MPT 1327

A Signalling Standard

for Trunked Private Land Mobile Radio Systems

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~~Part 1~~

MPT 1327

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A SIGNALLING STANDARD FOR

TRUNKED PRIVATE LAND MOBILE RADIO SYSTEMS

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1	October 1990	Incorporated in the version reprinted in October 1990. Amended text was highlighted by a bar in the margin.

FOREWORD

This standard defines the rules for communication between radio units and trunking system controllers operating in trunked private land mobile radio systems.

Applications and test conditions for this standard, applicable to Band III, are contained in the following specifications prepared by the Department of Trade and Industry, Radiocommunications Agency.

MPT 1343	System interface specification for radio equipment to be used with commercial trunked networks operating in Band III, sub-bands 1 and 2.
MPT 1347	Radio interface specification for commercial trunked networks operating in Band III, sub-bands 1 and 2.
MPT 1352	Test schedule for the approval of radio units to be used with commercial trunked networks operating in Band III, sub-bands 1 and 2.

Intellectual Property Rights

Firms intending to manufacture equipment which complies with the standard should be aware that certain features of the standard are subject to IPR claims.

All firms are therefore advised that they should make appropriate enquiries through their Patent Agents before proceeding.

CONTENTS

1. INTRODUCTION

MPT1327 is a signalling standard for trunked private land mobile radio systems. It defines the protocol rules for communication between a trunking system controller (TSC) and users' radio units.

The standard can be used to implement a wide variety of systems, from small systems with only a few radio channels (even single-channel systems), through to large networks which may be formed by the interconnection of TSCs.

The protocol offers a broad range of user facilities and system options. However, it is not necessary to implement all of the facilities available; an appropriate subset of the protocol could be implemented, according to the user requirements. Also, there is scope for customisation for special requirements, and provision has been made for further standardised facilities to be added to the protocol in the future.

The standard defines only the over-air signalling and imposes only minimum constraints on system design. Additional specifications will be required for specific implementations, for example, to define:

- the facilities that must be implemented
- parameter values
- a channel plan
- for a network, criteria for when a radio unit should register.

Section 1.1 of this introduction describes the user facilities which are explicitly provided by the protocol. (It does not describe additional facilities which may be offered in a radio unit but which do not require any specific protocol.)

Section 1.2 describes some protocol features, indicating the options available to system designers.

Section 1.3 provides an introduction to the operation of the protocol.

Subsequent sections of this document contain the protocol definition. In most of these sections, the protocol rules for the TSC and for radio units are specified separately, but with cross-referencing where convenient.

1.1 User Facilities

The facilities available to users are outlined below. For a full definition of the facilities, see the sections indicated.

1.1.1 Types of call

The standard protocol enables radio units to make the following types of call.

a. Speech call. (See section 9.)

Speech calls may be requested with normal or high priority. For group calls, the calling party may opt for a conversational mode, where all parties are able to speak, or for an announcement mode where only the caller may speak.

b. Data call, for the transmission of non-prescribed signalling. (See section 9.)

Parameters are available to specify either normal or high priority and, for a group call, whether the called group members can reply. (Provision has been made for specifying a standard method of data communication in the future).

c. Emergency call. (See section 10.)

Parameters are available to specify either a speech or a data call and, for a group call, whether the called group members can reply. Also, a radio unit may request 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.

d. Include call. (See section 11.)

During a call, a unit may request that another party joins the call. This facility may be used to implement a Conference Call or Call Transfer.

e. Status message. (See section 13.)

Thirty-two different status messages may be conveyed between units. The meanings of two of these messages are prescribed as a "call-me-back request" and "cancel previous call-me-back request". The remaining thirty messages have user-defined meanings. (Status messages can also be sent between radio units and the TSC.)

f. Short Data Message. (See section 14.)

Messages of up to 184 bits of free format data can be sent between units, or between units and the TSC.

1.1.2 Making calls

A radio unit may request a call to any of the following called parties (except for status messages, which cannot be addressed to PABX or PSTN destinations or to groups):

- an individual radio unit or line-connected unit
- a group, or all units in the system
- a PABX number, up to nine digits
- a PSTN number, up to 31 digits.

In addition, status messages and short data messages may be sent to the TSC.

During call set-up, the TSC may pass a wide variety of information to the caller, to indicate the progress of the call. For example, it may indicate the reason for any delays in call set-up or the reason for a call failure.

A call request may be cancelled at any time.

1.1.3 Receiving calls

A radio unit may receive calls from a radio unit or line unit, or (except for status messages) from a PABX extension or the PSTN. In addition, status messages and short data messages may be received from the TSC. For a call from a radio unit, a line unit or the TSC, the calling address may be supplied to the called unit. For a call from a PABX extension or from the PSTN, the calling gateway is indicated as the source of the call but the caller's number is not conveyed to the called unit.

Incoming calls may be addressed to the unit individually or to a group to which it belongs. A radio unit may be a member of an arbitrary number of groups; its group addresses can be chosen independently of its individual address.

A radio unit may refuse to accept all incoming calls, for example by means of a "busy" or "out-of-vehicle" control, or incoming calls could be refused selectively, depending on the source of the call. If a user does not wish to proceed with an incoming call immediately, he can indicate that he will call back later.

Systems may be configured to alert a called individual and require him to indicate that he is ready, before a traffic channel is allocated for a call.

1.1.4 Diverting Calls

If a radio unit does not wish to receive calls, it may request that future calls addressed to it be redirected to a specified alternative destination. A radio unit may also request redirection on behalf of a third party, for example, for a unit which is not equipped for call diversion. A radio unit calling a diverted party will be informed of the alternative destination to try; it may then re-make the call automatically, or it may give the user the option of deciding whether to call the alternative destination. See section 12 for the full diversion facilities.

1.2 System Features and Facilities

1.2.1 System dimensions

The numbering range of the protocol accommodates:

- 1,036,800 addresses per system
- 1024 channel numbers
- 32768 system identity codes.

1.2.2 System control

The protocol uses signalling at 1200 bit/s with Fast Frequency Shift Keying (FFSK) subcarrier modulation. It is designed for use by two-frequency half-duplex radio units and a duplex TSC.

The signalling for setting up calls is transmitted on a "control" channel. A TSC can be operated using either of two control channel strategies: dedicated or non-dedicated. A dedicated system has a control channel permanently available for signalling, whereas a non-dedicated system may assign the control channel for traffic (speech or data communication) if all the other channels are in use. The use of a dedicated control channel is appropriate for a TSC with many channels, whereas a non-dedicated control channel may be more appropriate for a TSC with only a few channels. The protocol allows the use of either strategy.

Broadcast messages are available to inform radio units of system information, such as the channels which the system may use for control signalling.

One of the problems of mobile radio signalling systems is the clashing of messages from different radio units transmitting at the same time. The problems of clashing are controlled by an access protocol which offers high efficiency, stability and flexibility. (See section 1.3.3 and section 7.)

Protection against interference is provided by labelling the signalling with a system identity code and, in some messages, the channel number. If heavy interference is encountered, control can be changed to a different channel.

To cope with system malfunction, a customised fall-back mode of operation may be defined by the system designer.

1.2.3 Call handling

The protocol is designed for use by systems which queue calls that cannot be set up immediately, for example, if no channel is currently available for traffic.

Before a traffic channel is assigned for a call to an individual radio unit, the TSC checks that the called unit is in radio contact, in order to avoid wasted channel assignments. It may also check that the radio unit's operator is ready for the call, to avoid a traffic channel being assigned to an unmanned unit.

Call maintenance signalling is defined for prompt release of traffic channels at the end of a conversation, or in case communication is lost during a call. (See section 1.3.5 and section 9.)

As a precaution against fraudulent use of a system by an unauthorised radio unit, the TSC may at any time instruct a radio unit to transmit its unique serial number; comparison of the received serial number with the expected value will assist in the detection of fraudulent users. (See section 15.)

1.2.4 Multi-site systems

The standard leaves scope for various multi-site wide-area coverage techniques to be used, for example:

- synchronous/quasi-synchronous operation
- a separate control channel at each site
- a single control channel shared by time division.

The protocol includes a registration facility to assist the implementation of multi-site systems and networks of TSCs: a radio unit can inform the TSC of its location as it roams between sites or systems. (The system identity code distinguishes the signalling from different sites and systems). The standard defines signalling procedures for registration (section 8), but the criteria for registration will be system-dependent.

A TSC can broadcast information to assist radio units hunting for a control channel when they roam; for example, it can announce the channels which may be used for control by itself or by TSCs on adjacent sites.

1.3 Guide to Some Key Protocol Aspects

This section provides an introduction to the operation of the protocol which, because of its scope and flexibility, is necessarily complex. The section outlines the control channel structure, the random access protocol and some message exchange procedures for call set-up.

This section is intended only as a guide: it should not be regarded as a protocol specification. Readers should refer to the main body of the standard for the complete and precise definition.

1.3.1 Control channel signalling structure

The signalling for setting up calls is transmitted on a "control" channel. Time on the control channel is divided into slots of duration 106.7 ms (128 bits), and one signalling message can be sent in each slot. The basic control channel signalling structure is illustrated in Figure 1-1.

Signalling on the forward channel (base station transmit frequency) is nominally continuous, with each slot comprising two 64-bit codewords, usually:

i) A Control Channel System Codeword (CCSC).
The CCSC identifies the system to radio units and provides synchronisation for the following "address" codeword.

ii) An "address" codeword.
An address codeword is the first codeword of any message and defines the nature of the message.

1.3.2 Control channel signalling messages

The messages sent on a control channel may be classified as follows:

Aloha messages	- Sent by the TSC to invite and control random access.
Requests	- Sent by radio units to request calls/transactions.
"Ahoy" messages	- Sent by the TSC to demand a response from an addressed radio unit.
Acknowledgements	- Sent by the TSC and by radio units.
Go To Channel messages	- Sent by the TSC to allocate traffic channels.
Single address messages	- Currently sent only by radio units.
Short data messages	- Sent by the TSC and by radio units.
Miscellaneous messages	- Sent by the TSC for system control.

Some uses of these messages are illustrated in the following sections.

1.3.3 Random access protocol

1.3.3.1 Principle of operation

One of the problems of mobile radio signalling schemes is the clash of messages from different radio units transmitting at the same time. In this standard, the problems of clashing are controlled by a random access protocol which is based on slotted Aloha, with a superimposed framing structure. The access protocol can be used to minimise access delays, ensure stability and maintain peak throughput under heavy traffic loads.

The basic principle of the access protocol is described with reference to Figure 1-2, which illustrates signalling on a control channel. The TSC transmits a synchronisation message (indicated by ALH in Figure 1-2) to invite radio units to send random access messages. The ALH message contains a parameter (N) which indicates the number of following timeslots, constituting a frame, that are available for access. If a frame is already in progress when a user initiates a call, the radio unit may send its random access message in the next slot. Otherwise the unit waits for a frame to be started and then chooses a random slot from the frame for its message. A unit wishing to send a repeat transmission after an unsuccessful message (corrupted by fading or clashing) chooses again from a new frame.

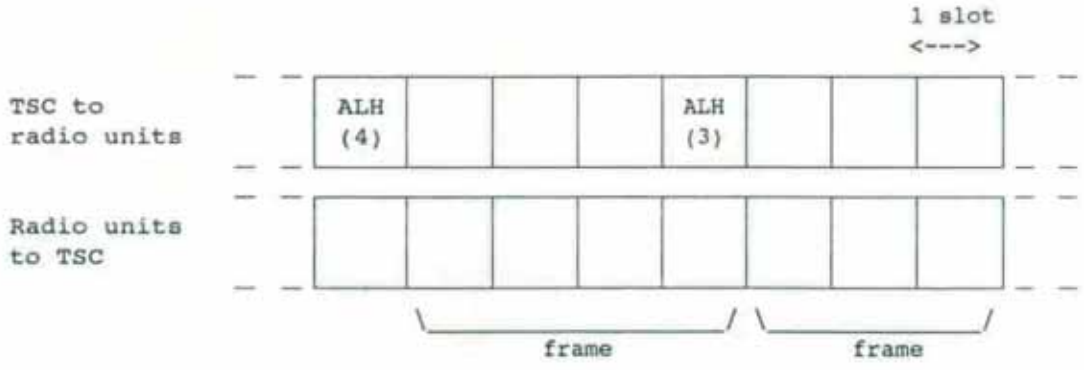


Fig. 1-2 Two random access frames, each marked by an ALH message

1.3.3.2 Features of the random access protocol

The main features of the access protocol are as follows:

a) The TSC can monitor activity on the control channel and can optimise the system performance by varying the framelength to prevent excessive clashing and to minimise access delays. Figure 1-3 illustrates an example of random access control.

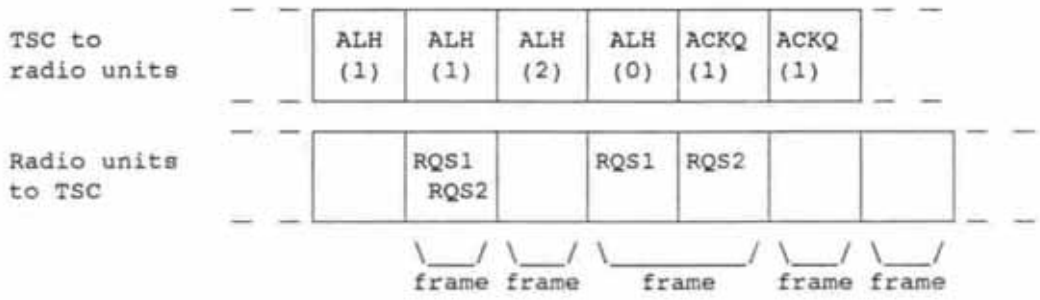
b) The signalling overhead for random access control is kept small by allowing Acknowledgements and Go To Channel messages to contain the framelength parameter (N), so that frames can be marked without requiring an explicit Aloha message. For example, see Figure 1-3.

c) During a frame, the TSC may transmit messages that demand a response from a specified radio unit. These outbound messages inhibit random access in the following slot, and so reserve the slot for the unit's reply.

d) The TSC may reserve frames for:

- specific types of call request, by means of specific Aloha messages (for instance, the Aloha message ALHE invites emergency calls only);

- subsets of the radio unit population (subdivision by address).



The TSC detects the clashing of requests RQS1 and RQS2, and marks a longer frame (with message ALH(2)). The radio units repeat their requests and, in this example, choose different slots. Each request is acknowledged in the following slot.

ALH(0) does not mark a frame.

ACKQ(1) acknowledges a request and also marks a new frame.

In the absence of clashing, the framelength may be reduced.

Fig. 1-3 Example of random access control

1.3.4 Addressing

A unit address is a 20-bit number comprising two fields: a 7-bit prefix and a 13-bit ident. (Normally, all members of a fleet will be allocated the same prefix.) The division into prefix and ident allows most messages to accommodate two addresses, the calling and called party, by including the prefix only once. For instance, call requests and Go To Channel messages contain two idents and only one prefix.

For a call to a unit with the same prefix, a request message contains all the information necessary to make the call. However, for a call to a unit with a different prefix, the call details cannot be accommodated in a single address codeword; this type of call requires the use of "extended addressing" procedures (as do some PABX and most PSTN calls).

1.3.5 Examples of signalling sequences

The precise signalling required for a call depends on the type of call and on the design of the TSC; (the standard does not prescribe the TSC algorithms). This section contains some examples of message exchange sequences. Note that, although not shown in the examples, messages will be retransmitted in the case of corruption by propagation errors or collision.

Examples of message exchange sequences for call set-up are presented in sections 1.3.5.1 to 1.3.5.3. These examples show control channel signalling, for:

- call requests
- instruction to send extended address information
- checking availability of radio units
- traffic channel allocation.

Signalling is also sent on an allocated traffic channel, for call maintenance and call clear-down. For instance:

a) To assist call maintenance, a radio unit sends a "Pressel Off" message at the end of each speech transmission. The system may also require the unit to start each speech transmission with a "Pressel On" message and to send call maintenance messages periodically within the transmission.

b) The calling unit in a group call, or both units in an individual call, send "Disconnect" messages to indicate end-of-channel-use when the user goes on-hook or equivalent.

c) The TSC sends CLEAR messages to clear down a call (after receiving a valid Disconnect message or if a time-out has expired).

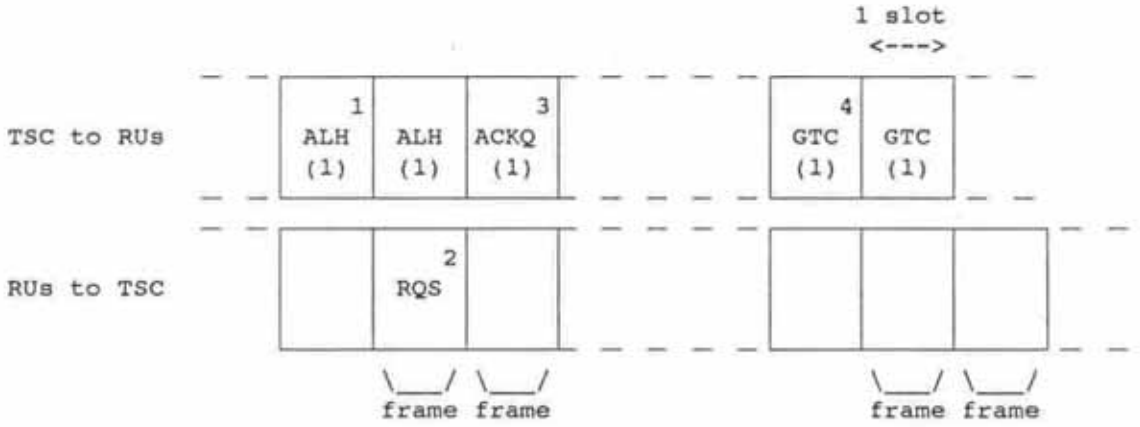
However, the examples do not cover traffic channel signalling.

The final example (section 1.3.5.4) illustrates the transmission of a short data message. This type of transaction does not use a traffic channel: it requires control channel signalling only.

1.3.5.1 Example: radio unit calls a group

Figure 1-4 illustrates a message sequence on a control channel to set up a group call between radio units with the same prefix.

The sequence includes call request and channel allocation signalling. (For group calls, an availability check on the called units is not performed.) In this example, all traffic channels are in use when the call is requested and so the call is queued.



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

2. RQS : The calling radio unit transmits its request, complying with the random access protocol.

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

4. GTC : When a traffic channel is available, the TSC sends the Go To Channel command, addressed to the calling unit and called group; this message instructs the units to switch to the traffic channel for their conversation. In this example the GTC is repeated, for added reliability.

Fig. 1-4 Common-prefix group call

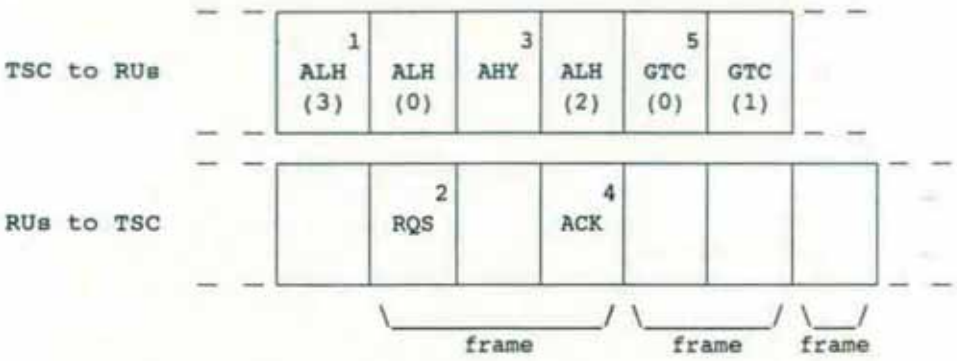
Alternative acknowledgements from the TSC are available if, for instance, the call request is invalid or the system is overloaded.

If a traffic channel is available when a group call is requested then the TSC may omit the ACKQ and send the GTC command immediately.

In this example the GTC message is repeated immediately. However, repeat messages may be delayed for other signalling.

1.3.5.2 Example: radio unit calls a unit with the same prefix

Figure 1-5 illustrates a message sequence on a control channel to set up a call between two radio units with the same prefix. The sequence includes call request, availability check and channel allocation signalling.



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

2. RQS : Random access call request.

3. AHY : Availability check message
   - acknowledges the RQS message
   - demands a response from the called radio unit (thereby checking whether the called unit is in radio contact)
   - inhibits random access in the next slot.

4. ACK : Acknowledgement from the called radio unit, sent in the reserved slot.

5. GTC : Go To Channel message instructing both radio units to switch to the specified traffic channel for their call. In this example the GTC is repeated, for added reliability.

