame occurs the radio unit may attempt random access with a DRUGI message.

The above-mentioned acknowledgements shall conform to the following rules:

- In a message which includes a NACK submessage, the GO submessage shall set RTRANS = ATRANS, and RNITEL to the value that was in the GO submessage which permitted that dataitem.

- A SACK message indicates that a selected codeword(s) of the dataitem is(are) required to be repeated.

[NOTE that security can be improved by ensuring that the number of EFLAGs set to '1' differs in successive SACK messages relevant to the same dataitem. Thus the value of FRAGL in the requested fragment can be related unambiguously to the number of EFLAGs set. This inequality can then be used as a further consistency test.]

- A PACK submessage informs the DSS that the dataitem has been successfully received.

In the HADT mode a DRS shall pass on only the user information to any other link or equipment.

- The GO submessage which accompanies a PACK submessage may be for any TRANS relevant to the DRS.

[Note that transmission security may be improved if this GO submessage refers to the same TRANS as that in the PACK submessage]

- A TSC may combine PACK and a Data Aloha type submessage into a single message

17.2.4 Procedures involving expedited data

17.2.4.1 DSS procedures

If a DSS receives expedited data from a preceding link or decides of its own volition to send expedited data it is preferred that it shall place that data at the head of any queue of data awaiting transmission.

If a DSS receives expedited data instead of an acknowledgement to one of its fragments it shall pass that data back to any preceding link or equipment and shall send no more data until a further message is received indicating that transmission may be resumed.

A TSC may send expedited data at any time. A radio unit may send expedited data upon receipt of a GO submessage or may send a DRQZ message in a random access frame.

If the expedited data is a RESET message then the DSS shall discard all other data queued for transmission and shall send no more data until the RESET message has been acknowledged.

17.2.4.2 DRS procedures

If a DRS receives expedited data it shall acknowledge that data and also shall pass that data on to any further link or equipment, preferably ahead of any other data.

A DRS may decide to originate expedited data for return to its corresponding DSS. A TSC may send such expedited data at any time.

A radio unit may send expedited data in place of an acknowledgement providing that the expedited data message is not longer than the replaced acknowledgement. Alternatively it may indicate by the TNITEL value in the GO part of an acknowledgement that it wishes to send data and send the expedited data when invited by a GO message. Alternatively it may send a DRQZ message in a random access frame.

If the expedited data is a RESET message then the DRS shall discard any data not yet passed on to a further link or equipment.

17.2.5 Closing a TRANS

17.2.5.1 TRANS closing procedures for a TSC

By sending a CLEAR message, a TSC may demand that all radio units close all TRANS and leave the data channel.

A TSC may close a group or System Wide link TRANS by sending a DAHYX message with IDENT = the group address or ALLI, the TRANS value to be closed, and RESP = '0'.

If a TSC receives a DRQX message for an individual TRANS with correct address then it shall send a DACKD(REASON='000') message as acknowledgement. If the address is incorrect the TSC may use DAHY to query either or both the TRANS and address.

A TSC may close all TRANS for a particular radio unit by sending a DAHYX message with PFIX and IDENT equal to the individual address of the radio unit, I/T set to '0' and the value '0000000000' in the TRANS field.

A TSC may close a particular TRANS for a radio unit by sending a DAHYX message with the TRANS value to be closed and I/T set to '1'.

A TSC may check whether a radio unit is still receiving a particular TRANS by sending the DAHY message. The acknowledgement to this message is DRUGI.

If the TSC receives no relevant messages from a radio unit for at least TDX then it shall assume that the TRANS is no longer active, and shall send a DAHYX message to close the TRANS.

A TSC may reuse the TRANS value of a closed TRANS after a period which accounts for the TRANS timer (TDX or TDN) of the radio unit(s) involved.

After closing a TRANS a TSC shall forward any data queued for transmission to any associated links.

If a TSC receives a DRQX message for a group TRANS it shall ignore it.

17.2.5.2 TRANS closing procedures for a radio unit

If its relevant timer TDX or TDN expires, a radio unit shall assume that the TRANS is closed.

By sending a DRQX message in an appropriate random access frame a radio unit may request, e.g. as a result of user action, that an individual TRANS be closed.

In response to a GO submessage or a message headed by SITH a radio unit may, by sending a DRQX message, request that an individual TRANS be closed.

