MPT 1343

Performance Specification

System Interface Specification for
radio units to be used with commercial
trunked networks operating in Band III
sub-bands 1 and 2

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FOREWORD

This specification contains the minimum performance requirements additional to MPT 1323 to be met by radio units used with commercial trunked networks operating in Band III, sub-bands 1 and 2. A companion specification, MPT 1347, contains the additional minimum performance requirements to be met by network fixed equipment. Together these common specifications are intended to allow a user to migrate from one trunked radio network to another without having to change radio equipment.

It should be noted that some aspects of the specification remain relatively unproven operationally. All reasonable efforts have been made to ensure accuracy, but it may prove necessary to amend some sections in the light of practical experience. An example is the way that the radio unit caters for time-shared and discontinuous control channels.

Intellectual Property Rights

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

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

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1. SCOPE

1.1 This specification covers the minimum performance requirements for radio units used with commercial trunked networks operating in Band III, sub-bands 1 and 2. It covers:

- signalling requirements based upon the standard MPT 1327.

  MPT 1343 is designed to be read in association with MPT 1327.

- radio frequency requirements, where they are additional to those in MPT 1323.

- user interface requirements, where advantages are to be gained from standardisation.

1.2 The specification includes two types of requirement:

- those that are mandatory in all radio units.

- those that are optional in a radio unit, but shall be implemented in a standard manner.

2. ASSOCIATED DOCUMENTS

MPT 1317 (1981)	Code of practice for the transmission of digital information over land mobile radio systems.
MPT 1318 (1986)	Engineering memorandum: Trunked systems in the land mobile service.
MPT 1323 (1987)	Angle modulated radio equipment for use at base and mobile stations in the private mobile radio service operating in the frequency band 174-225 MHz.
MPT 1327 (1988)	A signalling standard for trunked private land mobile radio systems.
MPT 1331 (1987)	Code of practice for radio site engineering.
MPT 1347 (1988)	Radio interface specification for commercial trunked networks operating in Band III sub-bands 1 and 2.
MPT 1352 (1991)	Test schedule for the approval of radio units to be used with commercial trunked networks operating in Band III sub-bands 1 and 2.
MAP27	Access Interface Standard for Trunked Radio Systems

3. GENERAL

3.1 Definitions

Section numbers appearing between !! !! delimiters in this specification refer to section numbers within MPT 1327.

Words appearing between asterisks in this section are defined terms.

Acquisition: The condition obtained by the successful completion of the *control channel acquisition procedure* for a control channel which allows a radio unit to transmit on that channel.

Acquisition Authorisation Data: *Network personalisation* data which enables the *radio unit* to determine by examination of the relevant sub-fields within a *system identity code* received on a *control channel* whether the *radio unit* is authorised to access on that *control channel*.

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 the 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 MPT 1327, 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*.

Available for Customisation: If the *trunking system controller* implements such a customised function, then if the *radio unit* implements the function it shall respond in the manner specified by the network operator of that *trunking system controller*. Such functions will not modify existing standardised functions. If the radio unit does not understand the customised function in the context of a *system* it is currently using, then it shall ingnore that function. The *radio unit* shall not infringe any of the requirements of section 5 of MPT 1327.

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 the *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 requests 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 *short addressing* procedures.

Confirmation: A procedure employed by the *radio unit* to facilitate the selection of an appropriate *control channel* to allow a *session* with a *system* to be initiated or continued. The *confirmation* process consists of applying prescribed tests to the signal content of the received *forward channel*.

Control Category: A designation given to the *radio unit* during *network personalisation* which governs that unit's right of access to *control channels* radiated by that *network*. A *radio unit* shall only access a *control channel* when the value of the LAB field in the *system identity code* indicates that the unit's *control category* is permitted to use that channel.

Control Channel: A *forward channel* and *return channel* being used for the transmission of *messages* conforming to MPT 1327 with the primary purpose of enabling the *trunking system controller* to control *radio units*.

Control Channel Acquisition Procedure: A procedure employed by the *radio unit* to select an appropriate *control channel* to allow a *session* with a *system* to be initiated or continued. The procedure consists of *hunting* for candidate *control channels* which are submitted to *confirmation* tests to determine if *acquisition* is permitted. *Hunting* continues until such time as a successful *acquisition* is confirmed.

Data Codeword: A 64-bit codeword, conforming to the requirements of MPT 1327, where the first bit is set to '0'. *Data codewords* are concatenated to an *address codeword* and supplement the information in the *address codeword*.

Decodable: A transmitted codeword shall be considered *decodable* if, after receipt, and after error correction (see Section 11.3.2.3) has been applied, a valid codeword from the (64,48) code defined in section 3.2.3 of MPT 1327 is formed.

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

Explicit Registration: A *registration* achieved by means of an RQR message.

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).

Fall-back Mode: A customised form of operation which may be used by a *network* suffering equipment malfunction.

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.

Fixed Radio Unit: A *radio unit* used with its antenna at a fixed location.

Forward Channel: A radio bearer where the direction of transmission is from the *trunking system controller* to the *radio units*.

Free Format Data: Data within a codeword which, in this specification, 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 the *system* (eg the PSTN). For the purpose of this specification 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.

Head Message: Single transmission of an MPT1327 HEAD *address codeword* and its appended *data codewords*.

Hunting: A procedure employed by the *radio unit* to facilitate the selection of an appropriate *control channel* to allow a *session* with a *system* to be initiated or continued. The *hunting* process consists of systematic sampling of the *forward channel* frequencies by the *radio unit* until it selects and *confirms* one of the *forward channels*, which together with its paired *return channel* is an appropriate *control channel*.

Hunting Sequence: A procedure employed by the *radio unit* during *hunting* which consists of one or more *hunting stages*. There are five described *hunting sequences*:

(a) "Resuming a control channel sequence"
(b) "Single channel hunt sequence"
(c) "Preferential hunt sequence"
(d) "Normal hunt sequence"
(e) "Comprehensive hunt sequence"

A *hunting sequence* is completed when all *hunting stages* appropriate to that *hunting sequence* have been completed or, prior to this, if a successful *control channel* *confirmation* is achieved.