Fig. 1-5 Common-prefix individual call

In this example, the called unit is in radio contact and therefore responds to the AHY. If the called unit cannot be contacted, the TSC may indicate the failure to the calling unit by sending acknowledgement ACKV.

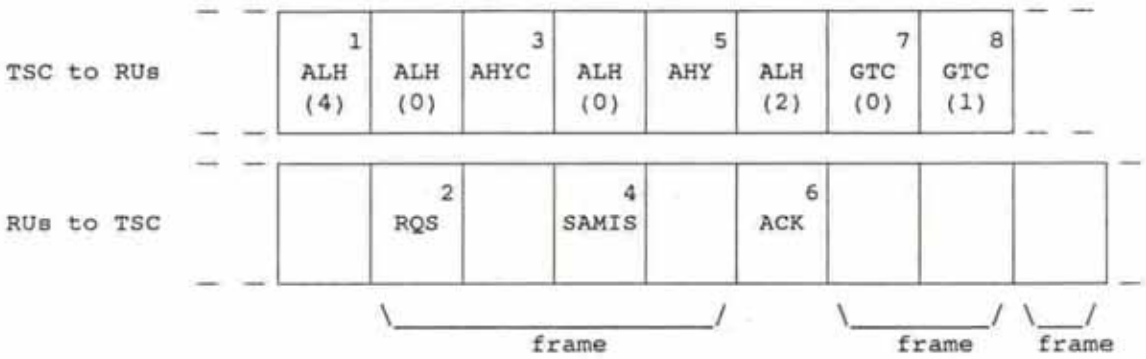
In both this and the following example, the TSC checks only that the called unit is in radio contact before allocating a traffic channel. The TSC may also check whether the called user is ready; if he is not, the unit responds with acknowledgement ACKI and takes action to alert him. Then, when the user is ready to receive the call, the unit may send a status message (RQQ) to inform the TSC.

The ALH(0) message in these examples is used as a "dummy" message, in slots carrying no signalling relevant to the example. In practice, these slots may be used for signalling for another call, or for broadcast messages (which contain information about system parameters).

1.3.5.3 Example: radio unit calls a unit with a different prefix

Figure 1-6 illustrates a message sequence on a control channel to set up a call between two radio units with different prefixes.

The sequence includes call request, availability check and channel allocation signalling (as in the previous example). However, this sequence has an extra phase: after receiving the RQS message, the TSC sends AHYC to invite the calling unit to transmit the full called address. Also, separate GTC messages instruct the two units, because GTC contains only one prefix.



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

2. RQS : Random access request for an interprefix call. (The request contains the calling unit's address (prefix/ident), but the called ident is set to a special "gateway" ident to indicate that extended addressing procedures are needed.)

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

4. SAMIS : Single Address Message from the calling radio unit, containing the address (prefix/ident) of the called unit.

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

6. ACK : Acknowledgement from the called radio unit.

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

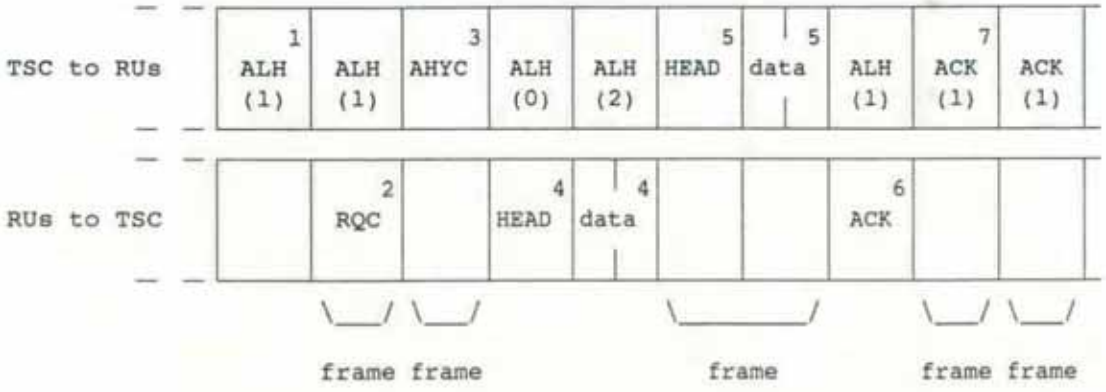
8. GTC : Go To Channel message instructing the calling radio unit to switch to the specified channel for the call.

Fig. 1-6 Interprefix individual call

1.3.5.4 Example: radio unit sends a short data message

Figure 1-7 illustrates a message sequence on a control channel for sending a short data message from one radio unit to another radio unit. In this example, the data message comprises an address codeword and two appended data codewords; (each of the data codewords contains 46 bits of free format data).

In the sequence, the radio unit sends its request; the TSC instructs the unit to send the data message, forwards the data message to the called unit and then indicates the success of the transaction to the calling unit.



1. ALH : General Aloha invitation (one-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.

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.

6. ACK : Acknowledgement from the called unit - message accepted.

7. ACK : Acknowledgement 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.

Fig. 1-7 Short data message

2. DEFINITIONS

Note - Words appearing within asterisks within these definitions are defined terms. (eg *defined term*)

Active on a Channel: A *radio unit* is *active on a channel* when, on that channel, it is enabled to respond to *messages* addressed to it, or is transmitting, or is in transition between these two states.

Note - a *radio unit* becomes active on an assigned *traffic channel* as soon as it can receive on that channel, whereas, on a *control channel* it shall not become active until it has received a codeword containing an appropriate *system identity code*.

Address: A 20-bit number by which a unit or group of units is known within a *system*. The *address* comprises two *fields*; a 7-bit *prefix* and a 13-bit *ident*.

Address Codeword: A 64-bit codeword, conforming to the requirements of this standard, where the first bit is set to '1'. An *address codeword* is always the first codeword in any *message*, and defines the nature of the *message*.

Base Station: The entirety of transmitters and receivers operated by a *trunking system controller* at any one site.

Call: A complete information exchange between two or more *parties* which includes one or more *transactions* and may include direct user-to-user communication on a *traffic channel*.

Called Unit (or Group): The unit, or group of units, which a *calling unit* identifies as the desired recipient(s) of a *call*. The *called unit (or group)* retains this designation for the duration of a *call* and this convention is used in *messages* relating to that particular *call*, irrespective of the origin of such *messages*.

Calling Unit: A *radio unit* or *line unit* which request a *call*. The *calling unit* retains this designation for the duration of a *call* and this convention is used in *messages* relating to that particular *call* irrespective of the origins of such *messages*.

Common Prefix Call: A *call* where the values of the *prefixes* in the calling and called *addresses* are the same. *Common prefix calls* use the *short addressing* procedures.

Control Channel: A *forward channel* and *return channel* being used for the transmission of *messages* conforming to this standard with the primary purpose of enabling the *trunking system controller* to control radio units.

Data Codeword: A 64-bit codeword, conforming to the requirements of this standard, where the first bit is set to '0'. *Data codewords* are concatenated to an *address codeword* and supplement the information in the *address* codeword*.

Dataitem: The whole, or a part of, a *Tmessage*. A dataitem may not include more than 62 data codewords.

Decodeable: A transmitted codeword shall be considered *decodeable* if, after receipt, and after any error correction (if used) has been applied, a valid codeword from the code defined in section 3.2.3 of this standard is formed.

Diversion: A procedure whereby a *party* may request that future *calls* to a particular called address be redirected to an alternative destination.

Extended Addressing: A method which allows called *party* details to be conveyed to the *trunking system controller* when the *call* details cannot be accommodated in a single *address codeword*. These called-party details may be an *address* or addressing information in a different form (eg PSTN dialling digits).

Field: A number of contiguous bits in a codeword which is specified in terms of the position within the codeword and the number of bits.

Forward Channel: A radio bearer where the direction of transmission is form the *base station* to *radio units*.

Fragment: A message which is either the whole of a *dataitem* or those codewords of a *dataitem* for which repetition has been requested by the receiving station.

Free Format Data: Data within a codeword which, in this standard, is constrained only by its position and length.

Gateway: A *special ident* which is used to identify a *message* relating to a *call* or *transaction* to or from a communications service outside of the *system* (eg the PSTN). For the purposes of this standard the interprefix *ident*, IPFIXI, is also regarded as a *gateway*.

Group Address: An *address* which is common to more than one unit and which, when nominated as the called *address*, signifies a *group call*. Units may be assigned any practicable number of *group addresses*.

Group Call: A *call* in which a *group address* is specified as the called *party* and, accordingly, provides a means of communication between more than two units. The calling *party* in a *group call* may opt for a conversational mode, where all *parties* are able to speak, or for an announcement mode where only the caller may speak.

Ident: A 13-bit number used for identification purposes. Values of *ident* between 1 and 8100 inclusive are assigned to individual units or groups, in which case they are associated with a *prefix* to form a 20-bit *address*. Values of *ident* above 8100 are designated *special idents* and these are not associated with any particular *prefix*, neither is the *ident* value 0 (DUMMMYI).

Idle State: A *radio* unit* is in the *idle state* on a *system* when it is *active on a control channel* belonging to that *system*, is not currently within a *message* exchange and has no current *message* transfer requirement.

Include: A procedure whereby *parties* may be introduced into a *call* in progress at the request of an existing *party* to the *call*.

Individual Address: An *address* by which a single unit is known within a *system*, allowing that unit to be uniquely addressed by that *system*. Units may be assigned any practicable number of *individual addresses* provides that at least one per *systems* is assigned to each unit.

Individual Call: A *call* between a calling *party* and a single called *party*.

Interprefix Call: A *call* where the values of the *prefixes* in the calling and called *addresses* are different. *Interprefix calls* require *extended addressing* procedures.

Invoking message: A message from the TSC to a radio unit which requires or invites an immediate message from the radio unit according to the timing rules specified in section 6 if the transmission rate is 1200 bit/sec or the equivalent rules at any other transmission rate.

Item: A complete user transmission on a *traffic channel* by one *party* within a *call* at the conclusion of which that *party* rests from transmission. It is possible for a *call* to contain only one *item*.

Line Unit (LU): A user station which is allocated an *individual address*, and is directly connected to the *trunking system controller* via a medium other than the radio spectrum to which this standard applies.

Link: Any transmission path in the communication chain between the end users in a Standard Data call, and particularly the radio connection between the TSC and its dependent radio unit in such a call.

Message: A single contiguous data transmission which consists of a codeword synchronisation sequence, an *address codeword* and (optionally) one or more *data codewords* conforming to this standard.

Non-prescribed data: Any data traffic which does not conform to the data protocols defined in this standard.

Party: A source and/or recipient of information within a *call*. The term includes the totality of equipment at the user station and, where the context permits, the equipment user. A party may be an individual or a group.

Prefix: The 7 most significant bits of an *address*. Normally units within a fleet will be allocated the same *prefix* since

calls between units and groups with the same *prefix* can be made without the use of *extended addressing* procedures. A *prefix* is only relevant to *individual addresses* and *group addresses*.

Radio Unit (RU): A mobile or other user station contacting a *system*, by normal land mobile radio in accordance with this standard.

Random Access Attempt: The method by which a *radio unit* transmits an unsolicited *message* to the *trunking system controller* on a *control channel*. The method requires that a *radio unit* repeats a random access *message* if a response *message* is not received within a designated waiting time. Further repeats are required, in the absence of an appropriate acknowledgement, until a designated number of repeats is reached. In this standard a *random access attempt* covers the period from initiation of the *transaction* to the receipt of an appropriate acknowledgement or the expiry of a timeout.

Ready-for-Communication Control (RFCC): A device or system to inform a unit of the user's readiness to communicate, eg a switch-hook.

Registration: A procedure which confirms that a *radio unit* is within a *session* on a *system*. The *registration* procedures may be initiated by a demand from the *trunking system controller*, or at the initiative of the *radio unit*, depending on the circumstances of the *registration*.

Requested Unit (or Group): A unit, or group of units, which takes part in a *transaction* initiated by the *trunking system controllers* or another *party*.

Requesting Unit: A *radio unit* or *line unit* which initiates a *transaction* with the *trunking system controller* or another *party*, via the *trunking system controllers*.

Reserved: Codewords and *fields* which are designated as *reserved* in this standard are intended for future phases of standardisation and shall not be used in the interim for the conveyance of information. *Reserved fields* must be set to the default value specified in this standard.

Return Channel: A radio bearer where the direction of transmission is from *radio Units* to the *base station*.

Session: A *session* is a period of operation associated with one *system*. A *session* on a *system* starts when the *radio unit* becomes *active on a control channel* of that *system*, either after switch-on or after being *active on a control channel* of a different *system*. A *session* ends either when the *radio unit* is switched off or when it starts its next *session*.

Short Addressing: The method used when the *parties* to a *call* can be completely specified by a single *prefix* and two *idents*. This form of addressing minimises the signalling required.

Short Data: A procedure which allows a data *message* to be exchanged between *parties*, or between *parties* and the *trunking system controller*. This procedure does not support *messages* which include more than four *data codewords*.

Short-Form PSTN Destination: A called PSTN *party*, previously agreed between the system operator and the user of the *calling unit*, which can be specified by a *special ident*, rather than the full stream of dialling digits representing the directory number.

Spare: Codewords and *fields* which are designated as *spare* are available for free use by *systems* (ie *system* customisation) provided that the conditions of this standard are not infringed. The use of spare codewords and *fields* may vary from *system* to *system*.

Special Ident: An *ident* with a value greater than 8100. These *idents* are used for a variety of special purposes. Some of these are specified in this standard, others may be nominated by system operators. *Special idents* are not associated with a *prefix* to form an *address*.

Standard Data: The procedure by which information exchange takes place using the data protocol defined in section 17 of this standard.

System: The totality of equipment required to provide the communication facilities associated with a single *system identity code*. *Systems* may be combined to form larger communications facilities, but the delineation of *systems* and methods of combination are not within the scope of this standard.

System Identity Code: A 15-bit number which contains a unique identification of a *system*. This code is radiated on each *forward control channel* within the *system* (in the SYS *field*).

Tmessage: A quantity of *user data* which the correspondents by previous bilateral agreement have mutually agreed is useful to them as a distinct entity, and is marked as such by the originator for end-to-end transmission.

Traffic Channel: A *forward channel* and *return channel* being used primarily for user communication.

TRANS: A 10 bit transaction number allocated to a *link* during set-up of a data call to replace the address and port of the radio unit. The validity of a TRANS ceases at the conclusion of the data call.

Transaction: A complete information exchange consisting of one or more *messages* between a *party* and the *trunking system controller*, or another *party*, via the *trunking system controller*.

Trunking System Controller (TSC): The central control intelligence necessary to enable the trunking system to function according to this standard. The *trunking system controller* may control one or more *basestations*.

User Data: Data from or to the user which is either to or from his correspondent, or is concerned with call routing but is transmitted after a *TRANS* for the call has been allocated.

User Data Message: A message headed by address codeword "SITH" and containing user data.

3. SIGNALLING FORMATS

This section defines the basic signalling formats used by this standard. The detailed structure of the codewords is defined in section 5, and the timing constraints for the transmission of messages are defined in section 6.

The provisions of this section do not preclude the use of other, non-prescribed formats on a traffic channel.

3.1 Basic Format

Signalling transmissions shall employ Fast Frequency Shift Keying (FFSK) at a bit rate of 1200 bit/s. The basic components of the signalling formats are illustrated in Figure 3-1.

Fig. 3-1. Basic format

3.1.1 LET

Signalling transmissions shall be preceded by a Link Establishment Time (LET) within which a transmission of undefined modulation at not less than 90% of maximum power shall take place. The duration of the LET shall be as specified in section 3.3.3.1 and section 6.

3.1.2 Preamble

Signalling transmissions shall begin with a preamble of bit reversals 1010...10 so that the receiver data demodulator can acquire bit synchronisation. The preamble shall consist of a minimum of 16 bits and shall end with a binary zero.

3.1.3 Message

A message is a contiguous transmission consisting of a codeword synchronisation sequence, an address codeword and, where appropriate, one or more data codewords (see 3.2).

3.1.4 Hang-over Bit, H

Signalling transmissions shall be terminated by appending a "hang-over" bit of either binary zero or binary one to the last transmitted message.

3.2 Message Format

A message consists of a codeword synchronisation sequence, an address codeword and, where appropriate, one or more data codewords, as shown in Figure 3-2. The address codeword defines the nature of the message, and data codewords supplement the information in the address codeword.

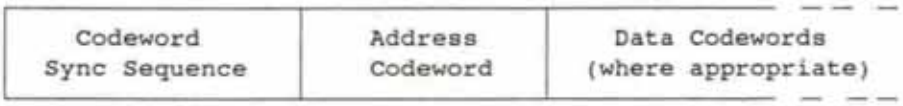


Fig. 3-2. Message format

3.2.1 Codeword synchronisation sequence

The codeword synchronisation sequence shall be transmitted to enable decoders to establish codeword framing. It consists of 16 bits.

3.2.1.1 Control channel codeword synchronisation sequence

The codeword synchronisation sequence for messages transmitted on a control channel, SYNC, is shown in Figure 3-3. Bit number 1 shall be transmitted first.

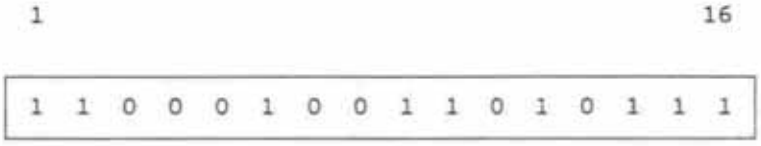


Fig. 3-3. Control channel codeword synchronisation sequence, SYNC

3.2.1.2 Traffic and Standard Data channel codeword synchronisation sequence

The codeword synchronisation sequence for messages transmitted on a traffic or standard data channel, SYNT, is shown in Figure 3-4. Bit number 1 shall be transmitted first. If a control channel is allocated for traffic, then SYNT shall be used for all messages transmitted while the channel is assigned for traffic.

Fig. 3-4. Traffic and Standard Data channel codeword synchronisation sequence, SYNT

3.2.2 Codewords

Messages shall be transmitted in 64-bit codewords. Each codeword shall contain 48 information bits followed by 16 check bits. There are two types of codeword, address and data codewords, which are distinguished by the first bit (A) within the codeword; see Figure 3-5. Bit number 1 shall be transmitted first.

bit no.	1	2 ... 48	49 ... 64
	A	information field	check bits
no. of bits	1	47	16

Bit 1 (A) - Binary one denotes an address codeword.
Binary zero denotes a data codeword.

Bits 2 to 48 - Information field; see section 5.

Bits 49 to 64 - Check bits; see section 3.2.3.

Fig. 3-5. Codeword structure

3.2.3 Encoding and error checking

The first 15 check bits are derived from a (63,48) cyclic code. For encoding, the codeword bits 1 to 48 represent the coefficients of a polynomial having terms from X^{62} down to X^{15}. This polynomial is divided modulo-2 by the generating polynomial:

$$X^{15} + X^{14} + X^{13} + X^{11} + X^{4} + X^{2} + 1$$

The 15 check bits correspond to the coefficients of the terms from X^{14} to X^{0} in the remainder polynomial found at the completion of the division. The final check bit of the (63,48) cyclic code (codeword bit 63) is then inverted. Finally, one bit is appended to the 63-bit block (including the inverted bit number 63) to provide an even parity check of the whole 64-bit codeword.

Decoding algorithms are not prescribed in this standard; for the error control properties of the codeword, see Appendix 2.

3.3 Signalling Transmission Variants

3.3.1 Single message format

The format for signalling transmissions which contain a single message is shown in Figure 3-6.

Fig. 3-6. Single message format

3.3.2 Multiple message format on a traffic channel

The format for standardised signalling transmissions which contain more than one message is shown in Figure 3-7. This format shall be used only on traffic channels.

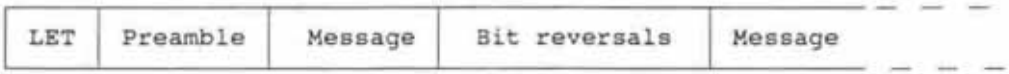


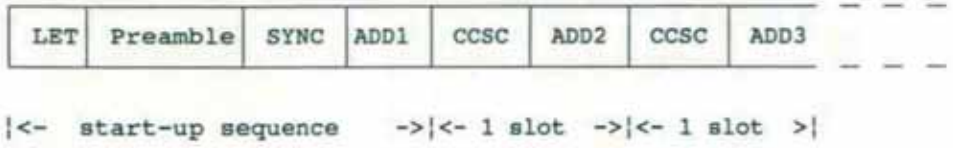
Fig. 3-7. Multiple message format

For multiple messages transmitted by a radio unit, there shall be 16 bits of bit reversals between messages. For multiple messages transmitted by the TSC, bit reversals may be inserted between the messages as required. The final bit of any bit reversals (before the next message) shall be a binary zero.