If a radio unit receives a CLEAR message, or a DAHYX message with its individual address and TRANS = '0000000000', it shall close all its TRANS and leave the channel. In the case of the DAHYX message with RESP='1', it shall send a DACKD (REASON='000') acknowledgement before it leaves the data channel.

If a radio unit receives a DAHYX message with its individual address and a relevant TRANS value it shall note that the TRANS is closed. In the case of the DAHYX message with RESP='1', it shall send a DACKD (REASON='000') acknowledgement.

If a radio unit receives a DAHYX message with a group or ALLI TRANS the radio unit shall close the TRANS but not send an acknowledgement.

If a radio unit closes its last remaining TRANS then it shall leave the channel (after sending any required acknowledgement).

17.2.6 Moving a radio unit in call to another data channel

17.2.6.1 Procedures for the TSC

A TSC may NOT move radio units by using a TRANS allocated to a group link because of the risk of one or more of the radio units being engaged in a concurrent call.

17.2.6.1.1 Moving an individual radio unit

A TSC may move an individual radio unit in call to another data channel if that radio unit has only one individual TRANS. The TSC may close all but one individual TRANS for that unit to ensure this. If the TSC is a DSS it shall accomplish the move after fully receiving an acknowledgement for a fragment and before it sends the next fragment.

If the TSC is a DRS it shall accomplish the move after acknowledging a (good quality) fragment and before it sends a GO submessage for another fragment.

To accomplish an individual move a TSC shall send a GTT message with the individual address of the radio unit and the new channel designation and TRANS value to be used in the link and appropriate settings of RNITEL and TNITEL and values of O/R and RATE fields equal to those used in the original GTT for that call.

The TSC may check that the channel movement has been successful by sending a DAHY message with the new TRANS value on the new channel.

Data exchange with the radio unit shall resume at the point at which the channel change occurred.

17.2.6.1.2 Moving ALL radio units from one data channel to another

A TSC may move ALL radio units from one data channel to another. The TSC shall not attempt to do this unless all demanded or invited responses on the return channel have had time to be completed.

To accomplish this move a TSC shall send a GTT message with IDENT = ALLI, TRANS = '0000000000', O/R='0', and RATE as originally given.

17.2.6.2 Radio unit procedures

If a radio unit on a data channel receives a GTT message nominating another channel and also containing any group address it shall ignore it.

17.2.6.2.1 An Individual move

If a radio unit having only one TRANS receives an individually addressed GTT message with a new channel and a new TRANS value and all other parameters in the GTT message matching those present in the original individual GTT message it shall move to the new channel and replace the old TRANS value with the new one. The timers TDX, TDA and TDD shall continue

without being reset. Data exchange shall be expected to resume at the point at which the channel change was made.

17.2.6.2.2 An ALLI move

If a radio unit receives a GTT message with the IDENT = ALLI and TRANS = '0000000000', O/R=0 and RATE as originally given then it shall move to the designated channel and maintain its TRANS number(s) and ALL other parameters and states that existed immediately before the move message. Data exchange shall be expected to resume at the point at which the channel change was made.

APPENDIX 1

SUGGESTED VALUES FOR PARAMETERS

Parameters such as radio unit time-outs and numbers of retries are represented by symbols in this standard; for example, the maximum item duration is referred to as TT. This Appendix contains suggested values for these parameters. However, note that a radio unit must use the values required by the system on which it is currently operating.

A brief indication of the usage of each parameter is given, but readers should refer to the procedures sections for the precise definitions of usage. The table below lists the sections which refer to each parameter.

The maximum permissible tolerance for radio units implementing the times given is 10 %.

Meaning	Symbol	Suggested Value	Refs.
Number of Disconnect messages sent by individually-called radio unit.	ND1	2	9.2.3.5 9.2.3.6
Number of Disconnect messages sent by calling radio unit.	ND2	4	9.2.3.5 9.2.3.6
Maximum number of random access transmissions of RQE.	NE	16	7.3.8 10.2.1
Maximum number of traffic channel transmissions of RQS or RQX.	NI	4	11.2.1 11.2.6
Number of Pressel On messages	NPON	2	9.2.3.1
Number of Pressel Off messages	NPOFF	3	9.2.3.1
Maximum number of random access transmissions of RQS, RQD, RQX, RQT, RQR, RQQ or RQC.	NR	8	7.3.8 8.2.2.2 9.2.1.1 9.2.1.7 12.2.1 12.2.6 13.1.2.2 13.1.2.6 13.2.2.1 13.2.2.6 14.2.1 14.2.7

contd.