Hunting Stage: A procedure employed by the *radio unit* during *hunting* which consists of sampling all channel numbers applicable to the type of *hunting sequence* in progress at a particular acquisition threshold level. A *hunting stage* is completed when all channel numbers applicable have been sampled and *confirmation* attempted on any candidate *control channels* located or may be completed prior to this if a successful *control channel* *confirmation* is achieved.

Ident: A 13-bit number used for identification purposes. Values of *ident* between 1 and 8100 inclusive are assigned to individual units or groups (see section 8.2), 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*, nor is the *ident* value 0 (DUMMYI).

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

Implicit Registration: A *registration* achieved by means other than an RQR message and associated Acknowledgement message from the *network*.

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* provided that at least one 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.

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 a *trunking system controller* via a medium other than that part of the radio spectrum to which this specification applies.

Mandatory: The *radio unit* shall implement the function or facility.

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 MPT 1327.

Network: Interconnected *systems*.

Network Personalisation: A procedure undertaken when a subscription to *network* is taken out by a user whereby that user's *radio units* are implanted with data to enable it to function correctly on that *network*. *Radio units* which are required to access more than one *network* shall be personalised for each *network* to be accessed.

Non-dedicated: A procedure which may be adopted by a *trunking system controller* whereby channels used by the *system* may be flexibly allocated as *control channels* or *traffic channels* depending on the traffic load on the *system*. When this procedure is employed, the current *control channel* would normally be allocated as a *traffic channel* when all other channels are in use for traffic and the *control channel* facility restored when possible, eg by allocating the next *traffic channel* to become free as a new *control channel*.

Non-prescribed data: Any data traffic which does not conform to the data protocols defined in MPT 1327.

Normal Operation Mode: The operation mode of a *radio unit* or *control channel* which is not in the *fall-back mode*.

Normal Registration Mode: A *control channel* mode in which the *network* will accept and maintain *registration* requests.

Normal Registration Record: A *registration* record which has an indication that the *network* is maintaining the *registration* record.

Null Registration Record: A *registration* record which includes a NULL indicator together with the AREA code.

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.

Personality: The totality of *network personalisation* data entered into the *radio unit*.

Portable radio unit: A portable radio unit is distinguished from any other radio unit by the following criteria:-

- the equipment covered is intended to be used only with an integral antenna, which may be detachable. When this equipment is used with a non-integral antenna it ceases to be defined as a portable radio unit for the purpose of this specification;

- the maximum effective radiated power shall not exceed 5 watts;
- the equipment shall be powered by a self contained battery unit.

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*.

Prime Registration Record: The most recently created *registration* record held by the *radio unit*. Note that the *prime registration record* does not include timing information.

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

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 specification 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.

Read-only Memory: A storage facility within the *radio unit* which contains *network personalisation* data. The contents of the *read-only memory* cannot be modified or added to by the action of the *radio unit* or its user. It is intended that the contents of

read-only memory are placed there only during *network personalisation* by a suitably authorised agent (normally a service provider).

Read/Write Memory: a storage facility within the *radio unit* the contents of which may be modified by the *radio unit*.

Ready for Communication Control (RFCC): A device or system to inform a unit of the user's readiness to communicate (see section 8.3).

Registration: A procedure which confirms that a *radio unit* is in 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 controller* 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 controller*.

Reserved: Codewords and *fields* which are designated as *reserved* in MPT 1327 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 MPT 1327.

Return Channel: A radio bearer where the direction of transmission is from *radio units* to the *trunking system controller*.

Segment: For a known *transaction*, the portion of the *T-message* contained in a *HEAD message*.

Selected Network: The *network* which the user of the *radio unit* has selected for the time being and which is the only *network* that the *radio unit* may attempt to access until such time as the user designates a new *selected network*. Where the *radio unit* does not allow the user to select from a choice of *networks* then only one *network* shall be available to that *radio unit* for access and this *network* shall be, per se, the *selected network*.

Session: A *session* is a period of operation associated with one *system*. A *session* on a *system* starts when a *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.

Single Segment Transaction (SST): Short data *transaction* requiring only one *segment*.

Spare: Codewords and *fields* which are designated *spare* are available for free use by *systems* (ie *system* customisation) provided that the conditions of MPT 1327 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 MPT 1327, others may be nominated by system operators. *Special idents* are not associated with a *prefix* to form an *address*.

Speech Call: A *call* as a result of the receipt of a GTC *message* with the 'D' *field* set to '0'. The audio is not muted.

Standard Data: The procedure by which information exchange takes place using the data protocol defined in section 17 of MPT 1327.

Standard Option: Any optional feature for which the implementation has been standardised in MPT 1327. Any unit implementing such an option shall implement it at least in the specified standardised manner. Units and *systems* shall not infringe any of the standardised formats in MPT 1327 when implementing customised features.

System: The totality of equipment required to provide the communication facilities at one location, associated with one or more *system identity codes*. *Systems* may be combined to form larger communications facilities.

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

T-message: totality of *free-format data* which is intended to be conveyed in a *short data* *transaction*.

Temporary Registration Mode: A *control channel* mode in which the *network* will accept but may not maintain *registration* requests. The *radio unit* may be required to re-register when the *normal registration mode* is resumed.

Temporary Registration Record: A *registration* record which has an indication that the *network* may not be maintaining the *registration* record.

Timed Registration Record: A *registration* record held by the *radio unit*, that has been displaced from the *prime registration record*. The record has a timer TD associated with it.

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

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 MPT 1327. The *trunking system controller* may control one or more *base stations*.

Undefined Registration Record: A *registration* record which has no indication that the *network* may or may not be maintaining the *registration* record.

Verified AREA code: The AREA subfield of the received *system identity code* (SYS) used to verify a *control channel*.

Verified SIL code: The SIL field of the *system identity code* (SYS) received and verified by a *radio unit* from the *control channel* on which that *radio unit* was most recently *active*.