3.3.3. Forward control channel format

3.3.3.1 Basic control channel format

The start-up sequence for a base station commencing transmission on a control channel shall be as shown in Figure 3-8.



LET - Link establishment time of at least 6 bit periods (5 ms).

Preamble - At least 16 bits of bit reversals, ending with a binary zero.

SYNC - Control channel codeword synchronisation sequence; see 3.2.1.1.

ADDn - Address codeword (any appropriate message); see section 5.

CCSC - Control Channel System Codeword; see 5.1.

Fig. 3-8. Basic control channel format

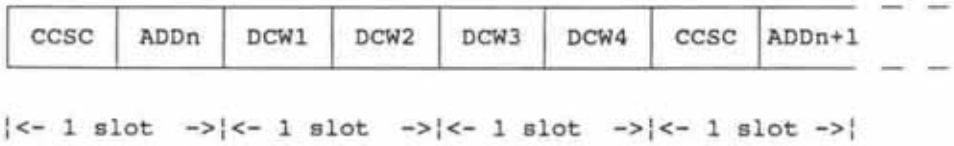
Following the start-up sequence the TSC shall divide time into slots, each comprising two codewords. The first codeword of a slot shall be the Control Channel System Codeword (CCSC), unless displaced by a data codeword from a previous message. The second codeword of a slot shall be an address codeword, unless displaced by a data codeword (see 3.3.3.2).

Every address codeword in a slot shall be preceded by a CCSC. The CCSC identifies the system to radio units and provides control channel slot synchronisation. It is a data codeword in which the final 32 bits form the preamble and codeword synchronisation sequence for the following address codeword (see 5.1).

The MARK address codeword (see 5.5.4.1) may be transmitted by the TSC on a newly designated control channel during the period allowed for radio units to locate and identify the control channel (see 6.1.1).

3.3.3.2 Data codeword displacement

When data codewords are transmitted as part of a message, they displace CCSCs and address codewords, as illustrated in Figure 3-9. Radio units must be capable of satisfactory operation despite this displacement (see section 6). The TSC shall not displace more than two CCSCs in consecutive timeslots.



CCSC - Control Channel System Codeword.
ADDn - Address codeword (any appropriate message).
DCWm - Data codeword in message.

Fig. 3-9. Example of data codeword displacement

When a message includes an odd number of data codewords, a "filler" data codeword shall be appended to the message (to maintain the slot structure); the content of the filler data codeword is not prescribed in this standard. See also section 7.2.5.

4. ADDRESSING

The unit address enables the TSC to recognise the source of messages and/or to direct messages to a particular unit or group of units. In addition, addresses may be used by the TSC to regulate access to the system.

This standard permits considerable flexibility in the way that unit addresses can be allocated, allowing each system full use of all available addresses. However system operators shall not allocate addresses in such a way that two units, using the same individual address, could be active on a system concurrently. Further, this standard does not support address reuse within interconnected systems.

The protocol allows over 32000 system identity codes and over one million addresses. A unit may be allocated different addresses for each system within which it is required to operate, or its addresses can be common to more than one system.

Unit addresses can be used for individual units or for groups of units. A group can be formed by allocating a common address to all members of the group. All units shall have at least one individual address.

Individual and group addresses consist of a 7-bit prefix and a 13-bit ident. Normally units within a fleet will share a common prefix, since this allows the short addressing procedures to be used during call set-up. Idents allocated to units must be equal to the binary equivalent of decimal numbers in the range 1 to 8100, inclusive.

The ident value 0 shall not be allocated to any unit and is designated the "dummy" ident, DUMMYI; this ident may be used as a null value.

Values of ident above 8100 are designated special idents and are not available for allocation to units. Use of these special idents allows a number of additional procedures and facilities to be achieved within this protocol standard. Some special idents are designated as gateways. These are used for calls which involve connection to communication facilities external to the system.

The arrangement of idents is summarised in Table 4-1.

Ident number 0 and special idents do not have a prefix associated with them; the prefix is only relevant to individual unit and group addresses.

The system-wide all-call ident applicable to all units (irrespective of prefix) is denoted by ALLI. The individual ident of the Trunking System Controller (TSC) is denoted by TSCI; this ident is the same for all TSCs.

Special idents are also employed within certain call procedures described in this standard. These include:

	SDMI:	which is used in the short data message procedures;
	DIVERTI:	which is used during call diversion procedures;
	INCI:	which is used by the TSC when checking the availability of a unit requested to be included in a call;
and	REGI:	which is used by the TSC in the registration procedures.

Two methods, both of which employ gateway idents, are provided for radio units requesting calls to the PSTN, namely:

- "short-form" calls, to destinations previously nominated (eg the radio unit's head office).
- "general" calls, to any PSTN destination.

Radio units requesting calls to prearranged PSTN or Data Network destinations use the short addressing procedures, with the called ident set to an appropriate "short-form" PSTN or Network ident. These short-form idents are denoted by PSTNSIj or NETSIj respectively, for j = 1 to 15. PSTNSIj is used for all appropriate call requests except RQD, and NETSIj is only used in RQD call requests. Each short-form ident allocated to a radio unit shall represent a complete destination previously agreed between the system operator and the radio user. A particular short-form ident may be reused for other radio units, each use having a distinct meaning. Thus, when a short-form call is requested, the TSC shall determine the meaning of the particular short-form ident by reference to the calling radio unit's address. The same principle can be applied to incoming calls.

Radio units requesting a "general" PSTN call use the gateway ident, PSTNGI. In this case, units are required to provide the full dialling information for the PSTN destination using the extended addressing procedures described in this standard.

Radio units requesting a "general" data network call use the gateway ident, DNI. In this case units will be allocated a data channel and TRANS. After this they supply the network addressing information on the data channel in a format appropriate to that network.

Radio units can request calls to PABX extensions using the short addressing procedures, provided that the extension number can be represented by 13 bits. A call may be to any one of four PABX exchanges, as previously agreed between the system operator and the radio use - the TSC shall determine the appropriate exchange by reference to the calling radio unit's address. Calls to PABX destinations that cannot be accommodated by the short addressing procedures use the PABX gateway ident, PABXI, and the extended addressing procedures.

Calls between units which do not share a common prefix also require use of the extended addressing procedures. For such calls the appropriate special ident is IPFIXI.

Meaning	Notation	Ident	
System-wide ident	ALLI	8191	
Ident of TSC	TSCI	8190	
Interprefix ident	IPFIXI	8189	
Short data message ident	SDMI	8188	
Divert ident	DIVERTI	8187	
Include ident	INCI	8186	
Registration ident	REGI	8185	
Reserved for future allocation		8181 - 8184	
Spare for customisation of systems		8136 - 8180	
Short-form PSTN idents	PSTNSIj	8121 -8135)	Note:Common
Short-form data Network idents (j = 1 ... 15)	NETSIj	8121 -8135)	range.
Reserved for future allocation		8104 - 8120	
Data Network gateway ident	DNI	8103	
PABX gateway ident	PABXI	8102	
General PSTN gateway ident	PSTNGI	8101	
User idents (individual and group idents)		1 - 8100	
Dummy ident	DUMMYI	0	

Table 4-1 - Ident Numbering Scheme

5. CODEWORD STRUCTURES

This section lists the codewords used in the standardised messages and defines their structure. A brief indication of the usage of the messages is given, but readers should refer to the procedures sections for a full definition of usage. Readers may find it helpful to study the procedures sections together with this section rather than consecutively.

It is not a mandatory requirement on either a TSC or a radio unit to understand the meaning of all the standardised messages. The messages that must be used will depend on the facilities implemented in a TSC and a radio unit; the procedures sections define which messages are required.

Standardised fields

The codewords are shown broken down into their constituent fields, with a definition of the meaning of each field. The fields in the codewords shall be set to appropriate values. Machine transmission of fields is most significant bit first.

In this standard, the numerical value of a field is referred to either by the decimal equivalent of the bit sequence concerned, with leading zeros suppressed, or in binary. Binary values are shown enclosed in apostrophes, e.g. Type '11', except in the codeword diagrams in this section.

Most address codewords contain a prefix and either one or two idents. When the prefix is not required to complete an address (e.g. for special ident ALLI), it may be set to an arbitrary value and, on reception, its value shall be considered to have no significance.

Reserved fields

Some fields are designated as "reserved". In the future development of this standard, the whole or any part of a reserved field may be designated for a specific purpose. Any such designation will be made in a manner that does not cause any existing application of this standard to cease to comply with the standard or to suffer a reduction in its functionality. Neither the existing protocol procedures nor the already designated meanings of messages will be changed in order to bring a reserved field into service.

Therefore, equipments complying with this issue of the standard shall, on transmission, set reserved fields to the specified default value and, on reception, shall consider the value of reserved fields to have no significance. Equipments which understand the designation of any previously reserved field shall, on transmission, note that the recipient equipment may attribute no significance to that field or, on reception, shall be prepared to accept the default value of that field.

Spare fields and codewords

There are "spare" fields and codewords available for customisation of services (see section 5.2). Spare fields and codewords will never be used within this standard, but may be designated for a specific purpose within any given application of this standard. In applications where spare fields or codewords are employed, rules shall be generated governing their use. Any designation of spare fields and codewords shall not modify the meaning of standardised fields and codewords.

Unless a radio unit knows the meaning of spare fields and codewords on the system it is currently using, it shall not transmit spare messages to the TSC, nor take any action on receiving spare messages from the TSC, nor use the spare fields in standardised messages received from the TSC.

5.1 System Codewords

5.1.1 Control Channel System Codeword (CCSC)

The Control Channel System Codeword is transmitted on a control channel by a TSC in order to identify the system to radio units and to provide control channel slot synchronisation (see section 3.3.3). It is a data codeword, structured as shown below.

	0	SYS	CCS	PREAMBLE 1010101010101010	P 1100010011010111
no. of bits	1	15	16	16	16

SYS - System identity code of the transmitting system. Values of SYS which result in production of the control channel codeword synchronisation sequence, SYNC, in any part of the 48 information bits of the CCSC are not permitted.

CCS - Codeword Completion Sequence, chosen so that the parity check bits P always form the control channel codeword synchronisation sequence. The bit values of the CCS will depend on the system identity code; an algorithm for generating the CCS is given in Appendix 3.

PREAMBLE - Preamble bit reversals, ending with a '0'.

P - Parity check bits. These complete the codeword and also form the control channel codeword synchronisation sequence, SYNC (section 3.2.1.1).

5.1.2 Data Channel System Codeword (DCSC)

The DCSC is transmitted on a data channel by the TSC in order to identify the system to radio unit's and to provide data channel slot synchronisation. It is a data codeword as shown below :

	0	SYS	CCS	PREAMBLE 1010101010101010	P 0011101100101000
no. of bits	1	15	16	16	16

SYS - System identity code of the transmitting system. Values of SYS which result in production of the data channel codeword synchronisation sequence, SYNT, in any part of the 48 information bits of the DCSC are not permitted.

DCS - Data-codeword Completion Sequence, chosen such that the parity check bits form the data channel sychronisation sequence (SYNT). An algorithm for determining the codeword completion sequence (DCS) of a data channel system codeword (DCSC) is given in appendix 3.

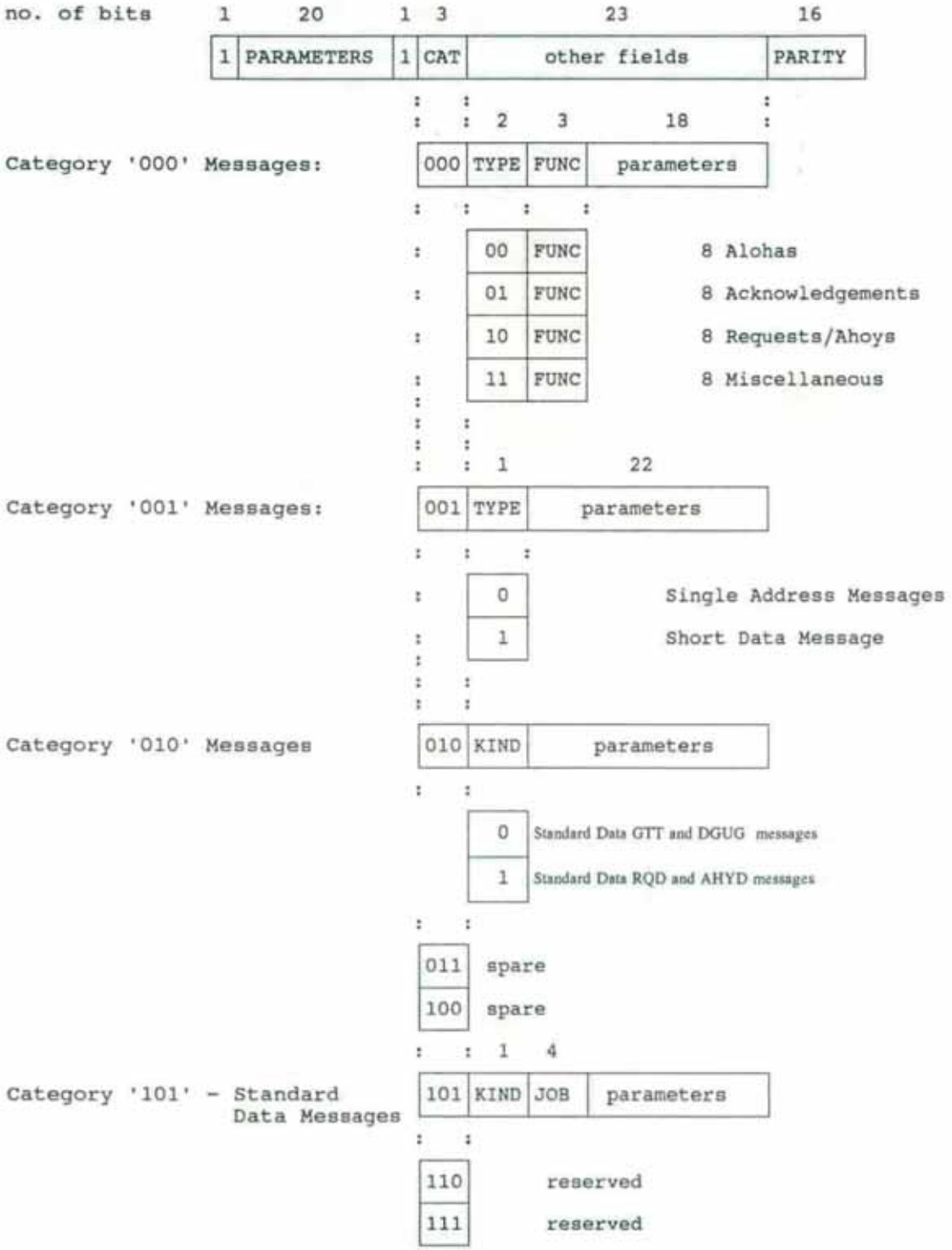
PREAMBLE - Preamble bit reversals, ending with a '0'.

P - Parity check bits.
These complete the codeword and also form the control channel codeword synchronisation sequence, SYNT (section 3.2.1.2).

5.2 General Address Codeword Structure

There is a general address codeword structure which is divided into 8 categories, and one special structure for a "Go To Channel" message (see 5.4). The general and GTC structures are distinguished by Bit 22 of the codeword; Bit 22 of the general structure is always '1' whereas Bit 22 of the GTC codeword is set to '0'.

The most usual general structure is shown below.



Categories zero and one (CAT = '000' and '001') contain standardised codewords. The "reserved" codewords are intended for future expansion of the standard message set, whereas the "spare" codewords may be used for customisation of services.

It is anticipated that reserved categories could be used for the definition of polling and data communication protocols etc. in a future phase of standardisation.

5.3 List of Address Codewords

	Mnemonic	Meaning	Section
GTC Message:	GTC	Go to channel command	5.4
CAT '000' Messages:			5.5
TYPE '00'		Aloha invitations:	5.5.1
	ALH	general	
	ALHS	standard data excluded	
	ALHD	"Simple" calls excluded	
	ALHE	emergency only	
	ALHR	registration or emergency	
	ALHX	registration excluded	
	ALHF	fall-back mode	
	reserved		
TYPE '01'		Acknowledgements:	5.5.2
	ACK	general	
	ACKI	intermediate	
	ACKQ	call queued	
	ACKX	message rejected	
	ACKV	called unit unavailable	
	ACKE	emergency	
	ACKT	try on given address	
	ACKB	call-back / negative ack	
TYPE '10'		Requests (sent by RUs):	5.5.3.1
	RQS	"Simple"	5.5.3.1.1
	RQD	standard data	5.5.3.1.2
	RQX	cancel/abort	5.5.3.1.3
	RQT	divert	5.5.3.1.4
	RQE	emergency	5.5.3.1.5
	RQR	registration	5.5.3.1.6
	RQQ	status	5.5.3.1.7
	RQC	short data	5.5.3.1.8
		Ahoys (sent by TSC):	5.5.3.2
	AHY	general availability check	5.5.3.2.1
	reserved		5.5.3.2.2
	AHYX	cancel alert/waiting state	5.5.3.2.3
	reserved		5.5.3.2.4
	reserved		5.5.3.2.5
	reserved		5.5.3.2.6
	AHYQ	status message	5.5.3.2.7
	AHYC	short data invitation	5.5.3.2.8
TYPE '11'		Miscellaneous:	5.5.4
	MARK	control channel marker	5.5.4.1
	MAINT	call maintenance	5.5.4.2
	CLEAR	call clear-down	5.5.4.3
	MOVE	move control channel	5.5.4.4
	BCAST	broadcast	5.5.4.5
	reserved		
	reserved		
	reserved		

contd.

List of Address Codewords, contd.

	Mnemonic	Meaning	Section
CAT '001' Messages:			5.6
TYPE '0'		Single address messages:	5.6.1
	SAMO	Outbound	5.6.1.1
		Inbound:	5.6.1.2
	SAMIU	inbound unsolicited	5.6.1.2.1
	SAMIS	inbound solicited	5.6.1.2.2
TYPE '1'	HEAD	Short data message	5.6.2
CAT '010' Messages:	Codewords applicable to Standard Data		5.7
Kind '1'	RQD	Request for Standard Data	5.7.1
	AHYD	Availability check	5.7.2
Kind '0'	GTT	Go To Transaction	5.7.3
	DRUGI	Radio Unit General Information	5.7.4
CAT '011' Messages:	spare		
CAT '100' Messages:	spare		
CAT '101' Messages:	Standard Data		5.8

KIND '0'

JOB	FROM TSC	FROM radio unit	
'0000'	DACK+DAL		5.8.2
'0001'	DACK+DALG		5.8.2
'0010'	DACK+DALN		5.8.2
'0011'	DACK+GO	DACK+GO	5.8.2
'0100'	DACKZ	DACKZ	5.8.3
'0101'	DACKD	DACKD	5.8.1
'1000'	DAHY	RSVD	5.8.4
'1001'	RSVD	RSVD	
'1010'	RSVD	DRQG	5.8.8
'1011'	RSVD	RSVD	
'1100'	DAHYZ	DRQZ	5.8.9
'1101'	RSVD	RSVD	
'1110'	DAHYX	DRQX	5.8.6/5.8.10
'1111'	RLA	RLA	5.8.7

KIND '1'

TASK			
'0'	SACK	SACK	5.8.11
'1'	SITH	SITH	5.8.12

CAT '110' Messages:	reserved	
CAT '111' Messages:	reserved	

5.4 Go To Traffic Channel Message, GTC

This message is transmitted on a control channel from a TSC to radio units. It directs the addressed radio units to switch to a designated channel and proceed with communication.

This message may also be transmitted on a traffic channel to move radio units already in communication to a replacement traffic channel. When the units have retuned to the replacement channel, communication may continue.

	1	PFIX	IDENT1	0	D	CHAN	IDENT2	(N)	P
no. of bits	1	7	13	1	1	10	13	2	16

PFIX - Unit or group prefix.

IDENT1 - Called party or gateway:
- Ident - for a common-prefix call, a call from a PABX extension or from the PSTN, or an Include call.
- Ident - for an interprefix call when the message is sent to the called party.
- IPFIXI - for an interprefix call when the message is sent to the calling party.
- ALLI - for a system-wide call.
- PABXI - for a call to a PABX extension.
- PSTNSIj - for a call to a prearranged PSTN destination.
- PSTNGI - for a call to a general PSTN destination.
- DUMMYI - for an intersite call where the calling party is active on the same control channel.