Meaning	Symbol	Suggested Value	Refs.
Maximum delay of TSC's response to an unsolicited message from a radio unit on a traffic channel. (The response SYNT begins not later than the start of bit NT, measured from the end of the radio unit's message.)	NT	103	6.1.2.2 6.2.2.2.2
Value of WAIT assumed at the start of a session. (WAIT is a number of slots.)	NW	4	7.3.7
Time-out for called radio unit after receiving AHY.	TA	60 seconds	9.2.2.2 9.2.2.4 13.1.2.1
Time barred from calling same ident after receiving ACK(QUAL=0), ACKX, ACKV or ACKB(QUAL=0), or any ident after receiving ACKT(QUAL=0).	TB	2 seconds	9.1.1.4 9.2.1.4 11.1.4 11.2.4 12.1.5 12.2.4 13.1.1.2 13.1.2.4 13.2.1.4 13.2.2.4 14.1.5 14.2.4
Time-out for requesting radio unit attempting random access.	TC	60 seconds	7.3.8 8.2.2.2 9.2.1.1 9.2.1.7 10.2.1 12.2.1 12.2.6 13.1.2.2 13.1.2.6 13.2.2.1 13.2.2.6 14.2.1 14.2.7
Time-out for requesting radio unit waiting for further signalling for an Include call.	TI	2 seconds	9.1.2.2 11.1.7 11.2.5

contd.

Meaning	Symbol	Suggested Value	Refs.
Time-out for requesting radio unit waiting for further signalling for a control channel transaction with the TSC (viz. registration, diversion request, or status message or short data message to the TSC).	TJ	20 seconds	7.3.8 8.2.1.3 8.2.2.4 9.1.1.7 9.2 12.1.7 12.2.5 13.1.1.4 13.1.2.5 14.1.9 14.2.6
Radio unit's inactivity time-out on a traffic channel.	TN	7 seconds	9.2.3.6
Maximum interval between periodic messages (within speech items) at the start of a session.	TP	5 seconds	9.2.2.6
Time when radio unit returns to the control channel acquisition procedures if no system identity code is decoded.	TS	5 seconds	6.2.1.2
Maximum item duration.	TT	60 seconds	9.2.3.6
Time-out for calling radio unit waiting for further signalling for a call or transaction that may require queueing (for a traffic channel or for a called party).	TW	60 seconds	7.3.8 9.1.1.7 9.1.1.10 9.2 9.2.1.6 10.1.7 10.2.7 13.2.1.7 13.2.2.5 14.1.9 14.2.6

List of Timers and Counters used for standard Data (see Section 17)

The foregoing parameters are also used for Standard Data.

Timeouts

No.	Meaning	Symbol	Range	Held By
1.	Time that a TSC may hold an undelivered Tmessage before destroying it.	TDF	System dependent	TSC
2.	Inactivity time before a TRANS is abandoned by an RU.	TDX	1, 2, 4, 8, 16, 32, 64 minutes indefinite.	TSC & RU
3.	Time that a radio unit waits waits to be allocated a TRANS after obeying GTT(TRANS=0), before returning to the control channel.	TDG		
4.	Time-out for requesting radio unit attempting random access on a data channel.	TDC	1 - 120 s	RU
5.	Time-out for requesting radio unit waiting for further signalling for a random access transaction on a data channel.	TDW	1 - 120 s	RU
6.	Time-out for called radio unit after receiving AHYD on a data channel.	TDA	1 - 120 s	RU
7.	Time-out for radio unit waiting for further data from TSC before impatiently trying DRQT.	TDE	1 - 120 s	RU
8.	Time-out for radio unit waiting for acknowledgement from TSC to data it sent before using DRQT.	TDH	1 - 120 s	RU
9.	Time barred from calling same ident on a data channel after receiving ACKV or ACKX in response to an RQD request.	TDB	1 - 60 s	RU
10.	Lack of signal timer on a standard data channel (see 17.2.0.3).	TDL	2 - 10 mins.	RU
11.	Time that a radio unit waits waits for received group data (including prearranged repeats). Started when a group GTT is received.	TDN	1 - 120 s	RU

contd.