3.2 Test Conditions

Unless otherwise specified, the *radio unit* shall meet the requirements of this specification under extreme test conditions, as defined in MPT 1323 section 2.4

3.3 General Requirements

The *radio unit* shall not operate duplex.

The facility to switch from one *network* to another is a *standard option*.

If implemented, it is *mandatory* that *network* switching shall be under control of the user. Autonomous switching between *networks* by the *radio unit* shall not be permitted.

It shall be possible to transfer, between *network(s)* in a *radio unit* by changing the *personality* (see section 6).

4. TRANSMITTER PARAMETERS

4.1 Frequency Parameters

This section contains the frequency parameters for radio units operating in Band III sub-bands 1 and 2.

All radio units shall operate on any of the channels in the frequency range to which they are directed by network messages and shall examine and if necessary,operate on that channel, in that range, in accordance with the procedures specified in Section 9. If directed by network messages to any channel outside this range, radio units shall not comply with the messages and shall remain on the channel from which the message was sent.

4.1.1 Channel Spacing and Designation for Sub-band 1

The channel spacing shall be 12.5 kHz. The channel designations shall be as follows:

Channel Number	Binary representation of channel number *	Radio Unit Transmit Frequency
1		184.5000 MHz
58	1000000001	185.2125 MHz
560	1111110111	191.4875 MHz

* Applicable to CHAN, CONT and CHAN4 fields

The radio unit equipment shall operate over channels 58 to 560 (185.2125 MHz to 191.4875 MHz) inclusively. Transmission outside this frequency range is not permitted.

4.1.2 Channel Spacings and Designation for Sub-band 2

The channel spacing shall be 12.5 kHz. The channel designations shall be as follows:

Channel Number	Binary representation of channel number *	Radio Unit Transmit Frequency
1		192.5000 MHz
58	0000000001	193.2125 MHz
560	0111110111	199.4875 MHz

* Applicable to CHAN, CONT and CHAN4 fields

The carrier frequency of a signal transmitted by a radio unit shall be within 1.5 kHz of the nominal transmit frequency.

This tolerance includes crystal ageing and shall be maintained under both normal and extreme temperature conditions, as defined in MPT 1323 sections 2.3.1 and 2.4.1, for a period of at least one year, without re-adjustment.

4.2 Modulation Characteristics

4.2.1 General

The peak permissible frequency deviation shall not exceed ±2.5 kHz.

4.2.2 Speech Modulation

Speech transmissions shall employ a phase modulation characteristic.

4.2.3 Data Modulation

4.2.3.1 Data Modulation Method

Standard data modulation shall be by subcarrier modulation employing phase continuous fast frequency shift keying (FFSK) to a frequency modulation characteristic. Speech shall be muted by at least 35 dB (measured at the transmitter output) during transmission of standard data. The parameters of the modulation shall be as follows:

Bit rate	1200 bit/s
Modulation rate	1200 baud
Binary '0'	1800Hz
Binary '1'	1200Hz
Amplitude difference	<1.5dB

During the transmission of call maintenance messages (pressel-on, periodic and pressel-off), speech shall be muted as follows:

(a) During all maintenance messages, speech shall be muted by at least 35dB from the start of the preamble to the end of the hang-over bit.

(b) For the periodic and pressel-off messages, the muting of speech shall not commence more than 20ms before the start of the preamble.

(c) For the periodic and pressel-on messages, the muting shall be removed no later than 10ms after the end of the hang-over bit.

The method for modulating non-standard data is not prescribed in this specification.

4.2.3.2 Data Peak Deviation

For standard data modulation.

Angle modulation:	Nominal	1.5 kHz ±250 Hz
	Extreme	1.5 kHz ±500 Hz

4.3 Performance Parameters

Radio units shall meet the requirements of MPT 1323.

5. RECEIVER PARAMETERS

The requirements of this section shall be met under normal test conditions, as defined in MPT 1323 section 2.3, unless otherwise specified.

5.1 Frequency Parameters

This section contains the frequency parameters for radio units operating in Band III sub-bands 1 and 2.

All radio units shall operate on any of the channels in the frequency range to which they are directed by network messages and shall examine and if necessary, operate on that channel, in that range, in accordance with the procedures specified in Section 9. If directed by network messages to any channel outside this range, radio units shall not comply with the messages and shall remain on the channel from which the message was sent.

5.1.1 Channel Spacing and Designations for Sub-band 1

The channel spacing shall be 12.5 kHz. The channel designations shall be as follows:

Channel Number	Binary representation of channel number *	Radio Unit Receive Frequency
1		176.5000 MHz
58	1000000001	177.2125 MHz
560	1111110111	183.4875 MHz

* Applicable to CHAN, CONT and CHAN4 fields

The radio equipment shall receive over channels 58 to 560 (177.2125 MHz to 183.4875 MHz) inclusively.

5.1.2 Channel spacing and designations for Sub-band 2

The channel spacing shall be 12.5 kHz. The channel designations shall be as follows:

	Binary representation of channel number*	Radio Unit Receive Frequency
1		200.5000 MHz
58	0000000001	201.2125 MHz
560	0111110111	207.4875 MHz

* Applicable to CHAN, CONT and CHAN4 fields

The radio equipment shall receive over channels 58 to 560 (201.2125 MHz to 207.4875 MHz) inclusively.

5.1.3 Frequency Tolerance

The centre frequency of the response of the radio receiver shall be within 1.5 kHz of the nominal receive frequency except during channel switching.

This tolerance includes crystal ageing and shall be maintained under both normal and extreme temperature conditions, as defined in MPT 1323 sections 2.3.1 and 2.4.1, for a period of at least one year, without re-adjustment.

5.1.4 Channel Switching

The radio equipment shall meet the channel switching time requirements of MPT 1327. (See MPT 1327 section 6).