D - '0' if the addressed radio units shall unmute the audio (for speech communication).
'1' if the addressed radio units shall mute the audio (for data communication), and need not send maintenance messages within items unless required by the system by prearrangement.

CHAN - Designates the allocated channel number.

IDENT2 - Calling party or gateway:
- Ident - for a common-prefix call to a unit or group of units, a system-wide call, or a call to a PABX extension or to the PSTN.
- Ident - for an interprefix call when the message is sent to the calling party.
- IPFIXI - for an interprefix call when the message is sent to the called party.
- PABXI - for a call from a PABX extension.
- PSTNGI - for a call from the PSTN.
- INCI - for an Include call.
- DUMMYI - for an intersite call where the called party is active on the same control channel.

(N) - Aloha number.
See random access protocol (section 7).

P - Parity check bits.

5.5 Category '000' Messages

5.5.1 Aloha Messages (Type '00')

These messages are transmitted on a control channel by a TSC - see section 7. They invite radio units to transmit single codeword random access messages in the designated frame of timeslots. An Aloha message may also be used to demand a response from an individually addressed radio unit.

1	PFIX	IDENT1	1	CAT 000	TYPE 00	FUNC	CHAN4	WT	RSVD	(M)	(N)	P
1	7	13	1	3	2	3	4	3	2	5	4	16

PFIX - Prefix (see also IDENT1).

IDENT1 - PFIX/IDENT1 specifies the radio units that are invited to transmit. Only the (M) least significant bits of the 20-bit address are used; the remaining address bits may be set arbitrarily.

CAT - '000'.

TYPE - '00'.

FUNC - Specifies the function of the Aloha invitation:

'000'	ALH	Any single codeword message invited.
'001'	ALHS	Messages invited, except RQD.
'010'	ALHD	Messages invited, except RQS.
'011'	ALHE	Emergency requests (RQE) only invited.
'100'	ALHR	Registration (RQR) or emergency requests (RQE) invited.
'101'	ALHX	Messages invited, except RQR.
'110'	ALHF	Fall-back mode; messages invited only from radio units which know the fall-back method used by this system. The fall-back mode is a customised mode of operation used only in the case of equipment malfunction.
'111'	Reserved for future use.	

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

CHAN4 - Least significant four bits of the channel number of the control channel on which the message is sent (to protect against breakthrough).

contd.

WT - Delay parameter for repeat transmissions.
See random access protocol (section 7).

RSVD - Reserved for future definition. Default value = '00'.

(M) - Address qualifier.
See random access protocol (section 7).

(N) - Aloha number.
See random access protocol (section 7).

P - Parity check bits.

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5.5.2 Acknowledgement Messages (Type '01')

These messages may be sent by the TSC at various stages of call set-up, and by a radio unit in response to a TSC message that demands a reply. The meanings of these messages vary both according to the function of the messages they acknowledge, and according to the source.

The basic structure of the acknowledgements is illustrated below but, for clarity, it is shown separately for TSC source and radio unit source in subsections 5.5.2.1 and 5.5.2.2 respectively.

1	PFIX	IDENT1	1	CAT 000	TYPE 01	FUNC	IDENT2	QUAL	(N)	P
1	7	13	1	3	2	3	13	1	4	16

PFIX - Prefix.

IDENT1 - Ident of the called party or gateway.
(This is the called party or gateway in the call for which the acknowledgement is being sent.)

CAT - '000'.

TYPE - '01'.

FUNC - Specifies the function of the acknowledgement:

'000'	ACK	General acknowledgement
'001'	ACKI	Intermediate acknowledgement, more signalling to follow
'010'	ACKQ	Acknowledge, call queued
'011'	ACKX	Acknowledge, message rejected
'100'	ACKV	Acknowledge, called unit unavailable
'101'	ACKE	Acknowledge emergency call
'110'	ACKT	Acknowledge, try on given address
'111'	ACKB	Acknowledge, call-back, or negative acknowledgement.

IDENT2 - Ident of the calling party or gateway.
(This is the ident of the party or gateway that originated the call for which the acknowledgement is being sent.)

QUAL - Qualifies the function (FUNC) of the acknowledgement.

(N) - Aloha number in messages transmitted by a TSC.
Reserved in messages transmitted by radio units; default value = '0000'.

P - Parity check bits.

5.5.2.1 Acknowledgement messages sent by the TSC

The acknowledgement messages may be sent by the TSC at various stages of call set-up (or during transactions), to indicate the progress of the call. Data codeword(s) may be appended to an ACKT address codeword to convey additional information, depending on the value of IDENT1.

Acknowledgement address codeword:

1	PFIX	IDENT1	1	CAT 000	TYPE 01	FUNC	IDENT2	QUAL	(N)	P
1	7	13	1	3	2	3	13	1	4	16

PFIX - Prefix of the calling radio unit.

IDENT1 - Called party or gateway:
- Ident - for a common-prefix call.
- IPFIXI - for an interprefix call.
- ALLI - for a system-wide call.
- PABXI - for a call to a PABX extension.
- PSTNSIj - for a call to a prearranged PSTN destination.
- PSTNGI - for a call to a general PSTN destination.
- TSCI - for an RQQ or RQC transaction with the TSC.
- DIVERTI - for general cancellation by a recipient of diversions.

In ACKT(QUAL=0), IDENT1 is the diversion ident or gateway; if IDENT1 = IPFIXI, PABXI or PSTNGI, the diversion address is given in appended data codeword(s) - see below. If a call to an individual address has been diverted to a group address, or vice versa, IDENT1 in ACKT is set to IPFIXI and the diversion address is given in an appended data codeword (with bit GF set appropriately).

In acknowledgements to RQR, IDENT1 = REGI.

CAT - '000'.
TYPE - '01'.

FUNC - ACK, ACKI, ACKQ, ACKX, ACKV, ACKE, ACKT or ACKB.

IDENT2 - Ident of the calling radio unit.

QUAL - Qualifies the function (FUNC) of the acknowledgement. See below.

(N) - Aloha number. See random access protocol (section 7).

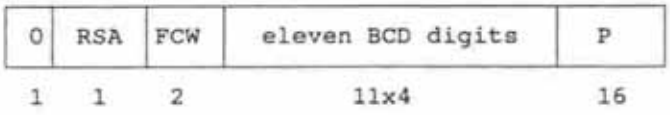
P - Parity check bits.

contd.

Data codewords following ACKT(QUAL=0) address codeword:

When ACKT(QUAL=0) is transmitted by the TSC, up to three data codewords may be appended to convey the diversion address or dialling information. The form of these data codewords depends on the value of IDENT1.

a. If IDENT1 = PSTNGI then up to three data codewords with the following structure may be appended to ACKT(QUAL=0):



RSA - Return Slot Access Flag.
When transmitted by the TSC on a control channel in the second half of a slot preceding an access slot:
'0' - radio units are not permitted random access in the following slot on the return control channel.
'1' - radio units are permitted random access in the following slot on the return control channel.
In all other cases of transmission, the meaning of the RSA flag is reserved, default='0'. See also 7.2.5.

FCW - Number of data codewords appended to this data codeword (in the same message):
'00' no data codewords follow
'01' one data codeword follows
'10' two data codewords follow
'11' reserved.

BCD - Eleven BCD groups representing the dialled digits of the diversion PSTN destination, coded in accordance with the table in Appendix 5. The BCD digits are transmitted in the dialled order (i.e. the leftmost digit in the above diagram is the earliest in the dialling order; digits in any following codeword are later in the dialling order).

P - Parity check bits.

contd.

b. If IDENT1 = PABXI then a single data codeword with the following structure is appended to ACKT(QUAL=0):

0	RSVD	SP	PARAMETERS	P
1	10	1	36	16

RSVD - Reserved for future definition. Default value = all '0's.

SP - '0' for a "long" PABX extension number.
'1' for an extension number that can be represented by 13 bits.

PARAMETERS - See parameter formats below.

P - Parity check bits.

Parameter formats

If SP='0'

BCD1	BCD2	BCD3	BCD4	BCD5	BCD6	BCD7	BCD8	BCD9
4	4	4	4	4	4	4	4	4

BCDn - BCD groups representing the dialled digits of the diversion PABX destination, coded in accordance with the table in Appendix 5. The BCD digits are transmitted in the dialled order.

If SP='1'

RSVD	EXCHANGE	Number
21	2	13

RSVD - Reserved for future definition.
Default value = all '0's.

EXCHANGE - Indicates the appropriate PABX exchange.

Number - PABX extension number.

contd.

c. If IDENT1 = IPFIXI then a single data codeword with the following structure is appended to ACKT(QUAL=0):

0	RSVD	GF	PFIXT	IDENTT	P
1	26	1	7	13	16

RSVD - Reserved for future definition. Default value = all '0's.

GF - '0' if the diversion address is an individual address.
'1' if the diversion address is a group address.

PFIXT - Prefix of the diversion address.

IDENTT - Ident of the diversion address.

P - Parity check bits.

contd.

Acknowledgements sent to calling radio unit to indicate progress of Simple or emergency call (as requested by an RQS or RQE message):

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

Acknowledgements sent to radio unit to indicate progress of Include call (as requested by an RQS on a traffic channel):

ACK	(QUAL=0)	- Include request accepted; called party will be directed to the traffic channel.
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.

Acknowledgements sent during set-up of standard data communication (as requested by an RQD message):

To be defined.

Acknowledgements to cancel/abort message RQX:

ACK	(QUAL=1)	- Acknowledgement of RQX.

contd.

Acknowledgements to call diversion request RQT:

ACK	(QUAL=0)	- Call diversion or cancellation has been accepted.
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.

Acknowledgements sent as response to emergency call request RQE:

ACKE	(QUAL=0)	- Acknowledgement, wait for further signalling.

Acknowledgements to registration request RQR:

ACK	(QUAL=0)	- Registration accepted.
ACKI	(QUAL=1)	- Intermediate acknowledgement; more signalling to follow.
ACKX	(QUAL=0)	- Invalid request; registration denied.
ACKX	(QUAL=1)	- System overload; registration failed.

Acknowledgements sent to radio unit to indicate progress of status transaction (as requested by an RQQ message):

ACK	(QUAL=0)	- Transaction has been successfully completed, i.e. the called destination has accepted the status information.
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.

Acknowledgements sent to radio unit to indicate progress of short data transaction (as requested by an RQC message):

ACK	(QUAL=0)	- Transaction has been successfully completed.
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.

5.5.2.2 Acknowledgement messages sent by radio units

An acknowledgement may be sent by a radio unit in response to a TSC Ahoy or HEAD message that demands a reply. An acknowledgement is also sent if a radio unit receives an individually addressed Aloha message and has no suitable random access message to send (see 7.4.1 and 8.3.2.1).

1	PFIX	IDENT1	1	CAT 000	TYPE 01	FUNC	IDENT2	QUAL	(N)	P
1	7	13	1	3	2	3	13	1	4	16

PFIX - Prefix of the transmitting unit.

IDENT1 - IDENT1 from the TSC's message, unless the acknowledgement is sent in response to an individually addressed Aloha message, in which case IDENT1 is set to TSCI.

CAT - '000'.

TYPE - '01'.

FUNC - ACK, ACKI, ACKX, ACKV or ACKB.

IDENT2 - IDENT2 from the TSC's message, unless the acknowledgement is sent in response to an individually addressed Aloha message, in which case IDENT2 is the transmitting unit's ident.

QUAL - Qualifies the function (FUNC) of the acknowledgement.

(N) - Reserved for future definition. Default value = '0000'.

P - Parity check bits.

Acknowledgements to AHY (i.e. general availability check):

i) From called unit (PFIX/IDENT1 from AHY):

ACK	(QUAL=0)	- General acknowledgement; unit/ user/ data equipment ready for call.
ACKI	(QUAL=0)	- Unit alerting but user/ data equipment not ready.
ACKX	(QUAL=0)	- Call cannot be accepted (e.g. no data equipment, for a data call).
ACKV	(QUAL=1)	- User does not wish to receive this call (e.g. his "Busy control" is in the busy state).
ACKB	(QUAL=0)	- Call accepted for call-back.
ACKB	(QUAL=1)	- Data codeword appended to AHY was not decodeable and unit requires the message to be retransmitted.

ii) From requesting unit (PFIX/IDENT2 from AHY):

ACK	(QUAL=0)	- Unit is waiting for signalling for a call.
ACKX	(QUAL=0)	- Unit is not waiting for signalling for a call.

contd.

Acknowledgement from called unit to AHYX (cancel alert/waiting state):

ACK (QUAL=1) - Acknowledgement.

Acknowledgements from called unit to AHYQ (status message):

ACK (QUAL=0) - Unit has accepted the information in the AHYQ message.
ACKX (QUAL=0) - Unit is not equipped to accept the information.
ACKX (QUAL=1) - Unit cannot accept the information at this time (e.g. its queue is full).
ACKV (QUAL=1) - Unit does not wish to accept status information from this calling party.
ACKB (QUAL=1) - Data codeword appended to AHYQ was not decodeable and the unit requires the message to be retransmitted.

Acknowledgements to AHYC (instruction to send short data):

i) From called unit (PFIX/IDENT1 from AHYC):
ACKX (QUAL=0) - Unit is not equipped to send the required data.

ii) From calling unit (PFIX/IDENT2 from AHYC):
ACKX (QUAL=0) - Unit is not waiting to send address information or short data message.

Acknowledgements from called unit to HEAD message (short data):

ACK (QUAL=0) - Unit has accepted the information in the HEAD message.
ACKX (QUAL=0) - Unit is not equipped to accept the data message.
ACKX (QUAL=1) - Unit cannot accept the message at this time (e.g. its data store is full).
ACKV (QUAL=1) - Unit does not wish to accept a data message from this calling party.
ACKB (QUAL=1) - Not all the appended data codewords were decodeable and the unit requires the message to be retransmitted.

Acknowledgement to an individually addressed Aloha message (if addressed radio unit has no random access message to send):

ACKX (QUAL=0) - Acknowledgement, nothing to send.

Acknowledgement to an individually addressed AHYD message

1	PFIX	IDENT1	1	CAT 010	TYPE 01	FUNC	IDENT2	QUAL	RSVD	MODEM	P
1	7	13	1	3	2	3	13	1	3	1	16

RSVD - Reserved. Default value = all '0's

MODEM - as a response to AHYD, availability of modem for Standard Data any other response, reserved for future definition.

Default value '0'

'0' - 1200 bits/sec FFSK only available
'1' - Both customised rate and 1200 bits/sec available

5.5.3 Type '10' Messages (Requests and Ahoys)

The Request messages sent by radio units and the Ahoy messages sent by the TSC have the same Category and Type. For clarity, they are shown separately:

- Section 5.5.3.1 defines the Request codeword structures.
- Section 5.5.3.2 defines the Ahoy codeword structures.

5.5.3.1 Request Messages (Type '10')

These messages are transmitted to the TSC from a radio unit requesting a function. Request messages on a control channel are sent using the random access protocol (see 7.3).

The most usual basic structure is illustrated below but, for clarity of definition, the message for each function is detailed separately in sections 5.5.3.1.1 to 5.5.3.1.8.

1	PFIX	IDENT1	1	CAT 000	TYPE 10	FUNC	PARAMETERS	P
1	7	13	1	3	2	3	18	16

PFIX - Prefix of the requesting radio unit.

IDENT1 - Ident of the called party or gateway.

CAT - '000'.

TYPE - '10'.

FUNC - Specifies the function of the request:

'000'	RQS	Request Simple call
'001'		Spare. Available for customisation
'010'	RQX	Request call cancel / abort transaction
'011'	RQT	Request call diversion
'100'	RQE	Request emergency call
'101'	RQR	Request to register
'110'	RQQ	Request status transaction
'111'	RQC	Request to send short data message.

PARAMETERS - See following pages.

P - Parity check bits.

5.5.3.1.1 Request "Simple" Call Message, RQS

This message is transmitted to the TSC on a control channel by a radio unit requesting a non-emergency conversation or a channel over which any appropriate audio signalling, even a non-standard modulation or format, can be sent. See section 9 for the call procedures.

The RQS codeword contains all the information necessary to request a call to a unit or group of units with the same prefix, to all units in the system, to a prearranged PSTN destination or to a PABX extension that can be accommodated in the range 0-8191. In addition, RQS may be used to request entry into the extended addressing mode for an interprefix call, a general call to the PSTN or a call to a PABX extension with a "long" number; in this case, after receiving the RQS message, the TSC demands the full called party information using the AHYC message (see 5.5.3.2.8).

The RQS message may also be sent to the TSC by a radio unit on its allocated traffic channel, to ask for another party to join the call. See section 11 for the Include call procedures.

1	PFIX	IDENT1	1	CAT	TYPE	FUNC	IDENT2	DT	LEVEL	EXT	FLAG1	FLAG2	P
				000	10	000							
1	7	13	1	3	2	3	13	1	1	1	1	1	16

PFIX - Prefix of the requesting radio unit.

IDENT1 - Called party or gateway:
- Ident - for a common-prefix call
- IPFIXI - for an interprefix call
- ALLI - for a system-wide call
- number - for a short addressing call to a PABX extension (EXT='1')
- PABXI - for a call to a "long" PABX extension number
- PSTNSIj - for a call to a prearranged PSTN destination
- PSTNGI - for a call to a general PSTN destination.

CAT - '000'.
TYPE - '10'.
FUNC - '000'.

IDENT2 - Ident of the requesting radio unit.

DT - RQS message on a control channel:
'0' if the caller is requesting speech communication.
'1' if the caller wishes to send non-prescribed data.
RQS message on a traffic channel:
This bit shall be set equal to bit D from the GTC message that allocated the traffic channel.

contd.

LEVEL - RQS message on a control channel:
This bit specifies 2 levels of priority
(both non-emergency).
High priority is '0', non-priority call is '1'.
RQS message on a traffic channel:
This bit shall be set to '1'.

EXT - '0' if IDENT1 is not a short addressing PABX extension number.
'1' if IDENT1 is a short addressing PABX extension number.

FLAG1 - For a group call (common-prefix or interprefix):
'0' - enable called users to reply
'1' - disable called users from replying.
For a short addressing call to a PABX extension,
FLAG1/FLAG2 indicates the appropriate PABX exchange.
For a general call to the PSTN:
'0' - number has up to 9 dialling digits
'1' - number has 10 to 31 dialling digits.
For all other types of call, FLAG1 is reserved for future
definition. Default value='0'.

FLAG2 - For a short addressing call to a PABX extension,
FLAG1/FLAG2 indicates the appropriate PABX exchange.
For all other types of call, FLAG2 is reserved for future
definition. Default value='0'.

P - Parity check bits.

5.5.3.1.2 Request Codeword Free for Customisation,Not defined

This message may be transmitted to the TSC on a control channel by a radio unit which is requesting a customised service.

5.5.3.1.3 Call Cancel / Abort Transaction Request Message, RQX

This message is transmitted to the TSC on a control channel by a radio unit in order to:

a. cancel a previous call request, while waiting for its requested call to be set up, or

b. abort a transaction e.g. a status transaction.

It may also be transmitted to the TSC on a traffic channel by a radio unit, in order to cancel an Include call request, while waiting for signalling for its Include call.

1	PFIX	IDENT1	1	CAT 000	TYPE 10	FUNC 010	IDENT2	RSVD	P
1	7	13	1	3	2	3	13	5	16

PFIX - Prefix of the requesting radio unit.

IDENT1 - Called party or gateway:
- Ident - for a common-prefix call
- IPFIXI - for an interprefix call
- ALLI - for a system-wide call
- PABXI - for a call to a PABX extension
- PSTNSIj - for a call to a prearranged PSTN destination
- PSTNGI - for a call to a general PSTN destination
- TSCI - for an RQQ or RQC transaction with the TSC
- DIVERTI - for aborting a general cancellation by a recipient of diversions.

Note: IDENT1 is the same as IDENT1 from the request being cancelled/aborted, except for a short addressing PABX call.

CAT - '000'.

TYPE - '10'.

FUNC - '010'.

IDENT2 - Ident of the requesting radio unit.

RSVD - Reserved for future definition. Default value = '00000'.

P - Parity check bits.

5.5.3.1.4 Request Call Diversion Message, RQT

This message is transmitted to the TSC on a control channel by a radio unit to request either that future calls addressed:

- to itself, or
- to another subscriber unit or group

be redirected to a specified alternative destination; the destination may be a radio or line unit, a group, a PABX extension or a PSTN number.

This message is also used by a radio unit to request:

- cancellation of the diversion of its calls, or
- cancellation of the diversion of another party's calls, or
- cancellation of any existing diversions to it.

See section 12 for the diversion procedures.