Retry Parameters

No.	Meaning	Symbol	Range	Held By
1.	Maximum number of (non-emergency) random access transmissions on the data channel.	NDR	1 - 16	RU
2.	Maximum number of emergency i.e. RQD(E=1) random access transmissions on the data channel.	NDE	1 - 16	RU
3.	Maximum number of times that a group message will be repeated by a TSC.	NDG	1 - 16	TSC & RU

APPENDIX 2

THE ERROR CONTROL PROPERTIES OF THE CODEWORDS

The error control properties of the codewords are at least the following.

With "hard decision" decoding:

a. Detect all odd numbers of errors, any 5 random errors, and any error-burst up to length 16, or

b. correct any 1 error and detect any 4 errors and any error-burst up to length 11, or

c. correct up to any 2 errors, and detect any 3 errors and any error-burst up to length 4, or

d. correct any single error-burst up to length 5.

With "soft decision" decoding:

Correct any 5 dubious bits and any single burst of dubious bits up to length 16, according to examination of the pattern of dubious bits.

Note. The higher the degree of error correction applied, the more likely is false decoding. The application of signal quality measurement on a bit-by-bit basis may help to guard against falsing if hard decision decoding is used, and is essential if soft decision decoding is used.

APPENDIX 3

AN ALGORITHM FOR DETERMINING THE CODEWORD COMPLETION SEQUENCE OF A CONTROL CHANNEL SYSTEM CODEWORD

1. Create a codeword starting with a 16-bit preamble followed by the bit sequence '1100010011010100' and the 15-bit system identity code, thus filling bits 1 to 47.

2. Assume bit 48 = '0'. Calculate the check bits (see section 3.2.3).

3. If the parity bit = '0', then the assumption in 2 was wrong. In this case, set bit 48 = '1' and recalculate the check bits. (See also Note 1).

4. The wanted Codeword Completion Sequence is bits 48 to 63 inclusive with bit 63 inverted.

Note 1. A quick way to reverse the assumed bit and recalculate the check bits is to add modulo-2 the generator polynomial '1110100000010101' to bits 47 to 63, and then calculate the parity bit.

Note 2. The algorithm works because bits 1 to 63 are completely cyclic, except for the inversion of bit 63, and there are an odd number of '1's in the generator polynomial. The parity bit remains unaltered by any cycling process.

APPENDIX 4

AN ALGORITHM FOR GENERATING FIELDS A AND B OF THE MARK CODEWORD

1. Bits 1, 22 to 30 and 49 to 64 of the MARK address codeword are fixed (see section 5.5.4.1). Bits 2 to 5 (CHAN4) and 7 to 21 (SYS) are system-dependent. Bit 6 (field A) and bits 31 to 48 (field B) are chosen to maximise the number of bit transitions between bits 33 and 49 of the codeword.

2. In order to calculate an initial candidate MARK codeword, assume that bits 6, 31 and 32 of the MARK codeword will be '0'.

3. Obtain a 16-bit sequence to insert in bits 33 to 48 by a method similar to that in Appendix 3, i.e.

   a. Create an intermediate codeword starting with the sequence '1100010011010101', followed by CHAN4, '0' (bit 6 of MARK), SYS, '100011000' and '00' (bits 31 and 32 of MARK).

   b. Assume bit 48 of the intermediate codeword = '0'. Calculate the check bits (see section 3.2.3).

   c. If the parity bit = '0', then the assumption in b. was wrong. In this case, set bit 48 = '1' and recalculate the check bits. (See also Note 1 of Appendix 3).

   d. The 16-bit sequence to insert in bits 33 to 48 of the candidate MARK codeword is bits 48 to 63 of the intermediate codeword, with bit 63 inverted.