5.2 Demodulation Characteristics

5.2.1 Speech Signals

The speech demodulator shall have a phase demodulation response characteristic. The permitted departure from the phase demodulation response amplitude characteristic over the audio frequency range 300 Hz to 2.55 kHz shall be ±3 dB, ie the total audio output power shall fit totally within the mask of figure 5.1. The radio unit shall be deemed to have passed this requirement if it meets the permitted departure either at the electrical connections to the loudspeaker (with a suitable resistive load if the loudspeaker is disconnected), or acoustically.

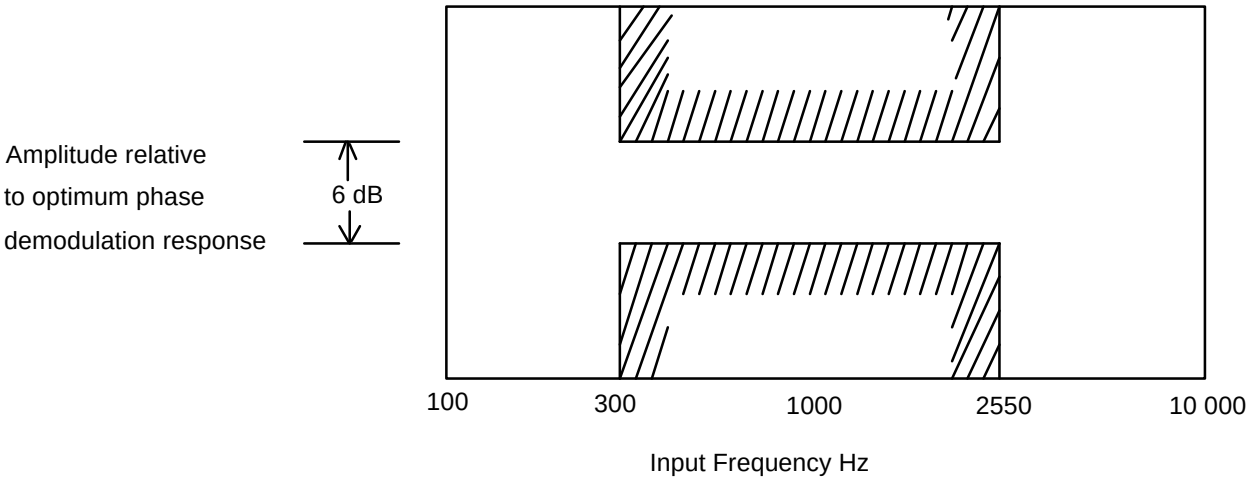


Figure 5.1

5.2.2 Data Signals

Received standard data signals have a fast frequency shift keying (FFSK) characteristic. Standard data modulation follows the requirements of MPT 1323, that is phase continuous 1200 baud FFSK, with 1800 Hz representing binary '0' and 1200 Hz representing binary '1'. Units shall meet the error performance requirements of Appendix A of this specification.

Note: The received peak deviation of standard data does not exceed ±2.0 kHz and is not less than ±1.0 kHz. For non-prescribed data, the peak frequency deviation does not exceed ±2.5 kHz.

5.3 Muting

The audio (other than confidence indications) normally heard by the user shall be muted when one of the following conditions is met:

(a) If the radio unit is not active on a traffic channel.

(b) If a call is set up as a result of the receipt of a GTC message (see MPT 1327 section 5.4) with the 'D' bit set to '1' (ie the call is a non-prescribed data call).

(c) If a call is set up as a result of the receipt of a GTT message (ie the call is a standard data call, see MPT 1327 section 5.7.3).

5.4 Performance Parameters

Radio units shall meet the requirements of MPT 1323.

6. STORAGE REQUIREMENTS

6.1 Introduction

This section tabulates data and parameters which radio units are required to store, either temporarily or long-term, in order to carry out functions defined in this specification.

The stored data and parameters may be gleaned by the radio unit from a number of sources:

- by network personalisation; examples of such data are the radio unit's individual address and operating parameters which define the required mode of operation;
- data implanted into the unit by the manufacturer; this method is specific to the radio unit security number (see section 7);
- data gleaned from operation on the selected network; examples of such data are the records of registrations following a registration attempt by the radio unit on an acquired control channel, or data obtained from BCAST messages received from the selected network.

This section is a compilation of the stipulations expressed in other areas of this specification or in MPT 1327 and reference to these should be made for a precise definition of storage requirements.

Radio units which provide the facility for the user to switch between selected networks shall maintain sufficient storage for the requirements herein to be met for each network, save that stored data which is not required to be preserved after a change of selected network may be accommodated in common storage areas which may be sufficient for only one network.

The requirement on radio units to store data depends upon the facility for which the data is required. For facilities which are mandatory in this specification, the storage of necessary data is also mandatory and all radio units shall provide storage for data identified as mandatory. For facilities which are optional but must be carried out in a prescribed manner, the storage of applicable data is mandatory only for radio units which employ the option. Storage of such data is regarded as a standard option. Some facilities are optional and are not fully prescribed. Radio units which employ such options, may choose to follow the procedure identified in this section for the storage of applicable data. Such storage is regarded as optional.

Where parameters relate to a requirement for the radio unit to measure elapsed time (the parameters T-), the radio unit shall be capable of implementing such measurements to a tolerance of ±10%.

6.2 Types of Memory

The storage requirements summarised in this section include a stipulation of the type of memory applicable to each item of data. In some cases variation is allowed, and this has been indicated. Four categories of memory are designated:

Type A - Read only memory which may be set by an external agency but not by the action of the radio unit. The medium of this storage must be such that the data may be reset by an external agency as required to accommodate changes in network subscription details (including changes in network allegiances).

Type B - Read/Write memory which shall be protected from the effects of switching off the radio unit for a period of at least 120 hours or disconnecting the external source of supply to the radio unit for a maximum period of 5 seconds. It is permissible for data to be held in unprotected memory whilst operational and transferred to protected memory on power down or equivalent. The radio unit shall discard any data held in protected memory unless its validity is reasonably assured.

Type C - Read/Write memory the contents of which may be discarded at some time between switching off the radio unit and being made ready for service after being switched on subsequently.