1	PFIX	IDENT1	1	CAT 000	TYPE 10	FUNC 011	IDENT2	SD	DIV	FLAG1	FLAG2	P
1	7	13	1	3	2	3	13	2	1	1	1	16

PFIX - Prefix of the requesting radio unit.

IDENT1 - For diversion requests:
party or gateway to which calls are to be redirected: ident, IPFIXI, PSTNSIj, PSTNGI or PABXI (for any PABX extension).
For "self" or "third-party" cancellation:
ident of the unit or group whose calls should be returned (or IPFIXI for an interprefix address).
For general cancellation by a recipient of diversions:
set to DIVERTI.

CAT - '000'.

TYPE - '10'.

FUNC - '011'.

IDENT2 - Ident of the requesting radio unit.

SD - Specifies the types of calls to which the request to divert or cancel divert applies:
'00' if both speech and data calls are to be redirected.
'01' if only speech calls are to be redirected.
'10' if only data calls are to be redirected.
'11' reserved for future use.
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'-'11110'), RQC or RQD.

contd.

```
  DIV  -  '0' for a request for call diversion.
          '1' for a request for cancellation of call diversion.

FLAG1  -  For IDENT1 = PSTNGI,
              '0' - number has  up to 9 dialling digits
              '1' - number has 10 to 31 dialling digits.
          For IDENT1 / PSTNGI, FLAG1 is reserved; default value='0'.

FLAG2  -  Specifies whether or not three addresses must be supplied:
          For DIV='0', '0' for self-initiated diversion
                       '1' for third-party diversion.
          For DIV='1', FLAG2 shall be set to '0'.

     P  -  Parity check bits.
```

5.5.3.1.5 Request Emergency Call Message, RQE

This message is transmitted to the TSC by a radio unit requesting an emergency call. The RQE codeword contains all the information necessary to request a call to a unit or group of units with the same prefix, to all units in the system, to a prearranged PSTN destination or to a PABX extension that can be accommodated in the range 0-8191. In addition, RQE may be used to request entry into the extended addressing mode for an interprefix call, a general call to the PSTN or a call to a PABX extension with a "long" number. See section 10 for the emergency call procedures.

RQE may also be used to request a special mode of service previously arranged with the system.

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.

1	PFIX	IDENT1	1	CAT 000	TYPE 10	FUNC 100	IDENT2	D	RSVD	EXT	FLAG1	FLAG2	P
1	7	13	1	3	2	3	13	1	1	1	1	1	16

PFIX - Prefix of the requesting radio unit.

IDENT1 - Called party or gateway:
- Ident - for a common-prefix call
- IPFIXI - for an interprefix call
- ALLI - for a system-wide call
- number - for a short addressing call to a PABX extension (EXT='1')
- PABXI - for a call to a "long" PABX extension number
- PSTNSIj - for a call to a prearranged PSTN destination
- PSTNGI - for a call to a general PSTN destination.

Note: If EXT='0'/FLAG2='1', the meaning of IDENT1 may be redefined.

CAT - '000'.

TYPE - '10'.

FUNC - '100'.

IDENT2 - Ident of the requesting radio unit.

D - '0' if the caller is requesting speech communication.
'1' if the caller is requesting data communication.

Note: If EXT='0'/FLAG2='1', the meaning of bit D may be redefined.

contd.

RSVD - Reserved for future definition. Default value='0'.

EXT - '0' if IDENT1 is not a short addressing PABX extension number.
'1' if IDENT1 is a short addressing PABX extension number.

FLAG1 - For a group call (common-prefix or interprefix):
'0' - enable called users to reply
'1' - disable called users from replying.
For a short addressing call to a PABX extension, FLAG1/FLAG2 indicates the appropriate PABX exchange.
For a general call to the PSTN:
'0' - number has up

5.5.3.1.6 Request to Register Message, RQR

This message is transmitted to the TSC on a control channel by a radio unit requesting to register. See section 8 for the registration procedures.

Registration may be required for the tracking of roamers, for wide-area systems with multiple control channels and for polling systems.

1	PFIX	IDENT1	1	CAT 000	TYPE 10	FUNC 101	INFO	RSVD	P
1	7	13	1	3	2	3	15	3	16

PFIX - Prefix of the requesting radio unit.

IDENT1 - Ident of the requesting radio unit.

CAT - '000'.

TYPE - '10'.

FUNC - '101'.

INFO - Available for customisation by systems, to convey additional information to the TSC. Null value = all '0's.

RSVD - Reserved for future definition. Default value = '000'.

P - Parity check bits.

5.5.3.1.7 Request Status Transaction, RQQ

This message is transmitted to the TSC on a control channel by a radio unit:

- to request that status information be relayed to the addressed line unit or radio unit, or
- to send status information to the TSC.

The status field in an RQQ message consists of 5 bits, allowing 32 different status values. Two of these values have been predefined (see below).

For a common-prefix status message, the RQQ message contains all the information necessary for the transaction. For an interprefix status message, the RQQ message is used to request entry into the extended addressing mode. See section 13 for the status procedures.

1	PFIX	IDENT1	1	CAT 000	TYPE 10	FUNC 110	IDENT2	STATUS	P
1	7	13	1	3	2	3	13	5	16

PFIX - Prefix of the requesting radio unit.

IDENT1 - Called party or gateway:
Ident - for a common-prefix transaction
IPFIXI - for an interprefix transaction
TSCI - for a transaction with the TSC.

CAT - '000'.

TYPE - '10'.

FUNC - '110'.

IDENT2 - Ident of the requesting radio unit.

STATUS - For a transaction with a line unit or radio unit:

'00000'	requests that the addressed unit call back with a speech call (no other status information indicated).
'00001' to '11110'	are user-defined status values.
'11111'	cancels a previous speech call request (no other status information indicated).

For a transaction with the TSC:

'00000'	indicates "off-hook" or equivalent.
'00001' to '11110'	are system-defined status values.
'11111'	indicates "on-hook" or equivalent.

P - Parity check bits.

5.5.3.1.8 Request to Transmit Short Data Message, RQC

This message is sent by a radio unit to request permission to transmit a short data message (comprising the HEAD address codeword and up to four data codewords). After receiving the request, the TSC uses the AHYC message to instruct the requesting unit to transmit the data message on the control channel. See section 14 for the short data message procedures.

1	PFIX	IDENT1	1	CAT 000	TYPE 10	FUNC 111	IDENT2	SLOTS	EXT	FLAG1	FLAG2	P
1	7	13	1	3	2	3	13	2	1	1	1	16

PFIX - Prefix of the requesting radio unit.

IDENT1 - Called party or gateway:
- Ident - for a common-prefix call
- IPFIXI - for an interprefix call
- ALLI - for a system-wide call
- number - for a short addressing call to a PABX extension (EXT='1')
- PABXI - for a call to a "long" PABX extension number
- PSTNSIj - for a call to a prearranged PSTN destination
- PSTNGI - for a call to a general PSTN destination
- TSCI - for a transaction with the TSC.

CAT - '000'.
TYPE - '10'.
FUNC - '111'.

IDENT2 - Ident of the requesting radio unit.

SLOTS - The number of timeslots required for the data message:
- '00' reserved
- '01' reserved
- '10' two slots (address codeword + 1 or 2 data codewords)
- '11' three slots (address codeword + 3 or 4 data codewords)

EXT - '0' if IDENT1 is not a short addressing PABX extension number.
'1' if IDENT1 is a short addressing PABX extension number.

FLAG1 - For a short addressing call to a PABX extension, FLAG1/FLAG2 indicates the appropriate PABX exchange.
For a general call to the PSTN:
'0' - number has up to 9 dialling digits
'1' - number has 10 to 31 dialling digits.
For all other types of call, FLAG1 is reserved for future definition. Default value='0'.

FLAG2 - For a short addressing call to a PABX extension, FLAG1/FLAG2 indicates the appropriate PABX exchange.
For all other types of call, FLAG2 is reserved for future definition. Default value='0'.

P - Parity check bits.

5.5.3.2 Ahoy Messages (Type '10')

These messages are transmitted by a TSC; they demand a response from an addressed radio unit.

The basic structure is illustrated below but, for clarity of definition, the message for each function is detailed separately in sections 5.5.3.2.1 to 5.5.3.2.8.

(Note that the request messages sent by radio units have the same Category and Type as the Ahoy messages sent by the TSC.)

1	PFIX	IDENT1	1	CAT 000	TYPE 10	FUNC	PARAMETERS	P
1	7	13	1	3	2	3	18	16

PFIX - Prefix.

IDENT1 - Ident of the called party or gateway.

CAT - '000'.

TYPE - '10'.

FUNC - Specifies the function of the Ahoy:

'000'	AHY	General availability check
'001'	Free for customisation	
'010'	AHYX	Cancel alert/waiting state
'011'	Reserved for future use	
'100'	Reserved for future use	
'101'	Reserved for future use	
'110'	AHYQ	Status message
'111'	AHYC	Short data invitation.

PARAMETERS - See following pages.

P - Parity check bits.

5.5.3.2.1 General Availability Check Message, AHY

This message is transmitted on a control channel by the TSC as follows.

a. It may be transmitted to a called radio unit to establish the availability of the called unit/user prior to allocating a traffic channel for a call (see 9.1.1.5), or prior to including a unit in an existing call (see 11.1.5).

b. It may be sent to check the availability of a called radio unit before the TSC transmits a short data message (HEAD); see 14.1.6.

c. It may be sent to a requesting radio unit to check that it is still in radio contact and to restart its waiting timer (see, for example, sections 8.2.1.3, 9.1.1.7 and 9.1.1.10).

AHY may also be sent by the TSC to a radio unit on a traffic channel, for example to check that the unit has reached, or is still on, the channel (see 6.1.2.1 and 9.1.2.2), or to restart the waiting timer of a radio unit which has requested an Include call (see 11.1.7).

One data codeword may be appended to the AHY address codeword, to convey additional information, depending on the value of bit AD. (In this issue of the standard, this facility is used only when the AHY is sent on a control channel to a called radio unit).

AHY demands an acknowledgement from the addressed unit:

i) For AD = '0' - On a control channel, the addressed unit responds in the slot following the AHY.
On a traffic channel, the unit times its response from the end of the AHY address codeword.

ii) For AD = '1' - On a control channel, the addressed unit responds in the slot following the data codeword (i.e. in the slot following the slot that contains the data codeword). On a traffic channel, the unit times its response from the end of the data codeword.

contd.

AHY address codeword:

1	PFIX	IDENT1	1	CAT 000	TYPE 10	FUNC 000	IDENT2	D	POINT	CHECK	E	AD	P
1	7	13	1	3	2	3	13	1	1	1	1	1	16

PFIX - Prefix of the radio unit.

IDENT1 - Called party or gateway:

a) For POINT='0' (i.e. availability check on called unit), IDENT1 is the ident of the called radio unit.

b) For POINT='1' (i.e. availability check on calling unit), IDENT1 is the called party or gateway as follows:

- Ident - for a common-prefix call
- IPFIXI - for an interprefix call
- ALLI - for a system-wide call
- PABXI - for a call to a PABX extension
- PSTNSIj - for a call to a prearranged PSTN destination
- PSTNGI - for a call to a general PSTN destination
- TSCI - for an RQQ or RQC transaction with the TSC
- DIVERTI - for general cancellation by a recipient of diversions.

For restarting the waiting timer of a radio unit that has requested registration, IDENT1 = REGI.

CAT - '000'.
TYPE - '10'.
FUNC - '000'.

IDENT2 - Calling party or gateway:

a) For POINT='0' (i.e. availability check on called unit), IDENT2 is the calling party or gateway as follows:

- INCI - for an Include call availability check
- SDMI - for a short data message availability check
- DUMMYI - for a "no-call" test availability check

For all other types of call,

- Ident - for a common-prefix call
- IPFIXI - for an interprefix call
- PABXI - for a call from a PABX extension
- PSTNGI - for a call from the PSTN.

If IDENT2 = IPFIXI or INCI, the address of the calling unit may be provided in an appended data codeword (see below).

b) For POINT='1' (i.e. availability check on calling unit), IDENT2 is the ident of the calling radio unit.

contd.

D - If the calling party requested speech communication (i.e. RQS(DT=0) or RQE(D=0)), then D='0'. Otherwise, D='1'.

(For an AHY sent to restart the waiting timer of a radio unit sending "off-hook" or "on-hook" signalling, D='1').

POINT - '0' demands an acknowledgement from the unit whose individual address is PFIX/IDENT1.
'1' demands an acknowledgement from the unit whose individual address is PFIX/IDENT2.
See sections 9.2.2.2, 9.2.2.3 and 9.2.3.2 for the appropriate acknowledgement.

CHECK - AHY message on a control channel:

a) For POINT='0' (i.e. availability check on called unit),
'0' indicates that the TSC is checking only that the unit is in radio contact (and can accept this call).
'1' indicates that the TSC is also checking:
- for D='0', whether the unit's user is ready for a speech call
- for D='1', whether the unit's data equipment is ready.

b) For POINT='1' (i.e. availability check on calling unit), CHECK is reserved for future definition. Default value='0'.

AHY message on a traffic channel:
CHECK is reserved for future definition. Default value='0'.

E - '0' if the calling party requested a non-emergency call or transaction.
'1' if the calling party requested an emergency call.

(For an AHY sent to restart the waiting timer of a radio unit requesting registration or an Include call, or sending "off-hook" or "on-hook" signalling, E='0').

AD - '0' if there is no appended data codeword.
'1' if there is a data codeword appended to the AHY.

P - Parity check bits.

contd.

Data codeword following AHY address codeword:

For a (control channel) availability check on the called unit, if bit AD in the AHY address codeword is set to '1', then a single data codeword with the following structure is appended to the AHY codeword.

FORM - Defines the format of the PARAMETERS field (see below).
'000' - Value used to convey the address of the calling unit in an interprefix or Include call.
'001' to '100' are reserved for future use.
'101' to '111' are spare for customisation.

PARAMETERS - See parameter formats below.

P - Parity check bits.

Parameter formats

PARAMETERS

FORM = '000'

RSVD - Reserved for future use.
Default value = all '0's.

PFIX2 - Prefix of the calling unit.

IDENT2 - Ident of the calling unit.

5.5.3.2.2 This section is free for customisation.

5.5.3.2.3 Cancel Alert/Waiting State Message, AHYX

This message is transmitted on a control channel by the TSC, to inform a called radio unit of cancellation of an incoming traffic channel call e.g. if the calling unit no longer wants the call. It demands a response ACK(QUAL=1) in the next slot from the called unit i.e. the unit whose individual address is PFIX/IDENT1 - see 9.2.2.4. (Note that this message is used only for cancelled individual calls to radio units.)

1	PFIX	IDENT1	1	CAT 000	TYPE 10	FUNC 010	IDENT2	RSVD	P
1	7	13	1	3	2	3	13	5	16

PFIX - Prefix of the called radio unit.

IDENT1 - Ident of the called radio unit.

CAT - '000'.

TYPE - '10'.

FUNC - '010'.

IDENT2 - Calling party or gateway:
- Ident - for a common-prefix call
- IPFIXI - for an interprefix call
- PABXI - for a call from a PABX extension
- PSTNGI - for a call from the PSTN
- INCI - for an Include call.

RSVD - Reserved for future definition. Default value = '00000'.

P - Parity check bits.

5.5.3.2.4 This section is reserved for future use.

5.5.3.2.5 This section is reserved for future use.

5.5.3.2.6 This section is reserved for future use.

5.5.3.2.7 Status Ahoy Message, AHYQ

This message is transmitted on a control channel by a TSC to inform a called radio unit of status information sent by a radio or 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. AHYQ is also used to send a 5-bit status message to a radio unit from the TSC.

AHYQ demands an response ACK, ACKX, ACKV or ACKB from the called unit (i.e. the unit whose individual address is PFIX/IDENT1):

- in the slot following the AHYQ address codeword, for a common-prefix status message (IDENT2 = ident) or a message from the TSC (IDENT2 = TSCI);
- in the slot following the appended data codeword, for an interprefix status message (IDENT2 = IPFIXI).

See 13.2.1.5 and 13.2.3.1 for the Status Ahoy procedures.

AHYQ address codeword:

1	PFIX	IDENT1	1	CAT 000	TYPE 10	FUNC 110	IDENT2	STATUS	P
1	7	13	1	3	2	3	13	5	16

PFIX - Prefix of the called radio unit.

IDENT1 - Ident of the called radio unit.

CAT - '000'.
TYPE - '10'.
FUNC - '110'.

IDENT2 - Calling unit or gateway:
Ident - for a common-prefix transaction
IPFIXI - for an interprefix transaction
TSCI - for a message from the TSC.

If IDENT2 = IPFIXI, the address of the calling unit is provided in an appended data codeword (see below).

STATUS - For a status message from a radio or line unit, this field contains the status information sent by the calling unit:
'00000' requests a speech call
'00001' to '11110' are user-defined status values
'11111' cancels a previous speech call request.

For a status message from the TSC, the meaning of the STATUS field is system-dependent.

P - Parity check bits.

contd.

Data codeword following AHYQ address codeword:

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

0	RSVD	PFIX2	IDENT2	P
1	27	7	13	16

RSVD - Reserved for future use. Default value = all '0's.

PFIX2 - Prefix of the calling unit.

IDENT2 - Ident of the calling unit.

P - Parity check bits.

5.5.3.2.8 Short Data Invitation Message, AHYC

This message is used by the TSC to instruct a radio unit to send a short data transmission (see sections 9.2.2.1, 11.3.1 and 15.2).

AHYC is used in two Modes:

- In Mode 1, AHYC instructs a calling radio unit to send addressing information (see SAMIS, section 5.6.1.2.2) or RQC data (see HEAD, section 5.6.2), when a preceding request message from the radio unit has indicated the requirement. Mode 1 is distinguished by setting PFIX/IDENT2 to a radio unit's individual address.

- In Mode 2, AHYC demands that a radio unit transmits a data message of a prescribed type (see section 15); for example, the TSC may demand the serial number of a radio unit. It is an interrogation mode, not part of a call requested by the radio unit. Mode 2 is distinguished by setting PFIX/IDENT1 to a radio unit's individual address (with IDENT2 as a non-radio-unit ident).

The type of data to be transmitted by the radio unit is indicated by the DESC field and the non-radio-unit ident; the meaning of DESC can be different for the two modes.

AHYC may be sent on either a control channel or a traffic channel.

1	PFIX	IDENT1	1	CAT 000	TYPE 10	FUNC 111	IDENT2	SLOTS	DESC	P
1	7	13	1	3	2	3	13	2	3	16

PFIX - Prefix of the radio unit.

IDENT1 - Called unit, gateway or special ident:

a. Mode 1 (instructing the unit with address PFIX/IDENT2 to send data):
   - IPFIXI - for inviting extended addressing information for an interprefix call
   - PSTNGI - for inviting dialled digits for a call to the PSTN
   - PABXI - for inviting address information for a call to a PABX extension
   - DIVERTI - for inviting the blocked address for third-party call diversion
   - SDMI - for inviting RQC data.

b. Mode 2 (interrogation): Ident of the radio unit.

contd.

CAT - '000'.

TYPE - '10'.

FUNC - '111'.

IDENT2 - Calling party:

a. Mode 1: Ident of the calling radio unit.

b. Mode 2 (instructing the unit with address PFIX/IDENT1 to send data): Ident of the interrogator:

For DESC='000' (serial number check), IDENT2 = TSCI.

SLOTS - The number of slots reserved for the data message:

SLOTS	No. of slots	No. of codewords
'00'	reserved	
'01'	1	address codeword only
'10'	2	address codeword + 1 or 2 data codewords
'11'	3	address codeword + 3 or 4 data codewords

For Mode 1, SLOTS shall correspond to the request message from the radio unit as follows:

IDENT1 in AHYC	SLOTS
IPFIXI	'01'
PSTNGI	'01' for up to 9 digits, or '10' for 10 to 31 digits
PABXI	'01'
DIVERTI	'01'
SDMI	equal to SLOTS from the RQC

For Mode 2, SLOTS shall correspond to the data required from the radio unit as follows:

DESC	SLOTS
'000'	'01'

contd.

DESC - Data message codeword descriptor. This field indicates the type of data message with which the radio unit shall respond:

i) When the first codeword of the radio unit's data message is required to be SAMIS, DESC is set to the value of the DESC field to be used in the SAMIS as follows; (note that the meaning of the SAMIS message may be different for Modes 1 and 2):

a. Mode 1:

'000' - for inviting extended addressing information for an interprefix call, or the blocked address for third-party diversion
'001' - for inviting dialled digits for a call to the PSTN
'010' - for inviting address information for a call to a PABX extension
'011' - Reserved
'100 to 111' are spare

b. Mode 2:

'000' - for demanding the serial number of a radio unit.
'001 to 011' are reserved
'100 to 111' are spare

ii) When the first codeword of the radio unit's data message is required to be HEAD (i.e. IDENT1=SDMI), DESC = '000'.
DESC = '001' to '011' are reserved.
DESC = '100' to '111' are spare

P - Parity check bits.