4. Derive seven other candidate MARK codewords having the alternative combinations of bits 6, 31 and 32. This may be performed by adding modulo-2 the following sequences to bits 33 to 48 of the initial candidate MARK codeword:

   If bit 6 = '1' add '0100000000101110'
   If bit 31 = '1' add '0111000001111110'
   If bit 32 = '1' add '0011100000111111'

5. For each candidate MARK codeword, count the number of bit transitions occurring between bits 33 and 49.

6. The required MARK codeword is a candidate which provides the greatest number of counted transitions.

APPENDIX 5

BCD CODING

Where BCD coding is specified in this standard, the following representation shall be used:

Binary value	Character represented
'0000'	0
'0001'	1
'0010'	2
'0011'	3
'0100'	4
'0101'	5
'0110'	6
'0111'	7
'1000'	8
'1001'	9
'1010'	reserved
'1011'	*
'1100'	#
'1101'	reserved
'1110'	reserved
'1111'	NULL

Note: These BCD groups shall be arranged in codewords so that the most significant bit of the binary value is transmitted first (i.e. the leftmost bit in the above table shall be transmitted first).

APPENDIX 6

Reserved for Timing of Responses for Standard Data at a customised rate

APPENDIX 7

OTHER IDEAS CONSIDERED DURING THE DRAFTING OF SECTION 17 (STANDARD DATA)

1. As explained in section 17, the Standard Data protocol is an optional feature of MPT 1327. In considering whether to implement it, firms might therefore like to be aware of other ideas which arose in the drafting discussions but were not specifically used in the protocol.

2. The ideas set out below are believed by their originators to be already in the public domain or, with their agreement , are hereby offered to it. Before proceeding, however, firms are advised to make appropriate enquiries through their Patent Agents so as to ensure that any relevant IPR claims not compromised.

3. The ideas are:

a) An "ackvitation", ie a message sent by a TSC to a radio unit, the ackvitation message being a combination of an acknowledgement to a user data message sent by the radio unit and an invitation to the same unit to send more data or repeat the data previously sent according to the requirements of the acknowledgement, see STDWP CP 623. This latter part of the message can include a parameter stating the maximum amount of data which may be transmitted next. An essential point of an ackviatation is that it needs only one address label because only one radio unit is being addressed. An example of an ackvitation is the selective acknowledgement message, "SACK".

The "DACK" acknowledgement messages included in the standard are not ackvitations because they contain two addresses, one for the acknowledgement submessage and one for the GO submessage. If both addresses are the same then the function of the DACK message is indistinguishable from that of an ackvitation.

b) Inclusion of repeated data and new data in a single message, STDWP CP 629. Each user data message is responded to in the manner described in the text. Whereas in the text, if selective repeats are required only the repeated data is then sent by DSS in a new message, in this idea the repeated data occupies the front part of the new message and new data then is appended to the repeated data. The DRS can distinguish the repeated data from the new data by referring to the last acknowledgement it sent which, of necessity, includes the number of codewords to be repeated. The DRS has to keep a running record of the position or order of every codeword it requires to be repeated until that codeword has been successfully received.

c) Inclusion of the SYStem identity code in each message header as a means of combatting radio over-reach. The idea was extended to include either the SYS or radio unit address modulo-2 added into every user data codeword. However, it was judged that the incidence of the problem is too low to warrant inclusion of the idea.

d) Distinguishing Dataitems by length rather than by label.
STDWP CP 650

The idea here is to use a separate label for each segment, but instead to differentiate between them by their lengths. For example the length might alternate between adjacent segments or might progressively increase or decrease over the whole Tmessage. Thus each header only need include the name of the Tmessage (or TRANS). The message length could be indicated in any known manner, eg by a FRAGL field or a continuation bit in each codeword. The only requirement is that adjacent messages have different lengths unless the whole message is repeated. This serves to distinguish new messages from repeated ones, which is the only absolute necessity.

The method in the standard is to use a separate segment label but restrict this to only one bit (ITENUM). However, the length differentiation method is noted in 17.2.3.2.3 as a means of increasing security, although in this case the length is controlled by the DRS varying the number of assigned EFLAGs set.

e) To include both a message header and a message tail codeword.

A problem with reception is that if the header cannot be decoded then the whole of the user data message is lost. If a tail codeword containing substantially the same information as the header is added to the message then a DRS could record any data codewords received without a decodeable header in the hope that the tail codeword might then be decoded and hence perhaps make the received data codewords usable.

A multipath fading simulation study indicated that there could be an increase in air-time efficiency in very poor reception conditions but a decrease in efficiency in most other conditions. The latter outweighed the advantage given by the former.