Type D - Read only memory, protected by the security measures specified in Section 7.

6.3 Summary of Storage Requirements

The radio unit storage requirements are summarised in Table 6.1. The columns of this table contains the following information:

Column 1 - a serial item number which has no relevance other than allowing ease of reference to items in the tabulation.

Column 2 - a brief description of the data required to be stored. For a more precise definition of the data, reference should be made to the area of the specification indicated in Column 8.

Column 3 - the storage category to be used. Type A, B, C or D.

Column 4 - the data item size in bits where this is specified. If not specified, the range of values to be accommodated and granulation, where appropriate, are given. FLAG indicates that one of two possible states must be recorded. Where a range of values and, where appropriate, a granulation are stated these shall be accommodated by the radio unit in its storage allocation. Where the size of the parameter is stated (eg 13 bits), this is provided for information only and not intended as a limitation on the form in which the radio unit stores the date.

Column 5 - the number of individual records which shall be accommodated. In some cases the number given is indicated as a maximum or minimum value.

Column 6 - the source of the data. NP indicates network personalisation data. Manufacturer indicates data implanted into the unit by the manufacturer. Operation indicates data gleaned from operation on the selected network.

Column 7 - whether the storage requirement is mandatory (M), a standard option (SO), optional (O), mandatory for units implementing the keypad scheme in section 8.2 (MK) or an option for units implementing the keypad scheme (OK).

Column 8 - comments for clarification.

Column 9 - the area in MPT 1343 or !!MPT 1327!! where the requirement is defined.

ITEM NO.	ITEM	STORAGE TYPE	ITEM SIZE/RANGE OF VALUES	NO. OF ENTRIES	SOURCE OF DATA	M/O SO	COMMENTS	REFERENCE
1	Own Prefix	A	7 bits	1	NP	M		!!4!!
2	Own Individual Ident	A	13 bits	1	NP	M		!!4!!
3	Own group address	A	20 bits	4 Min	NP	M	Incoming Group Calls Responded to	!!4!!
4	Individual Base Ident	A	13 bits	1	NP	MK		8.2.3
5	Group Base Ident	A	13 bits	1	NP	MK		8.2.3
6	Two or three digit individual calls appropriate to own fleet	A	Flag	1	NP	MK	Could be deduced from form of Highest Permitted Own Fleet Individual Ident (item 8), if stored in dialled digit form	8.2.1
7	Two or three digit group calls appropriate to own fleet	A	Flag	1	NP	MK	Could be deduced from form of Highest Permitted Own Fleet Group Ident (item 9), if stored in dialled digit form	8.2.1
8	Highest Permitted Own Fleet Individual Ident	A	13 bits	1	NP	MK	Could be stored as dialled number rather than IDENT	8.2.4
9	Highest Permitted Own Fleet Group Ident	A	13 bits	1	NP	MK	Could be stored as dialled number rather than IDENT	8.2.4
10	Single Digit Number Destination	A	Unspecified	10 Max	NP	OK	Destination applicable to Digit 0-9	8.2.4.1
11	Look-up table for 5-digit Inter-Fleet Calls	A	Unspecified	Unspecified	NP	OK		8.2.4.5
12	Inter-Fleet Group Calls Barred	A	Flag	1	NP	MK		8.2.4
13	*0# and *0nn# Immediate Access	A	13 bits	1 or 2	NP	OK	Prime Dispatcher Address	8.2.8.2.1

ITEM NO.	ITEM	STORAGE TYPE	ITEM SIZE/RANGE OF VALUES	NO. OF ENTRIES	SOURCE OF DATA	M/O SO	COMMENTS	REFERENCE
14	** Abbreviated Dialling Maximum Limit	A	8 bits	1	NP	OK		8.2.8.1.1
15	*9# Immediate Address	A	Undefined	1	NP	OK	Prime Emergency Number	8.2.8.2.5
16	Acquisition Authorisation Data	A	Max 9 bits plus Unspecified Classifier	8 Min	NP	M		9.3.4.2.3
17	Zone sub-field length (LZ)	A	Range 0-9 bits	1	NP	M		9.3.4.2.3
18	Area sub-field length (LA)	A	Range 0-9 bits	1	NP	M		9.3.4.2.3
19	Identity Code of Selected Network	A	NET-2 bits	1	NP	M	Need to differentiate 2 bit and 7 bit values	9.3.4.2.3
20	Radio Unit Control Category	A	4 possible Values	1	NP	M	LAB field choice	9.5.3
21	Normal Hunt Channel Numbers	A	10 bits + TS Flag	32	NP	M		9.2.1
22	Size of Normal Hunt	A	Range 1 to 32	1	NP	M	Could be achieved by Null Values of Channel Numbers	9.2.1
23	Lowest Channel No. in Network	A	10 bits	1	NP	M		9.2.1
24	Highest Channel No. in Network	A	10 bits	1	NP	M		9.2.1
25	Non-Applicable Channel Numbers	A	10 bits	Unspecified	NP	O	Channels which may be omitted in Comprehensive Hunt	9.3.3.5
26	Last Active Control Channel - Channel Number	C	10 bits	1	Operation	M		9.2.1
27	Last Active Control Channel - SYS Code used for Confirmation	C	12 bits	1	Operation	M		9.4.1