5.5.4 Miscellaneous Control Messages (Type '11')

These are various messages required for system control. The basic structure is illustrated below, but the detailed structure for each message is defined separately on the following pages.

1	PARAMS	1	CAT 000	TYPE 11	FUNC	PARAMETERS	P
1	20	1	3	2	3	18	16

PARAMS - Dependent on FUNC.
Where applicable, PARAMS is an address (PFIX/IDENT1); otherwise bits 2-21 are used for other purposes.
See following pages.

CAT - '000'.

TYPE - '11'.

FUNC - Specifies the function of the message:

'000'	MARK	Control channel marker
'001'	MAINT	Call maintenance message
'010'	CLEAR	Clear down from allocated channel
'011'	MOVE	Move to specified control channel
'100'	BCAST	Broadcast message for system parameters
'101'	Reserved for future use	
'110'	Reserved for future use	
'111'	Reserved for future use	

PARAMETERS - See following pages.

P - Parity check bits.

5.5.4.1 Control Channel Marker, MARK

This message may be transmitted on a control channel by a TSC. For example, it may be sent as the first address codeword(s) on a newly designated control channel in order to accelerate control channel acquisition by radio units (see 3.3.3.1). It does not need an address PFIX/IDENT1, so bits 2-21 are reused.

The message fields A and B are chosen so that:

i) the parity check bits always form the control channel codeword synchronisation sequence, SYNC (see section 3.2.1.1), and

ii) the number of bit transitions included between bits 33 and 49 is the maximum achievable, taking into account condition i) above. The bit values of these fields will depend on CHAN4 and the system identity code. An algorithm for generating these fields is given in Appendix 4.

1	CHAN4	A	SYS	1	CAT 000	TYPE 11	FUNC 000	B	P 1100010011010111
1	4	1	15	1	3	2	3	18	16

CHAN4 - Least significant four bits of the channel number of the control channel on which the message is sent

A - See i) and ii) above and Appendix 4.

SYS - System identity code of the transmitting system.

CAT - '000'.

TYPE - '11'.

FUNC - '000'.

B - See i) and ii) above and Appendix 4.

P - Parity check bits.
These complete the codeword and also form the control channel codeword synchronisation sequence.

5.5.4.2 Call Maintenance Message, MAINT

These messages are transmitted on an allocated traffic channel during a call.

A radio unit sends MAINT messages (OPER = '000', '001', '010', '011') during a call; see 9.2.3. The TSC may send MAINT (OPER = '110') to clear down from the channel any radio units that should not be there, and may send MAINT (OPER = '111') to disable radio units from user transmission.

1	PFIX	IDENT1	1	CAT 000	TYPE 11	FUNC 001	CHAN	OPER	RSVD	P
1	7	13	1	3	2	3	10	3	5	16

PFIX - Prefix.

IDENT1 - Transmitted by radio unit:
PFIX/IDENT1 is the unit's individual address if it was individually addressed by the GTC message; otherwise PFIX/IDENT1 is either its individual address or the group address (PFIX/IDENT1) from the GTC, as specified by the system - see 5.5.4.5c, 9.2.2.6 and 9.2.3.

Transmitted by TSC:
OPER = '110' PFIX/IDENT1 is the "call-labelling" address: either address from the GTC message.
OPER = '111' Individual or group ident, or ALLI; see below.

CAT - '000'.
TYPE - '11'.
FUNC - '001'.

CHAN - Channel number of the channel on which the message is sent.

OPER - '000' Pressel On
'001' Pressel Off
'010' Periodic message within an item
'011' Disconnect message, end of channel use
'100' Spare for customisation (eg radio transmitter power control)
'101' Reserved for future use
'110' Clear down radio units for which PFIX/IDENT1 is not a valid call-labelling address
'111' Disable user transmission, as follows:
a) an individual radio unit, if PFIX/IDENT1 is an individual address
b) called radio units in a group, if PFIX/IDENT1 is the group address
c) all radio units on the channel, if IDENT1 is ALLI.

RSVD - Reserved for future use. Except for OPER = '100' when these bits are available for synchronisation when reserved, default value = '00000'.

P - Parity check bits.

5.5.4.3 Clear-Down Message, CLEAR

This message is transmitted by a TSC; it directs all radio units to clear down from a traffic channel. It does not need an address PFIX/IDENT1, so bits 2-21 are reused.

1	CHAN	CONT	1	CAT 000	TYPE 11	FUNC 010	RSVD	SPARE	REVS 101010101010	P
1	10	10	1	3	2	3	4	2	12	16

CHAN - Channel number of the traffic channel on which the message is sent.

CONT - Channel number of the control channel to which radio units should move (unless CONT = '0000000000', in which case the channel movement is system-dependent).

CAT - '000'.

TYPE - '11'.

FUNC - '010'.

RSVD - Reserved for future use. Default value = '0000'.

SPARE - These bits are available for customisation.

REVS - Bit reversals, ending with a '0'.

P - Parity check bits.

5.5.4.4 Move to Control Channel, MOVE

This message is transmitted on a control channel by a TSC; it directs selected radio units to a different control channel. (See sections 6.1.1 and 7.4.2).

1	PFIX	IDENT1	1	CAT 000	TYPE 11	FUNC 011	CONT	(M)	RSVD	SPARE	P
1	7	13	1	3	2	3	10	5	2	1	16

PFIX - Prefix.

IDENT1 - PFIX/IDENT1 specifies the radio units that should move. Only the (M) least significant bits of the 20-bit address are used; the remaining address bits may be set arbitrarily.

CAT - '000'.

TYPE - '11'.

FUNC - '011'.

CONT - Channel number of the control channel to which the addressed radio units should move (unless CONT = '0000000000', in which case the channel movement is system-dependent).

(M) - Address qualifier.

RSVD - Reserved for future use. Default value = '00'.

SPARE - This bit is available for customisation.

P - Parity check bits.

5.5.4.5 Broadcast Message, BCAST

This message is transmitted on a control channel by a TSC; it contains information about system parameters for either this system or another system. It does not need an address PFIX/IDENT1, so bits 2-21 are reused.

32 different types of information can be broadcast using BCAST messages, by setting the SYSDEF and parameter fields appropriately. The parameter fields for each SYSDEF are detailed on the following pages.

1	SYSDEF	SYS	1	CAT 000	TYPE 11	FUNC 100	PARAMETERS	P
1	5	15	1	3	2	3	18	16

SYSDEF - Specifies which system parameters are being broadcast:

'00000'	Announce control channel
'00001'	Withdraw control channel
'00010'	Specify call maintenance parameters
'00011'	Specify registration parameters
'00100'	Broadcast adjacent site control channel number
'00101'	Vote now advice
'00110') : '01111')	Reserved for future use
'10000') : '11111')	Spare for customisation of services

SYS - System identity code of the system to which the broadcast message refers.

CAT - '000'.

TYPE - '11'.

FUNC - '100'.

PARAMETERS - Parameter fields - see following pages.

P - Parity check bits.

Parameter fields in BCAST messages

a) Announce control channel (SYSDEF = '00000')

This message announces a channel that may be used for control by the named system; radio units may then include it in their list of channels to scan.

1	SYSDEF 00000	SYS	1	CAT 000	TYPE 11	FUNC 100	CHAN	SPARE	RSVD	P
1	5	15	1	3	2	3	10	2	6	16

CHAN - Channel number of the control channel being announced.

SPARE - These bits are available for customisation.

RSVD - Reserved for future definition. Default = all '0's.

b) Withdraw control channel (SYSDEF = '00001')

This message withdraws a channel that could previously be used for control by the named system; radio units may then delete it from their list of channels to scan.

1	SYSDEF 00001	SYS	1	CAT 000	TYPE 11	FUNC 100	CHAN	SPARE	RSVD	P
1	5	15	1	3	2	3	10	2	6	16

CHAN - Channel number of the control channel being withdrawn.

SPARE - These bits are available for customisation.

RSVD - Reserved for future definition. Default = all '0's.

c) Specify call maintenance parameters (SYSDEF = '00010')

This message specifies:

(i) whether this system requires radio units to send call maintenance messages on traffic channels periodically within speech items; if so, it specifies the maximum interval between the periodic messages;

(ii) whether this system requires radio units on traffic channels to send NPON Pressel On messages at the start of speech items;

(iii) whether this system requires that 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.

This message shall be sent only by the system to which the broadcast refers.

Default requirements are specified in section 9.2.2.6.

1	SYSDEF 00010	SYS	1	CAT 000	TYPE 11	FUNC 100	PER	IVAL	PON	ID	RSVD	SPARE	P
1	5	15	1	3	2	3	1	5	1	1	2	8	16

PER - '0' if radio units shall send call maintenance messages periodically within speech items.
'1' if radio units shall not send call maintenance messages periodically within speech items.

IVAL - If PER = 0, IVAL is the maximum interval (in seconds) between the start of the item and the first periodic message, and then between subsequent periodic messages.
If PER = 1, IVAL is reserved. Default value = '00000'.

PON - '0' if radio units shall send NPON Pressel On messages at the start of speech items.
'1' if radio units shall not send any Pressel On messages at the start of speech items.

ID - '0' if a called unit in a group shall set PFIX/IDENT1 in MAINT messages it sends to the group address from the GTC message.
'1' if a called unit in a group shall set PFIX/IDENT1 in MAINT messages it sends to its individual address.

RSVD - Reserved for future definition. Default value = '00'.

SPARE - These bits are available for customisation.

d) Specify registration parameters (SYSDEF = '00011')

This message is available for systems to specify parameters which radio units may require for implementing registration.

1	SYSDEF 00011	SYS	1	CAT 000	TYPE 11	FUNC 100	RSVD	SPARE	P
1	5	15	1	3	2	3	4	14	16

RSVD - Reserved for future definition. Default value = '0000'.

SPARE - These bits are available for customisation.

e) Broadcast adjacent site control channel number (SYSDEF = '00100')

This message specifies a control channel currently being used for signalling on an adjacent site. It gives the system identity code of the adjacent site and the channel number of the specified control channel, and may also give the local serial number of the adjacent site.

1	SYSDEF 00100	SYS	1	CAT 000	TYPE 11	FUNC 100	CHAN	SPARE	RSVD	ADJSITE	P
1	5	15	1	3	2	3	10	2	2	4	16

CHAN - Channel number of the control channel being specified.

SPARE - These bits are available for customisation.

RSVD - Reserved for future definition. Default value = '00'.

ADJSITE - For ADJSITE = 0, radio units shall ignore this field.
For ADJSITE = 1 to 15, ADJSITE is the local serial number of the adjacent site, as assigned by the transmitting site.

The use of site serial numbers is system-dependent. The adjacent site number is useful for wide-area systems that provide more than one control channel with the same system identity code (SYS). (Note that the same call information should be sent on control channels with the same SYS).

f) Vote now advice (SYSDEF = '00101')

This message gives an opportunity to idle radio units to use the next slot for signal assessment of the control channel specified by the broadcast message. It gives the system identity code of the adjacent site that is using the specified control channel and the channel number of the control channel, and may also give the local serial number of the adjacent site.

Note that the TSC should not use the next slot on the transmitting site to signal to units that are likely to be assessing the signal strength received from the adjacent site.

1	SYSDEF 00101	SYS	1	CAT 000	TYPE 11	FUNC 100	CHAN	SPARE	RSVD	ADJSITE	P
1	5	15	1	3	2	3	10	2	2	4	16

CHAN - Channel number of the control channel being specified.

SPARE - These bits are available for customisation.

RSVD - Reserved for future definition. Default value = '00'.

ADJSITE - For ADJSITE = 0, radio units shall ignore this field.
For ADJSITE = 1 to 15, ADJSITE is the local serial number of the adjacent site, as assigned by the transmitting site.

5.6 Category '001' Messages

5.6.1 Single Address Messages (Type '0')

5.6.1.1 Outbound Single Address Messages, SAMO

The SAMO messages are for the transmission of short data messages from the TSC to radio units. They are not used in this issue of the standard, but are reserved for future definition.

1	PFIX	IDENT1	1	CAT 001	TYPE 0	PARAMETERS	P
1	7	13	1	3	1	22	16

PFIX - Prefix of the called radio unit or group.

IDENT1 - Ident of the called radio unit or group.

CAT - '001'.

TYPE - '0'.

PARAMETERS - Reserved for future definition.

P - Parity check bits.

5.6.1.2 Inbound Single Address Messages

5.6.1.2.1 Inbound Unsolicited Single Address Message, SAMIU

The SAMIU messages are for the transmission of random access short data messages from radio units to the TSC. They are not used in this issue of the standard, but are reserved for future definition.

1	PFIX	IDENT1	1	CAT 001	TYPE 0	SOL 1	PARAMETERS	P
1	7	13	1	3	1	1	21	16

PFIX - Prefix of the originating unit.

IDENT1 - Ident of the originating unit.

CAT - '001'.

TYPE - '0'.

SOL - '1'.

PARAMETERS - Reserved for future definition.

P - Parity check bits.

5.6.1.2.2 Inbound Solicited Single Address Message, SAMIS

The SAMIS message is for the transmission of a short data message by a radio unit in response to an AHYC message from the TSC. For example, it is used in the extended addressing procedures, in third-party call diversion (section 12) and for data interrogation (section 15). When appropriate, data codewords are appended to a SAMIS address codeword.

The meaning of a SAMIS message is indicated by the DESC field. The AHYC message which solicits a SAMIS is used in two different Modes (see 5.5.3.2.8); the meaning of the SAMIS message is specified independently for the two Modes.

The SAMIS message may be transmitted on a control channel and on a traffic channel.

SAMIS address codeword:

1	PARAMETERS1	1	CAT 001	TYPE 0	SOL 0	DESC	PARAMETERS2	P
1	20	1	3	1	1	3	18	16

PARAMETERS1 - See parameter formats below.

CAT - '001'.

TYPE - '0'.

SOL - '0'.

DESC - Codeword descriptor:

a. Mode 1: (AHYC with radio unit address as PFIX/IDENT2):

'000' - extended addressing information for an interprefix call, or blocked address for third-party diversion
'001' - dialled digits for a call to the PSTN
'010' - address information for a call to a PABX extension
'011' is reserved
'100' to '111' are spare

b. Mode 2: (AHYC with radio unit address as PFIX/IDENT1):

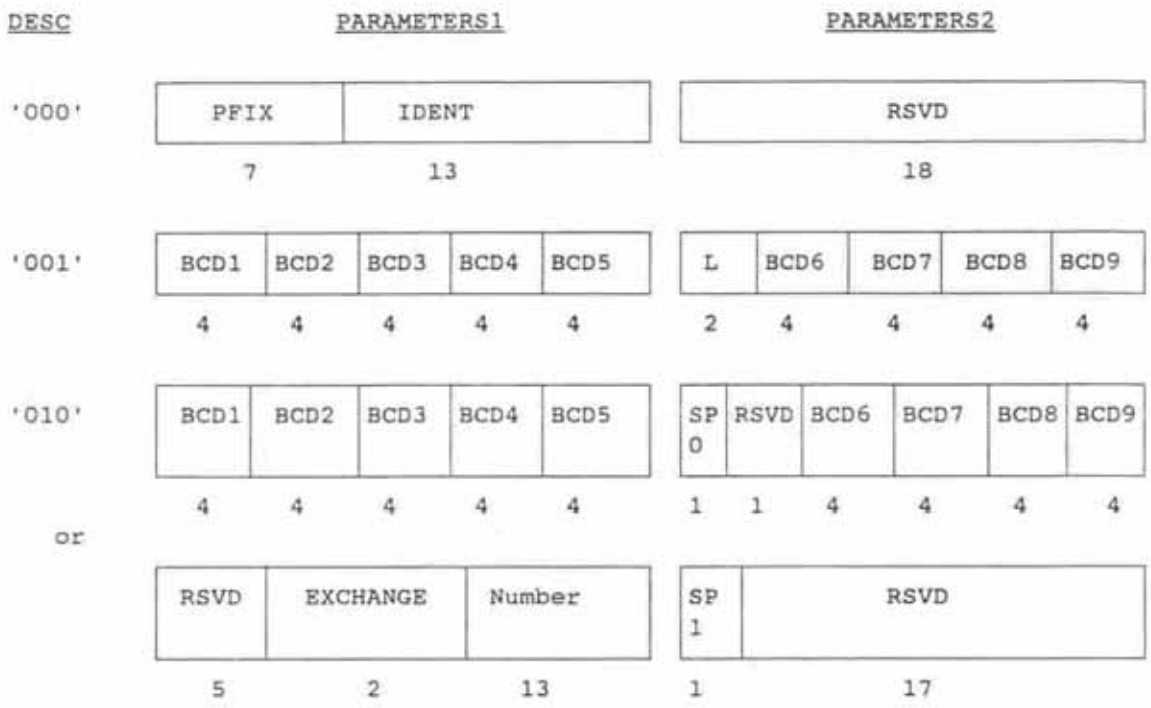
'000' - radio unit's serial number.
'001' to '011' are reserved.
'100' to '111' are spare.

PARAMETERS2 - See parameter formats below.

P - Parity check bits.

contd.

Parameter formats for Mode 1



PFIX - Prefix of unit or group.

IDENT - Ident of unit or group.

RSVD - Reserved. Default value = all '0's.

L - Number of data codewords appended to SAMIS:

'00' - no data codewords
'01' - one data codeword
'10' - two data codewords
'11' - reserved

BCDn - BCD groups representing the dialled digits, coded in accordance with the table in Appendix 5. BCD digits are transmitted in the dialled order (i.e. the leftmost digit in the above diagram is the earliest in the dialling order; digits in any following codeword are later in the dialling order).

EXCHANGE - Indicates the appropriate PABX exchange.

Number - PABX extension number.

SP - Indicates the format of the PABX address information:
'0' - BCD digits.
'1' - 13-bit extension number plus 2-bit exchange number.
(Note that SP='1' is used only in the call diversion procedures).

contd.

Data codewords appended to SAMIS, Mode 1:

For DESC = '001', in response to AHYC inviting PSTN digits, one or two data codewords having the following format may be appended:

0	RSVD	eleven BCD digits	P
1	3	11 x 4	16

RSVD - Reserved. Default value = '000'.

BCD - Eleven BCD groups representing the dialled digits, coded in accordance with the table in Appendix 5. BCD digits are transmitted in the dialled order.

P - Parity check bits.

Parameter formats for Mode 2

DESC	PARAMETERS1	PARAMETERS2
'000'	1st part of serial number	2nd part of serial number
	20	18

The form of the serial number is system-dependent.

Data codewords appended to SAMIS, Mode 2:

Reserved for future definition.

5.6.2 Short Data Message Header, HEAD (Type '1')

This codeword is the address codeword in a short data message having up to four data codewords and transmitted on a control channel. A radio unit may request to send a short data message using the RQC message (see 5.5.3.1.8). The TSC instructs the radio unit to send its short data message (using AHYC), and then forwards the message to the called party (or the TSC may be the called destination). The TSC may also transmit short data messages originated from a line unit, a PABX extension or the PSTN, or from the TSC itself. See section 14 for the short data message procedures.

A HEAD message transmitted by the TSC to an individually addressed radio unit demands a response from the unit, in the slot following the last data codeword of the message.

HEAD address codeword:

1	PFIX1	IDENT1	1	CAT 001	TYPE 1	LEN	PFIX2	IDENT2	P
1	7	13	1	3	1	2	7	13	16

PFIX1 - Prefix of the called party (if applicable).

IDENT1 - Called party or gateway:
- Ident - for a common-prefix or interprefix call
- ALLI - for a system-wide call
- PABXI - for a call to a PABX extension
- PSTNSIj - for a call to a prearranged PSTN destination
- PSTNGI - for a call to a general PSTN destination
- TSCI - for a call to the TSC.

CAT - '001'.

TYPE - '1'.

LEN - Indicates the number of data codewords appended to the HEAD address codeword:
- '00' one data codeword
- '01' two data codewords
- '10' three data codewords
- '11' four data codewords.

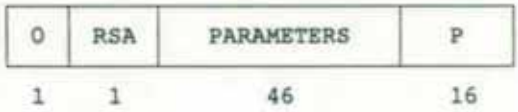
PFIX2 - Prefix of the calling party (if applicable).

IDENT2 - Calling party or gateway:
- Ident - for a common-prefix or interprefix call
- PABXI - for a call from a PABX extension
- PSTNGI - for a call from the PSTN
- TSCI - for a call from the TSC.