ITEM NO.	ITEM	STORAGE TYPE	ITEM SIZE/RANGE OF VALUES	NO. OF ENTRIES	SOURCE OF DATA	M/O SO	COMMENTS	REFERENCE
28	Add Channel Nos. to Normal Hunt	C	10 bits + TS Flag	Unspecified	Operation	SO	Compiled from BCAST SYSDEF = '00000'	9.2.2
29	Subtract Channel Nos. from Normal Hunt	C	10 bits	Unspecified	Operation	SO	Compiled from BCAST SYSDEF = '00001'	9.2.2
30	Adjacent Site Information	C	10 bits + Unspecified	15	Operation	O	Use of BCAST SYSDEF '00100' and '00101' Unspecified	9.2.2
31	Suppress Comprehensive Hunt	A	Flag	1	NP	M		9.3.3.5
32	Timed Registration Record - AREA Code	C	Range 0-9 bits plus NULL Flag	2	Operation	SO		10.3.1
33	Timed Registration Record - Channel Number	C	10 bits	2	Operation	SO		10.3.1
34	Timed Registration Record - Registration Indication	C	2 bits	2	Operation	SO		10.3.1
35	Prime Registration Record - AREA Code	B	Range 0-9 bits plus NULL Flag	1	Operation	M		10.2.1 and 10.3.1
36	Prime Registration Record - Channel Number	B	10 bits	1	Operation	SO		10.2.1 and 10.3.1
37	Prime Registration Record - Registration Indicator	B	2 bits	2	Operation	M		10.2.1 and 10.3.1
38	Denied Registration - AREA Code	C	Range 0-9 bits	8 Min	Operation	M	FIFO Store	10.2.1 and 10.3.1
39	REG - Temporary or Normal Registration Indicator	B	1 bit (plus "undefined" state indicator)	1	Operation	M	Received in BCAST SYSDEF '00011'	10.2.1 and 10.3.1
40	Value of INFO to be used in RQR	A	15 bits	1	NP	M	Default to all zeros	!!8.2.2.2!!

ITEM NO.	ITEM	STORAGE TYPE	ITEM SIZE/RANGE OF VALUES	NO. OF ENTRIES	SOURCE OF DATA	M/O SO	COMMENTS	REFERENCE
41	Channel Number for Fall-Back Service	A	10 bits	1	NP	SO	If set to zero disables fall-back	13.2
42	Value of NDD in SYS Code for Fall-Back Service	A	4 bits or 9 bits	1	NP	SO		13.2
43	Security Serial Number	D	38 bits	1	Manufacturer	M		7
44a	LM1 - Level margin	A	0-40 dB in steps of 6 dB	1	NP	SO	Tolerance ±6 dB	9.3.3.7.6
44b	LM2 - Level margin	A	0-40 dB in steps of 6 dB	1	NP	SO	Tolerance ±6 dB	9.3.3.7.6
44c	LM3 - Level margin	A	0-40 dB in steps of 6 dB	1	NP	SO	Tolerance ±6 dB	9.3.3.7.6
44d	LM4 - Level margin	A	0-40 dB in steps of 6 dB	1	NP	SO	Tolerance ±6 dB	9.3.3.7.6
45								
46								
47	NA - Number of Multiple Registrations	B	Range 1 to 3 in steps of 1	1	Operation	SO	Received in BCAST SYSDEF '00011'	10.3.1
48	NC1 - Size of Error Check Sample prior to confirmation	A	0-255 Codewords in steps of 1	2	NP	M	Different Values for Time-shared and continuous channels. Maximum value may be reduced on review.	9.3.4.3
49	NC2 - Size of Error Check Sample after confirmation	A	0-255 Codewords in steps of 1	2	NP	M	Different Value for Time-shared and continuous channels. Maximum value may be reduced on review.	9.3.4.3

ITEM NO.	ITEM	STORAGE TYPE	ITEM SIZE/RANGE OF VALUES	NO. OF ENTRIES	SOURCE OF DATA	M/O SO	COMMENTS	REFERENCE
50	NT - Maximum TSC response delay to unsolicited traffic channel message	A	103-1236 bit periods in steps of 103 bit periods	1	NP	SO		!!Appendix 1!!
51	NV - Number of consecutive CCSCs to select a value of SYS for verification	A	1-16 in steps of 1	2	NP	M	Different Value for Time-shared and continuous channels	9.3.4.2.1
52	NX1 - Error Codewords Limit prior to confirmation	A	0-255 Codewords in steps of 1	2	NP	M	Different Value for Time-shared and continuous channels. Maximum value may be reduced on review.	9.3.4.3
53	NX2 - Error Codewords Limit after confirmation	A	0-255 Codewords in steps of 1	2	NP	M	Different Value for Time-shared and continuous channels. Maximum value may be reduced on review.	9.3.4.3
54	NZ1 - Number of contiguous error check samples containing no error events	A	1-255 Samples	1	NP	M	Maximum value may be reduced on review	9.3.4.4
55	NZ2 - Number of contiguous error check samples each generating a codeword error event following an initial error event	A	1-255 Samples	1	NP	M	Maximum value may be reduced on review	9.4
56	NPON - Number of Pressel On messages on traffic channel	A	1-5	1	NP	SO		!!9.2.3.1!!
57	NPOFF - Number of Pressel Off messages on traffic channel	A	1-5	1	NP	SO		!!9.2.3.1!!
58	NS - Number of samples	A	1-10 in steps of 1	1	NP	SO		9.3.3.7.6
59	NDD preference data	A	Maximum 9 bits	4 min.	NP	SO		9.3.4.2.3

ITEM NO.	ITEM	STORAGE TYPE	ITEM SIZE/RANGE OF VALUES	NO. OF ENTRIES	SOURCE OF DATA	M/O SO	COMMENTS	REFERENCE
60	PREFERRED NDD sub-field length	A	Range 0-9 bits	4 min.	NP	SO		9.3.4.2.3
61	PREFERRED NDD priority indicator	A	1-10 in steps of 1	4 min.	NP	SO		9.3.4.2.3
62	TA - Timeout for called radio unit after receiving AHY	A	10-120 Sec. steps OR fixed at 60 Secs.	1	NP	M	Standard option that TA is variable by network personalisation	Appendix B !!Appendix 1!!
63	TH - Sampling activity duration	A	0-100 slots in 1 slot steps	1	NP	SO		9.3.3.7.3
64	TL - Sampling activity interval	A	0-3000 slots in 100 slot steps or 0-320 seconds in 10 second steps	1	NP	SO		9.3.3.7.1
65	SIL System Indicator Locator sub-field length	A	Range 3-9 bits in Steps of 1	1	NP	SO		9.3.4.2.2
66	TC - Random Access Timeout	A	0-120 Secs. in 10 Sec. Steps	1	NP	M		Appendix B !!Appendix 1!!
67	TD - Registration Record Timeout	A	0-70 Minutes in 5 Minute Steps	1	NP	SO		10.3.1
68	TGI - Individual Incoming Short Data Timer	A	1-15 Secs. in 1 Sec. Steps	1	NP	SO		14.4.2.1.3
69	TGG - Group Incoming Short Data Timer	A	1-30 Secs. in 1 Sec. Steps	1	NP	SO		14.4.2.2.2
70	TJ - Further Signalling Timeout	A	0-60 Secs. in 10 Sec. Steps	1	NP	M		Appendix B !!Appendix 1!!
71	TN - Traffic Channel Timeout	A	0-10 Secs. in 1 Sec. Steps	1	NP	M		Appendix B !!Appendix 1!!

ITEM NO.	ITEM	STORAGE TYPE	ITEM SIZE/RANGE OF VALUES	NO. OF ENTRIES	SOURCE OF DATA	M/O SO	COMMENTS	REFERENCE
72	TS - Delay before leaving a Control Channel	A	0-10 Secs. in 1 Sec. Steps	1	NP	M		Appendix B !!Appendix 1!!
73	TT - Maximum Item Duration	A	0-60 Secs. in 10 Sec. Steps	1	NP	M		Appendix B !!Appendix 1!!
74	TU - Data Call Duration Timer	A	30 Secs.-3 Minutes in 30 Sec. Steps	1	NP	SO		12.4
75	Suppress Data Call Duration Timer	A	Flag	1	NP	SO		12.4
76	TW - Timeout for Radio Unit waiting for Call	A	10-120 Secs. in 10 Sec. Steps OR fixed at 60 Secs.	1	NP	M	Standard option that TW is variable by network personalisation	Appendix B !!Appendix 1!!
77	WT - Wait Parameter in Operation	C	3 bits	1	Operation	M	Storage of latest advised WAIT Value	!!7.3.7!!
78	Latest Value of PER	C	1 bit	1	Operation	M	Received in BCAST SYSDEF '00010'	!!9.2.2.6!!
79	Latest Value of IVAL	C	5 bits	1	Operation	M	Received in BCAST SYSDEF '00010'	!!9.2.2.6!!
80	Latest Value of PON	C	1 bit	1	Operation	M	Received in BCAST SYSDEF '00010'	!!9.2.2.6!!
81	Latest Value of ID	C	1 bit	1	Operation	M	Received in BCAST SYSDEF '00010'	!!9.2.2.6!!
82	"Home" ZONE	A	Range 0-9 bits	1	NP	M		10.2.1 and 10.3.1
83	Disable FOASCU	A	Flag	1	NP	SO	Default State is Enabled	11.9.2.2.2

ITEM NO.	ITEM	STORAGE TYPE	ITEM SIZE/RANGE OF VALUES	NO. OF ENTRIES	SOURCE OF DATA	M/O SO	COMMENTS	REFERENCE
84	CLIM - Network personalisation data; maximum call duration for a non-emergency call.	A	10 seconds to 4 mins. 14 seconds, in 1 sec. steps, or 5 mins. to 13 mins. in 1 min. steps, or inhibited.	1	NP	O		11.9.2.3.6
85	CLIME - Network personalisation data; maximum call duration for an emergency call.	A	10 seconds to 4 mins. 14 seconds, in 1 sec. steps, or 5 mins. to 13 mins. in 1 min. steps, or inhibited.	1	NP	O		11.9.2.3.6
86	TSCLIM - Current traffic channel call duration.	C	8 bits	1	Operation	O	Received in BCAST SYSDEF '00010'	11.9.2.3.6
87	*2 Immediate Access	A	Undefined	1	NP	O	Prime Short Data Number	8.2.8.2.3.2
88	TM - Timeout for called radio unit after receiving AHY, IDENT2=SDMI or an MST segment	A	1-60 Sec. 1 second steps OR fixed at 60 Secs.	1	NP	O	Standard option that TM is variable by network personalisation	14.4.2.1.2.3
89	MST Flag	A	1 bit	1	NP	O	Determines whether unit uses original or revised MST procedures	14.4.2.1
90	MST call abandonment (E=1)	A	1 bit	1	NP	O	Causes radio unit to abandon an MST for a non--emergency AHY in mid-call.	14.4.2.1.2.b)
91	MST call abandonment (E=0)	A	1 bit	1	NP	O	Causes radio unit to abandon an MST for an emergency AHY in mid-call.	14.4.2.1.2.b)
92	TT timeout Disconnect Inhibit	A	Flag	1	NP	O		9.2.3.6 B
93	Dynamic Regroup Prefix/Ident	B	20 bits	16	Operation	O		Appendix AN6
94	Electronic Security Number Flag	A	Flag	1	Operation	SO	Allows ESN check before expecting ACK or ACKX to RQR	10.2.3

ITEM NO.	ITEM	STORAGE TYPE	ITEM SIZE/RANGE OF VALUES	NO. OF ENTRIES	SOURCE OF DATA	M/O SO	COMMENTS	REFERENCE

7. SECURITY

The radio unit shall meet the following requirements:

1. Each radio unit shall have a unique 38 bit security number (which may be stored encoded) which will be programmed only by the radio unit manufacturer. The radio unit manufacturer shall take reasonable steps to ensure that:

   (a) the method of programming the security number is known only to that manufacturer,

   (b) any modification to the security number other than by that manufacturer shall disable the radio unit.

2. The radio unit shall be designed such that removal of the device (or any of the devices) containing the security number is highly likely to cause irreparable damage to the radio unit and/or the device(s) (eg encasing a PROM containing the security number and the immediate surrounding area in epoxy resin).

3. Removal of any device containing the security number or part of the security number shall disable the radio unit.

4. The radio unit shall not contain the method by which the 8 check bits defined below are calculated.

5. The security number (excluding the check bits, see below) of the radio unit shall be marked visibly and permanently on a part of the radio unit which is inseparable without damage from the device containing the security number. It is preferable that this number is visible with a minimum of dismantling of the radio unit, eg by removing 2 screws or equivalent.