P - Parity check bits.

contd.

Data codeword(s) following HEAD address codeword:



0	RSA	PARAMETERS	P
1	1	46	16

RSA - Return Slot Access Flag.
When transmitted by the TSC on a control channel in the second half of a slot preceding an access slot:
'0' - radio units are not permitted random access in the following slot on the return control channel,
'1' - radio units are permitted random access in the following slot on the return control channel.
When transmitted in the first or third data codeword following HEAD, RSA = SPARE, default = '0'.

PARAMETERS - This field is available for free format data.

P - Parity check bits.

5.7 Codewords applicable to Standard Data Call Set-Up

5.7.1 Request Standard Data Communication RQD

This message is transmitted to the TSC on a control channel by a radio unit requesting to send a data message using the Standard Data Protocol

1	PFIX	IDENT1	1	CAT 010	KIND 1	PORT	FAD	IDENT2	INTER	LEVEL	HADT	E	MODEM	P
1	7	13	1	3	1	3	1	13	1	1	1	1	1	16

PFIX - Prefix of the requesting radio unit

IDENT1 - Called party or gateway
- Ident - for a common-prefix call
- IPFIXI - for an interprefix call
- ALLI - for a system wide call
- PABXI - for a call to a PABX extension
- PSTNSIj - for a call to a prearranged PSTN destination
- NETSIj - for a call to to a pre-arranged data Network destination
- PSTNGI - for call to a general PSTN destination
- DNI - for a call to a data network

CAT - '010'

KIND - '1'

PORT - Logical Port number of the called party

FAD - Flag to indicate greater than 9 dialled digits for PSTN call

'0' - 9 or fewer dialled digits
'1' - greater than 9 dialled digits

IDENT2 - Ident of the requesting radio unit

INTER - interactive contact required

'1' interactive contact with the called party is required
'0' interactive contact with the called party need not be provided

LEVEL - required priority

'1' non-priority
'0' high priority

HADT - '0' high accuracy data transfer not required
'1' high accuracy data transfer required

E - '0' if the calling party requested a non-emergency call or transaction.
'1' if the calling party requested an emergency call.

cont.

MODEM - requested data rate

'0' - standard rate 1200 b/s only
'1' - customised rate and standard rate are supported.

P - parity check bits

5.7.2 Availability Check for Standard Data AHYD

1	PFIX	IDENT1	1	CAT 010	KIND 1	PORT	RSVD	IDENT2	INTER	POINT	HADT	E	AD	P
1	7	13	1	3	1	3	1	13	1	1	1	1	1	16

PFIX - Prefix of the radio unit

IDENT1 - Called party or gateway :

Ident	-	for a common prefix call
IPFIXI	-	for an interprefix call
ALLI	-	for a system wide call
PABXI	-	for a call to a PABX extension
NETSIj	-	for a call to a pre-arranged Data Network
PSTNSIj	-	for a call to a pre-arranged PSTN destination
PSTNGI	-	for a call to the PSTN
DIVERTI	-	for general cancellation by a recipient of diversions
DNI	-	for a call to a Data Network

CAT - '010'

KIND - '1'

PORT - Logical port number

RSVD - Reserved. Default value = all '0's

IDENT2 - Calling party or gateway as follows:

DUMMYI	-	for a "no-call" test availability check for standard data
Ident	-	for a common prefix call
IPFIXI	-	for an interprefix call
PABXI	-	for a call from a PABX extension
PSTNGI	-	for a call from the PSTN
NETSIj	-	from a pre-arranged Data Network source
DNI	-	for a call from a Data Network

If IDENT2=IPFIXI, the address of the calling unit may be provided in an appended data codeword

INTER - interactive contact required

'1' interactive contact with the called party is required
'0' interactive contact with the called party need not be provided.

POINT - '0' demands an acknowledgement from the called unit i.e the unit whose individual address is PFIX/IDENT1
'1' demands an acknowledgement from the calling unit i.e the unit whose individual address is PFIX/IDENT2

HADT - '0' high accuracy data transfer not required
'1' high accuracy data transfer required

contd.

E - '0' if the calling party requested a non-emergency data call.
'1' if the calling party requested an emergency data call.

AD - '0' if there is no appended data codeword
'1' if there is a data codeword appended to the AHYD

P - parity check bits

Data codeword following AHYD address codeword

FORM - Defines the format of the PARAMETERS field (see below)

'000' - Value used to convey the address of the calling unit in an interprefix call

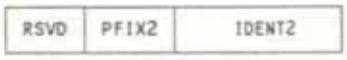
'001' to '100 ' are reserved for future use
'101' to '111' are spare for customisation

PARAMETERS - see parameter formats below

P - parity check bits

Parameter formats

FORM = '000'



RSVD - Reserved for future use. Default value = all '0's.

PFIX2 - Prefix of the calling unit

IDENT2 - Ident of the calling unit

5.7.3 Go To Transaction GTT

This message is transmitted from a TSC to radio units. It directs addressed radio units to switch to a designated Standard Data channel in order to proceed with or continue a data call.

The message is used :

a) On a control channel to send the RU to a data channel, and allocate its TRANS. If TRANS='0000000000' then the TRANS will be allocated on the data channel using an additional GTT.

b) On a data channel, with an IDENT set to a value in the range 1-8100, to allocate an additional TRANS to the RU. In this case the channel number MUST be set to the current data channel

c) On a data channel to move an individual RU to another data channel. This is only possible if the radio unit already has one TRANS assigned to it. In this case, a new TRANS will replace the current TRANS on the new channel and the data call will continue.

d) On a data channel to move ALL radio unit's to another data channel. In this case IDENT is set to ALLI and TRANS='0000000000'. All radio units moved shall retain their already allocated TRANS. The O/R and the RATE fields have no meaning and shall be set to '0'.

1	PFIX	IDENT	1	CAT 010	KIND 0	CHAN	O/R	RATE	TRANS	P
1	7	13	1	3	1	10	1	1	10	16

PFIX - Prefix of radio unit

IDENT - Ident of the radio unit

Ident - any ident applicable to the radio unit.
ALLI - for a system wide call

CAT - '010'

KIND - '0'

CHAN - Designates the allocated channel number

O/R - Originator or Recipient
'0' - radio unit is the originator
'1' - radio unit is the recipient

RATE - Transmission rate to be used
'0' - standard rate 1200 b/s
'1' - customised rate

TRANS - Transaction number

P - parity bits

5.7.4 Standard Data Random access
Radio Unit General Information - DRUGI

This message shall be transmitted by a radio unit:

a) In response to DAHY

b) In random access when TDE or TDH has expired

c) When it wishes to resume data transfer after a pause

1	PFIX	IDENT1	1	CAT 010	KIND 0	RNITEL	TNITEL	TRANS	P
1	7	13	1	3	1	6	6	10	16

PFIX - Prefix of the requesting radio unit

IDENT1 - Ident of the requesting radio unit

CAT - '010'

KIND - '0'

RNITEL - Maximum number of data codewords which could be received in a New Fragment

TNITEL - The number of codewords proposed for the next dataitem transmitted by the radio unit.

TRANS - Transaction number

P - parity check bits

5.8 Codewords applicable to Standard Data Traffic Handling

5.8.1 Standard Data general purpose acknowlegement DACKD

This message may be transmitted by either a TSC or a radio unit as a general purpose acknowledgement on the data channel.

1	PFIX	IDENT	1	CAT 101	KIND 0	JOB 0101	RSVD	REASON	TRANS	P
1	7	13	1	3	1	4	5	3	10	16

PFIX - Prefix of the radio unit

IDEN - Ident of the radio unit

CAT - '101'

KIND - '0'

JOB - '0101'

RSVD - Reserved for future use. Default value = all '0's.

REASON - Reason for this acknowledgement

'000' response for DAHYX
'001' as a response to a GO submessage if a pause in user data transmission is required
'010'-'101' reserved
'110'-'111' spare

TRANS - Transaction number to be closed

P - parity check bits

5.8.2 Standard Data Codeword DACK containing Submessages DAL, DALG or GO

This message consists of an DACK acknowlegement submessage combined with either:

1. A marker for a random access frame (codeword layout no.1) transmitted by the TSC only, or
2. An invitation to transmit a 'GO' for a fragment (codeword layout no.2).

CODEWORD LAYOUT NUMBER 1

1	ATRANS	RTRANS	1	CAT 101	KIND 0	JOB 00XX	WF	P/N	RSVD	DN	TNITEL	ITENUM	P
1	10	10	1	3	1	4	3	1	2	5	6	1	16

ATRANS - TRANS number for the submessage for which this is the acknowledgment.If ATRANS='0000000000' then this submessage has no significance.

RTRANS - Transaction number for random access. See 17.2.1.2.1.

CAT - '101'

KIND - '0'

JOB - '0000' - DACK+DAL where DAL marks a general random access frame

'0001' - DACK+DALG where DALG marks a frame for requesting group message repeats

'0010' - DACK+DALN where DALN marks a frame for all except group message repeats

WF - Delay parameter for repeat transmissions i.e number of frame marks that must be counted before further random access of this type may be made.

ND - the Aloha Number for the random access frame

P/N - Positive (PACK) or Negative (NACK) Acknowledgement.

(PACK) P/N = '1' indicates whole dataitem successfully received.

(NACK) P/N = '0' indicates whole dataitem to be repeated.

TNITEL - Proposed Transmitted next dataitem length in the same direction as this message (ATRANS).

ITENUM - Dataitem number from the message to which this is the acknowledement (ATRANS).

RSVD - Reserved. Default value = all '0's

P - Parity check bits

CODEWORD LAYOUT NUMBER 2

1	ATRANS	RTRANS	1	CAT 101	KIND 0	JOB 0011	RSVD	P/N	RSVD	RNITEL	TNITEL	ITENUM	P
1	10	10	1	3	1	4	3	1	1	6	6	1	16

ATRANS - TRANS number for the submessage for which this is the acknowledgment.If ATRANS='0000000000' then this submessage has no significance.

RTRANS - Transaction number for the GO submessage.

CAT - '101'

KIND - '0'

JOB - '0011' - DACK+'GO'

P/N - Positive (PACK) or Negative (NACK) Acknowledgement.

(PACK) P/N = '1' indicates whole dataitem successfully received.

(NACK) P/N = '0' indicates whole dataitem to be repeated.

RNITEL - to indicate the maximum length of fragment that the sender of this message can accept next (RTRANS).

TNITEL - Proposed Transmitted next dataitem length in the same direction as this message (ATRANS).

ITENUM - Dataitem number from the message to which this is the acknowlegement (ATRANS).

RSVD - Reserved. Default value = all '0's

P - Parity check bits

5.8.3 Standard Data Acknowledgement for expedited data DACKZ

Acknowledgement for expedited data, transmitted by both the TSC and Radio Unit.

1	ATRANS	SPRE	1	CAT	KIND	JOB	SX	SPRE	CAUSE	P
1	10	10	1	3	1	4	3	7	8	16

ATRANS - Transaction number of the relevant TRANS for the acknowledgement

SPRE - for SX = 000 to 101 - RSVD.
Default value = all '0's.
for SX = 110 to 111 - SPARE for customisation.

CAT - '101'

KIND - '0'

JOB - '0100'

SX - Type of expedited data.
'000' = RESET
'001' to '111' - RSVD. Default value = all '0's.

CAUSE - Reason for expedited data.
Default value = all '0's

P - parity check bits

5.8.4 Standard Data General ahoy DAHY

This message is transmitted by a TSC on a data channel to query availability relating to a particular TRANS. It demands an immediate response.

1	TRANS	RSVD	1	CAT 101	KIND 0	JOB 1000	RSVD	SPARE	P
1	10	10	1	3	1	4	10	8	16

TRANS - Transaction number

RSVD - Reserved for future use. Default value = all '0's.

CAT - '101'

KIND - '0'

JOB - '1000'

SPARE - Spare for customisation

P - parity check bits

5.8.5 Standard Data ahoy containing expedited data DAHYZ

This message is transmitted by a TSC on a data channel to convey expedited data relating to a particular individual TRANS. It demands an immediate response.

1	SPRE	RSVD	1	CAT 101	KIND 0	JOB 1100	SX	SPRE	CAUSE	P
1	10	10	1	3	1	4	3	7	8	16

TRANS - Transaction number

SPRE - for SX = 000 to 101 - RSVD.
Default value = all '0's.
for SX = 110 to 111 - SPARE for customisation.

RSVD - Reserved for future use. Default value = all '0's.

CAT - '101'

KIND - '0'

JOB - '1100'

SX - Type of expedited data

'000' - Reset the link to a known state

'001' to '101'- Reserved

'110' to '111'- Spare

CAUSE - Reason for expedited data.
Default value = all '0's.

P - parity check bits

5.8.6 Standard Data ahoy for closing a TRANS. DAHYX

This message is transmitted by a TSC to close one or all TRANS' of a particular radio unit.

The message may also be used to clear ALL radio units from a data channel by setting IDENT='ALLI'. In this case there will be no response and the fields PFIX, I/T, TOC, and TRANS shall have no meaning and default to all '0's with RESP='0'.

1	PFIX	IDENT	1	CAT 101	KIND 0	JOB 1110	I/T	RESP	SPRE	TOC	TRANS	P
1	7	13	1	3	1	4	1	1	3	3	10	16

PFIX - Prefix of radio unit

IDENT - Ident of the radio unit

Ident - any ident applicable to the radio unit.

ALLI - to clear ALL radio units from a data channel.

CAT - '101'

KIND - '0'

JOB - '1110'

I/T - IDENT/TRANS

I/T='0' Close all TRANS associated with that PFIX/IDENT. See RESP. (TRANS shall be set to '0000000000')

I/T='1' Close the specified TRANS. See RESP.

RESP - '0' no response to the DAHYX is expected

- '1' An acknowledgement to the AHYX is required

SPRE - for TOC = 000 to 101 - RSVD.
Default value = all '0's.

for TOC = 110 to 111 - SPARE for customisation.

TOC - Type Of Clear

'000' ALLCLR Data transfer abandoned and incomplete

'001'ALLDONE Data Transfer for this link has been completed

'010' - '101' Reserved

'110' - '111' Spare

TRANS - Transaction number

P - parity check bits

5.8.7 Repeat last ACK - RLA

This message is transmitted on a data channel by a TSC or a radio unit to request a repeat of the last acknowledgement.

1	TRANS	RSVD	1	CAT 101	KIND 0	JOB 1111	RSVD	SPARE	P
1	10	10	1	3	1	4	12	6	16

TRANS - Transaction number

RSVD - Reserved for future use. Default value = all '0's.

CAT - '101'

KIND - '0'

JOB - '1111'

SPARE - Spare for customisation

P - parity check bits

5.8.8 Repeat group message DRQG

This codeword is transmitted by radio unit's using random access procedures to request the retransmission of the relevant group message.

1	TRANS	SPARE	RSVD	1	CAT 101	KIND 0	JOB 1010	RSVD	P
1	10	7	3	1	3	1	4	18	16

TRANS - Transaction number

SPARE - Spare for customisation

RSVD - Reserved. Default value = all '0's

CAT - '101'

KIND - '0'

JOB - '1010'

P - parity check bits

5.8.9 Request containing expedited data DRQZ

This codeword is transmitted by radio unit's using random access or 'GO' procedures as a request for expedited data to be transmitted to the other correspondant.

1	TRANS	SPRE	1	CAT 101	KIND 0	JOB 1100	SX	SPRE	CAUSE	P
1	10	10	1	3	1	4	3	7	8	16

TRANS - Transaction number

SPRE - for SX = 000 to 101 - RSVD.
Default value = all '0's.

for SX = 110 to 111 - SPARE for customisation.

CAT - '101'

KIND - '10'

JOB - '1100'

SX - Type of expedited data

'000'	Reset the link to a known state
'001' to '101	Reserved
'110' to '111'	Spare

CAUSE - Reason for expedited data

SX - Type of expedited data

P - parity check bits

5.8.10 Request to close a transaction DRQX

This codeword is transmitted by a radio unit to request the closure of one or all of its TRANS

1	PFIX	IDENT1	1	CAT 101	KIND 0	JOB 1110	SPRE	TOC	TRANS	P
1	7	13	1	3	1	4	5	3	10	16

PFIX - Prefix of the requesting radio unit

IDENT1 - Ident of the requesting radio unit

CAT - '101'

KIND - '0'

JOB - '1110'

SPRE - for TOC = 000 to 101 - RSVD.
Default value = all '0's.

for TOC = 110 to 111 - SPARE for customisation.

TRANS - Transaction number to be closed. If TRANS '0000000000' then close all transactions for this radio unit.

TOC - Type Of Clear

'000' ALLCLR Data transfer abandoned and incomplete

'001' ALLDONE Data Transfer for this link has been completed

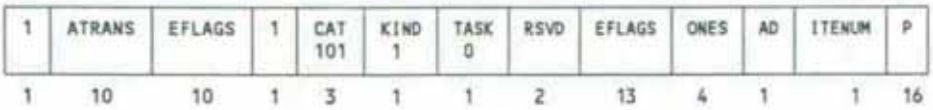
'010' - '101' Reserved

'110' - '111' Spare for customisation

P - parity check bits

5.8.11 Standard Data Selective Acknowledgement Header SACK

This message is transmitted by a TSC or radio unit on a Standard Data channel as a selective acknowledgement to a user data message. If there are more than 22 data codewords in the dataitem then a data codeword is appended to the SACK address codeword.



ATRANS - Transaction number of the original header to which this SACK refers

EFLAGS - Error Flags. See next page for rules of use

CAT - '101'

KIND - '1'

TASK - '0'

RSVD - Reserved. Default value = all '0's

ONES - the modulo 16 sum of all 23 EFLAG bits in this codeword

AD - '0' if there is no appended data codeword
'1' if there is an appended data codeword

ITENUM - itemnumber from the data header to which this acknowledgment refers.

P - parity check bits

Data codeword following Standard Data Acknowledgement Header SACK

EFLAGS - Error Flags (unused Error Flags='0')

ONES - the modulo 16 sum of all 40 EFLAG bits in this codeword

RSVD - Reserved. Default value = all '0's

P - parity check bits

contd.

Rules governing the use of both EFLAG's fields

1. Every data codeword in a user dataitem shall have an EFLAG assigned to it. Each assigned EFLAG shall be set to '1' if its corresponding codeword is required to be repeated, otherwise it shall be set to '0'

2. Within the EFLAG fields the assigned EFLAGs shall be arranged contiguously in the same order as their data codewords in the message to which they are assigned, starting with the first EFLAG i.e bit 12 of the SACK address codeword.

3. The EFLAG bit following the last assigned EFLAG shall be used as a marker and set to '1' and any remaining EFLAG bits shall be set to '0'.

4. The EFLAGs in the address codeword are assigned first and only if they are all assigned is a data codeword appended. Thus if there are 23 assigned EFLAGs then there will be only the marker and filler '0's in the appended data codeword.

5.8.12 Standard Data Address Codeword Dataitem SITH

This message is transmitted by a TSC or radio unit as an address codeword for a fragment.

Individual Dataitem

1	TRANS	USER DATA	1	CAT 101	KIND 1	TASK 1	I/G 0	MORE	LASTBIT	FRAGL	TNITEL	ITENUM	P
1	10	10	1	3	1	1	1	1	6	6	6	1	16

Group Dataitem - TSC to Group

1	TRANS	USER DATA	1	CAT 101	KIND 1	TASK 1	I/G 1	MORE	LASTBIT	FRAGLG	RSVD	ITENUM	P
1	10	10	1	3	1	1	1	1	6	8	4	1	16

TRANS - Transaction number

USERDATA - 10 bits of user data

CAT - '101'

KIND - '1'

TASK - '1'

I/G - '0' if this fragment is within an individual link

'1' if this fragment is within a group link

MORE - '0' if this dataitem is the last in the Tmessage.

'1' if more to follow

ITENUM - The number of the dataitem which includes the information in this message.

LASTBIT - Indicates the bit number (see 17.0.2.5) of the last bit of user information within the last data codeword holding user information.

FRAGL - Number of data codewords appended

FRAGLG - fragment length (8 bit field for group) number of data codewords appended

TNITEL - Proposed Transmitted next dataitem length

RSVD - Reserved. Default value = all '0's

P - parity check bits

6. CHANNEL DISCIPLINE

This section defines basic discipline for the TSC and radio units on control, traffic and Standard Data channels. In particular, timing constraints are specified covering:

- the transmission of standardised messages,
- change-over between transmitting and receiving, and
- channel switching.

The timings for the transmission of standardised messages on a traffic channel are applicable to the procedures defined in this issue of the standard.

Some minimum rules are specified for radio unit control channel acquisition, but additional specifications are likely to be necessary for a specific system implementation.

6.1 Channel Discipline for TSC

6.1.1 Control channel discipline for TSC

For as long as a suitable channel is available, the TSC shall provide at least one control channel substantially continuously, conforming to the basic format defined in section 3.3.3. The TSC may operate either a dedicated or a non-dedicated control channel. If the TSC transmits from more than one base station site then a separate control channel may be provided at each site, or a single control channel may be used with simultaneous transmission at each site, or a single control channel may be shared by time division.

Interruptions in the control channel signalling will occur when, for example, sites are switched in a time-division scheme, or all channels are allocated for traffic in a system with a non-dedicated control channel. Slot synchronisation need not be maintained across interruptions.

If the TSC operates a non-dedicated control channel, it is recommended that the TSC does not allocate the control channel for traffic during a random access frame (except for emergency calls).

When the TSC commences transmission on a different control channel, it should provide an adequate transmission period for the radio units to locate and identify the control channel before it allocates traffic channels for calls; see 6.2.1.1 for control channel acquisition by radio units.

It is recommended that broadcast messages (BCAST) are used to announce the channel numbers of the channels that can be used for control by the TSC. The broadcast messages may also be used to announce the control channels of other systems, for example, to facilitate roaming. It is also recommended that, before a channel is taken out of control service, another control channel shall be indicated if practicable (for example, by sending an appropriate MOVE message).

The TSC shall be prepared to receive messages which conform to the format specified in section 3 for radio unit transmissions on a control channel, and which conform to the timings specified in section 6.2.1.3.

When the TSC sends a message in response to a random access message received from a radio unit, the response may be sent in the slot following the random access message or it may be delayed (see 7.2.4).

6.1.2 Traffic channel discipline for TSC

6.1.2.1 Monitoring

The TSC shall be prepared to receive messages which conform to the format specified in section 3 for radio unit transmissions on a traffic channel.

The TSC shall monitor all traffic channels continuously while they are allocated for traffic. If there is any reason to doubt whether communication is still taking place, the TSC may query whether an individual radio unit is on the traffic channel by means of an AHY message (see 9.1.2.2), and shall be prepared to receive an acknowledgement within the timings given in 6.2.2.2.

6.1.2.2 Signal timing

The format for standardised messages transmitted on a traffic channel by the TSC is defined in section 3. In particular, unless the TSC is already transmitting, each transmission shall be introduced by at least 6 bit periods (5 ms) of link establishment time. Note that the appropriate codeword synchronisation sequence (SYNT) shall be used.

When the TSC sends a response to an unsolicited message from a radio unit (e.g. a response to an Include request), the codeword synchronisation sequence in the response message shall not begin before the start of bit 52 nor later than the start of bit NT, measured from the end of the last codeword transmitted by the radio unit. (For the suggested value of NT, see Appendix 1).

6.1.3 Data channel discipline for TSC

6.1.3.1 Monitoring

The TSC shall be prepared to receive messages which conform to the format specified in section 3 for radio unit transmissions on the data channel.

6.1.3.2 Signal Timing

The format for messages transmitted at the standard rate on a data channel by the TSC is defined in section 3. In particular, unless the TSC is already transmitting, each transmission shall be introduced by at least six bit periods (5 ms) of LET. Note that the appropriate codeword synchronisation sequence, of SYNT, shall be used.

6.2 Channel Discipline for Radio Units

6.2.1 Control channel discipline for Radio Units

6.2.1.1 Control channel acquisition

When not assigned to a traffic channel (including immediately after switch-on), the radio unit shall attempt to find a control channel. The search for a control channel may be performed by a general hunt through all likely channels or by reference to memory within the radio unit; the search strategy is likely to be system-dependent and is not included in this standard. However, when a radio unit leaves an allocated traffic channel, it shall commence its search on the control channel on which it was last active, unless it has been directed to a different control channel by a CLEAR message.

The radio unit shall not make any transmissions on a control channel unless it is active on that channel. It shall not become active until it has received an appropriate codeword containing an appropriate system identity code; the codewords / system identity codes which shall be considered appropriate are system-dependent.

If a radio unit is hunting over a number of channels, it should leave a candidate channel as soon as it becomes clear that it is unlikely to become active on the channel. In some systems it may be necessary to specify a maximum time between channel changes for channels on which no control channel codeword synchronisation sequence is detected.

6.2.1.2 Retaining a control channel

If, while a radio unit is active on a control channel, a time TS elapses during which no system identity code is decoded, then the unit shall cease to be active on that channel and shall return to the control channel acquisition procedures. (For the suggested value of TS, see Appendix 1). Some systems may impose additional rules for returning to the control channel acquisition procedures.

If the radio unit receives an appropriate codeword containing an inapplicable system identity code (system-dependent), or receives a CHAN4 field that does not match the least significant four bits of the number of the channel to which the unit is tuned, then the unit shall not transmit or act on any other received information until either:

- it has received a correct value of system identity code or CHAN4, respectively, on that channel (whether or not a channel hunt has been made in the interim), or

- it has become active on a different control channel.

(Note that the codewords / system identity codes which cause a radio unit to temporarily suspend activity may be different from those which enabled the radio unit to become active).

The radio unit shall be capable of satisfactory operation when there are interruptions of duration less than TS in the signalling (slot timing may not be maintained across interruptions), and when CCSCs are displaced by data codewords in up to two consecutive timeslots.

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

6.2.1.3 Signal timing

The radio unit shall not transmit on the return control channel at any time unless permitted by the requirements of this standard. All transmissions shall conform to the formats specified in section 3 and the timing requirements specified below. (If, under any circumstances, the radio unit's timing is not sufficiently accurate then it shall refrain from transmitting.)

For the transmission of a random access message, the radio unit shall choose a timeslot for transmission in accordance with the requirements of the random access protocol defined in section 7. The radio unit shall derive the timing of slots from the frame marker message or from any other message transmitted by the TSC within the same frame.

For a radio unit response to a message received from the TSC, the radio unit shall commence transmission of its message in the timeslot following the end of the TSC message.

The start of slots on the return control channel shall be deemed to be coincident with the start of the control channel system codewords on the forward channel, and timings are specified in bit periods relative to this point in time. (Note, however, that slot delineation is maintained even when a CCSC is displaced by a data codeword; see 3.3.) Figure 6-1 illustrates the timing for a single codeword message; the start of each slot is designated time T0.

The radio unit shall not commence r.f. transmission before the start of bit 21 (time T2 in Figure 6-1), nor shall it reach 90% of its maximum power later than the start of bit 37 (time T4). The radio unit shall provide a link establishment time of at least 6 bit periods (5 ms). At the conclusion of the link establishment time it shall transmit a 16-bit preamble; the 16-bit preamble shall not begin before the start of bit 30 (time T3), nor later than the start of bit 43 (time T5). Following the preamble, the radio unit shall transmit the control channel codeword synchronisation sequence, an address codeword, any data codewords and one "hang-over" bit of either '0' or '1'. It shall then cease transmission so that power is reduced by at least 60 dB by the start of the next occurring bit 15 of a slot (time T1).

The radio unit shall then retune to the forward channel in time to be capable of decoding address codewords as follows:

- For a radio unit transmission with no data codewords, the radio unit shall be capable of decoding an address codeword in the first forward channel slot following the start of the radio unit transmission.

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

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

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

6.2.2 Traffic channel discipline for Radio Units

6.2.2.1 Monitoring

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

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

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

6.2.2.2 Signal timing

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

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

6.2.2.2.1 Radio unit response

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

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

6.2.2.2.2 Unsolicited transmission that requires a response

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

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

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

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

6.2.3 Data channel discipline for radio units

6.2.3.1 Monitoring

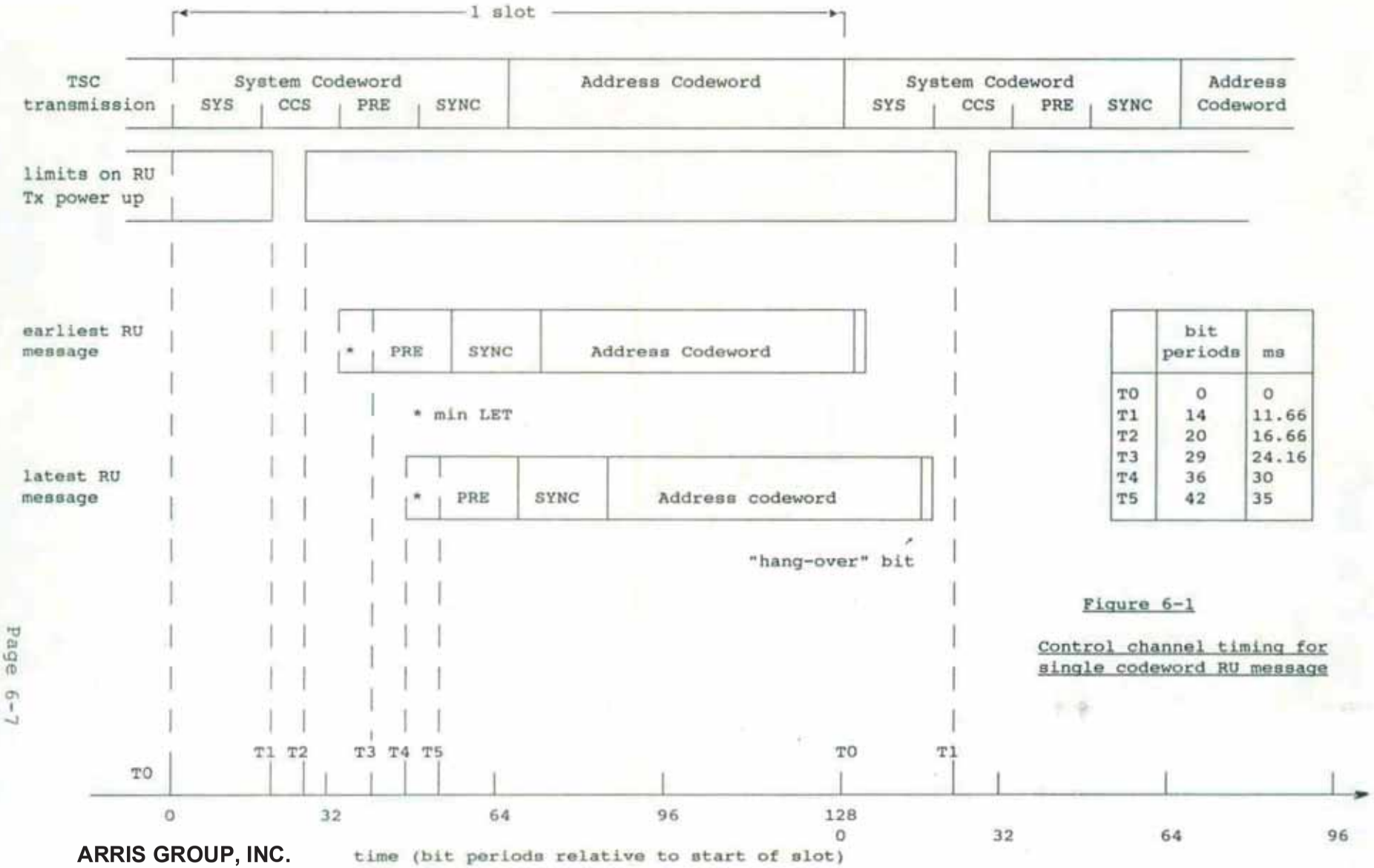
Whilst receiving on the forward channel, the radio unit shall monitor the channel to take appropriate actions for all relevant received messages.

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

6.2.3.2 Signal Timing

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

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



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

Figure 6-1

Control channel timing for single codeword RU message

7. RANDOM ACCESS PROTOCOL

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

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

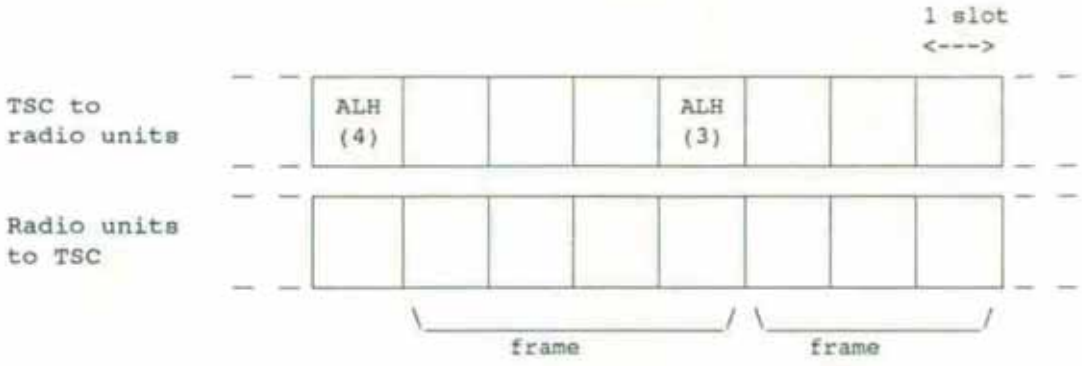
The slotting structure of the control channel and timing constraints for the transmission of messages are defined in sections 3 and 6.

7.1 The Principle

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

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

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



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

7.2 TSC Random Access Facilities

7.2.1 Marking random access frames

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

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

All other Aloha numbers mark the beginning of a frame.

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

7.2.2 Subdividing the radio unit population

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

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

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

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

- This process continues up to M = 19.

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

7.2.3 Inviting specific types of random access message

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

7.2.4 TSC responses

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

7.2.5 Withdrawing slots from frames

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

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

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

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

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

7.3 Radio Unit Random Access Protocol

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

7.3.1 Checking subsets of the radio unit population

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

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

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

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

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

7.3.2 Checking the Aloha function

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

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

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

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

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

7.3.3 Frames defined by Aloha numbers

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

Four-bit Aloha number:

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

Two-bit Aloha number:

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

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

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

7.3.4 First try option

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

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

and

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

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

7.3.5 Choosing a slot from a new frame

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

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

7.3.6 Check for withdrawn slot

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

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

b. The following address codewords:

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

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

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

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

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

7.3.7 Noting the response delay

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

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

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

7.3.8 Retry decision and time-outs

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

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

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

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

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

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

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

If the unit's access attempt fails, then:

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

ii) For access attempts for other messages:

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

7.4 Related Procedures for All Radio Units on a Control Channel

7.4.1 Individually addressed Aloha message

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

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

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

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

7.4.2 MOVE message

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

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

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

8. REGISTRATION PROCEDURES

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

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

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

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

8.1 Registration Facilities

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

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

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

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

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

   See also sections 7.2.2 and 7.3.1.

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

d. The TSC may reject individual registration requests.

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

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

8.2 Procedures for Registration by Random Access

8.2.1 TSC Procedures

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

8.2.1.1 Responses to a random access RQR message

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

8.2.1.2 Acknowledgements sent to indicate progress of registration

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

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

8.2.1.3 TSC time-out

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

8.2.2 Radio Unit Procedures for Registration by Random Access

8.2.2.1 Criteria for registration

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

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

8.2.2.2 Registration request and valid responses

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

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

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

8.2.2.3 Acknowledgement received

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

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

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

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

8.2.2.4 Time-out after waiting

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

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

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

8.3 Procedures for Registration on Demand

8.3.1 TSC Procedures for Demanding Registration

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

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

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

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

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

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

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

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

8.3.2 Radio Unit Procedures for Registration on Demand

8.3.2.1 Individually addressed ALHR message

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

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

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

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

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

8.3.2.2 Responses to RQR sent on demand

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

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

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

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

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

9. BASIC CALL PROCEDURES

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

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

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

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

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

a) call set-up

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

b) call maintenance and call clear-down.

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

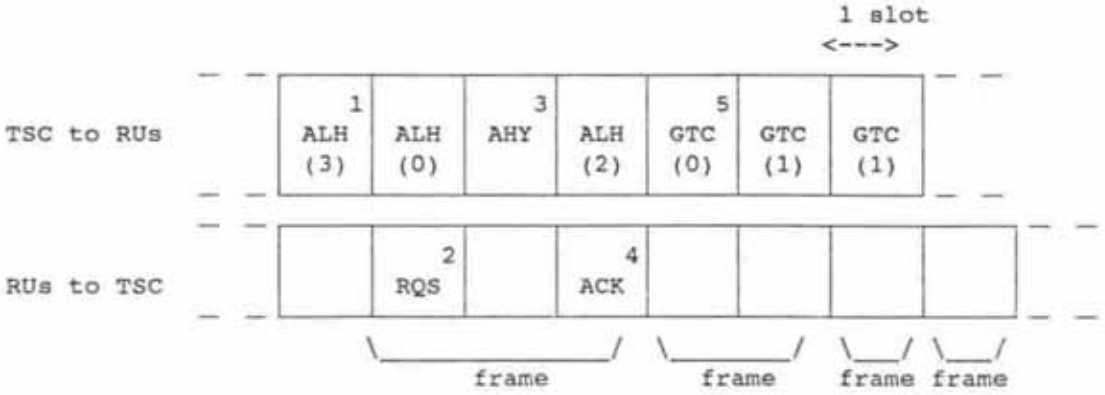
a) the "Called Party Answer" mechanism

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

Examples of typical message sequences to set up:

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

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



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

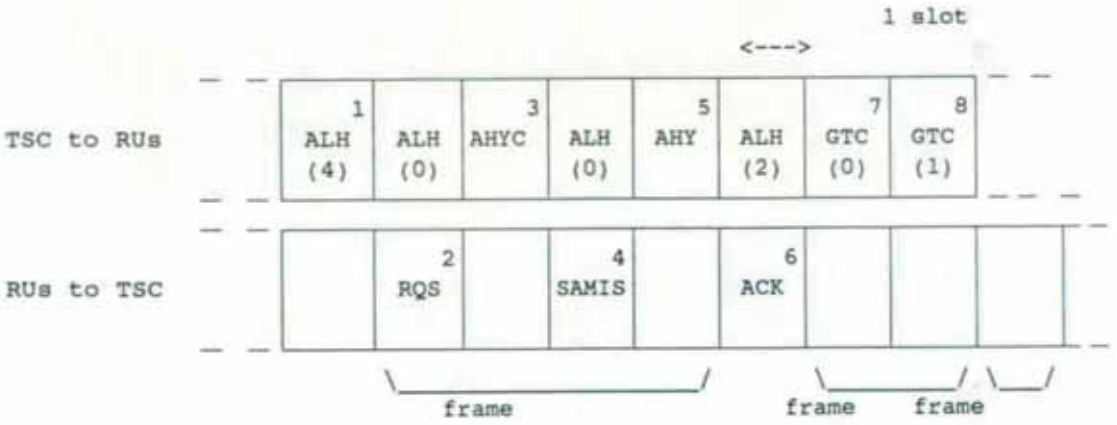
1. ALH : General Aloha invitation (three-slot frame).

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

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

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

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



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

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

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

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

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

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

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

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

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

9.1 Basic Call Procedures for TSC

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

9.1.1 Basic TSC Procedures for Setting Up Calls

9.1.1.1 Responses to a short addressing RQS message

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

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

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

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

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

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

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

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

9.1.1.2 Responses to an extended addressing RQS message

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

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

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

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

9.1.1.3 Instruction to send extended address information

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

9.1.1.5 Availability check on called radio unit

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

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

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

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

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

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

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

9.1.1.6 Availability check for calls to PABX extensions and PSTN destinations

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

9.1.1.7 Availability check on requesting radio unit

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

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

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

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

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

9.1.1.8 Call cancellation

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

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

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

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

9.1.1.9 Call amalgamation

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

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

9.1.1.10 Queue management and queue time-out

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

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

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

9.1.1.11 Resolving call conflicts

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

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

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

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

9.1.1.12 Traffic channel allocation

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

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

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

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

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

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

9.1.2.1 Call maintenance options

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

9.1.2.2 Availability check on a traffic channel

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

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

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

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

9.1.2.3 Disabling user transmission

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

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

9.1.2.4 Allocating replacement traffic channel

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

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

9.1.2.5 Clearing down unwanted radio units during a call

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

Note that:

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

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

9.1.2.6 Call clear-down

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

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

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

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

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

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

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

9.2 Basic Call Procedures for Radio Units

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

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

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

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

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

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

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

9.2.1 Procedures for Radio Units Making Simple Calls

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

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

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

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

9.2.1.1 Request for a Simple call

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

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

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

The unit shall attempt access until:

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

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

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

9.2.1.2 Valid responses to short addressing RQS

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

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

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

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

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

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

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

9.2.1.3 Valid responses to extended addressing RQS

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

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

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

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

9.2.1.4 Acknowledgement received

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

9.2.1.5 Availability check and channel allocation for own call

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

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

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

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

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