6. It is recommended that a check is made on the validity of the security number within the radio unit, using a different set of check bits to the 8 check bits defined below, and that the radio unit shall be disabled if the check bits differ.

7. The format of the security number is as follows:

Manufacturer's Code	Model	Serial number for this model	Check bits
8 bits	4 bits	18 bits	8 bits

Note: The security number need not be stored in this format in the radio unit.

8. When requested by the TSC (see section 11.15.2 and also section 15.2 of MPT 1327), the radio unit shall send the security number data to the TSC using the SAMIS message (see MPT 1327 sections 15 and 5.6.1.2.2). The parameter fields of the SAMIS message are constructed as follows:

PARAMETERS 1 (20 bits)			PARAMETERS 2 (18 bits)
Manufacturer's Code	Model	Check bits	Serial number for this model
8 bits	4 bits	8 bits	18 bits

Manufacturer's code: An 8 bit number (0 to 255), one or more of which is issued to each radio unit manufacturer by the Radiocommunications Agency(RA).

Model: A 4 bit number (0 to 15) which is unique to a radio unit type for a given manufacturer's code. The model number is allocated by the manufacturer as and when new radio unit models are to be type approved. In the event of a radio unit manufacturer producing more than 16 type approved models, the manufacturer may apply for an additional manufacturer's code.

Serial number (for this model): The serial number of the radio unit of a given model. This number is allocated by the manufacturer, and would normally run from 1 up towards 262143. Where this capacity is exceeded, the radio unit manufacturer may allocate an additional model number to radio units of the same type approval type.

Check bits: The algorithm for calculating the check bits is based on the data contained in the other fields above. The algorithm used in the UK is available from the Radiocommunications Agency to manufacturers and network operators. If the check bits are incorrect in a radio unit, a network may refuse access to that radio unit. The algorithm shall not be present in the radio unit.

9.The security number shall be marked on the radio unit in the following form:

xxx/yy/zzzzzz where xxx is the manufacturer's code,
yy is the model, and
zzzzzz is the serial number.

eg 019/09/000129

10. Information about the check bits shall not be visible.

11. Manufacturers codes and the security algorithm may be obtained by writing to the following address:

Mobile Technology Section
Radiocommunications Agency
South Quay Three
189 Marsh Wall
London E14 9SX

8. MAN-MACHINE INTERFACE

8.1 Confidence Indications

8.1.1 Introduction

The user is an important element in any communications network since his behaviour can contribute to the overall efficiency of network operation and the grade of service which can be offered to users. Experience with telecommunications systems has shown that the provision of appropriate indications to the user of any call or transaction using the network to which he is a party can help to regulate user behaviour in ways which benefit system efficiency. Indications of this type, often referred to as confidence indications, also benefit the user and should improve user satisfaction levels.

This section of the Specification seeks to promote an acceptable and appropriate regime of user confidence by ensuring that users will experience a similar set of confidence indications, especially the audible indications, no matter what manufacture of radio unit is used.

It is recognised that manufacturers of radio units will wish to exercise design independence in their products and, accordingly, the requirements of this section of the Specification have been kept reasonably flexible in that, though the cadences are defined for ease of recognition, the audible quality of the tones is not specified. Similarly the visual indications have not been specified and these may be, for example, steady or flashing illuminated legends, coloured lamps or legends displayed on alpha-numeric displays, thus giving a large freedom of choice. Manufacturers are recommended, in the case of equipment which is designed to be mounted in vehicles, to pay due regard to the requirements of the Highway Code and Road Safety considerations in general. In such equipment audible signals are often to be preferred to visual indications. Manufacturers should also bear in mind that, where visual indications are employed that may occur during speech calls, they should be easily visible to the user at all times during normal call operations.

The designer of each radio unit is free to design radio units to either accept or reject incoming signalling for a new call, while the mobile is waiting for its own call to be set up. However if the radio unit accepts signalling for the new incoming call, it shall suspend the confidence indications associated with its own call, replacing them with indications for the new call.

When the new call is complete the suspended confidence indications shall be resumed, providing that the call waiting timer for its own call has not expired.

8.1.2 Basic Requirements

Each individual confidence indication is described in the following terms:

- Concerned Party (either CALLING or CALLED)

- Conditions to Initiate

- Conditions to Cancel

- Provision Mandatory or a Standard Option

Figure 8.1 details each indication in summary form. A more detailed description of the indications is given in the following section.

Designers of radio units should note that the use of additional indications is not prohibited. However any such additional indications shall be implemented so as to be consistent with those detailed in this section.

The indications are not necessary if the call requires no human involvement, for example automatic data messages or covert emergency calls.

Note also that an indication need not be repeated if further messages which initiate the indication are received for the transaction.

8.1.3 Type of Confidence Indications

Mobiles shall provide the following confidence indications:

(a) Call Set Up in Progress (Calling Party)

(b) Call Set Up in Progress (Called Party)

(c) Number Unobtainable

(d) Call Fail

(e) Alert

(f) GTC sent on a control channel

(g) Transaction Confirmed

(h) Call Clear Indication

y provide the following indications, which are recommended:

(i) No Service

(j) Call Queued

(k) Called Party Ringing

(l) Manual Call Diversion

Mobiles may provide the following indications which are optional:

(m) GTC sent on a traffic channel

The indications shall be unambiguous with the following permitted exceptions. Indications (a) and (b) may use the same form of indication. Indications (f) and (m) may use the same form of indication.

Audible indications shall be of the form indicated in sections 8.1.3.1 to 8.1.3.11.

Cadence Timings shall be as defined with a tolerance of ± 20% with the tone ON to tone OFF ratio controlled to within ± 20%.

The two audible tones noted in each section shall be approximately:

"Hi" - maximum frequency 1000Hz
"Lo" - minimum frequency 300Hz

The "Hi" frequency shall be twice that of the "Lo" frequency ±100 Hz.

8.1.3.1. No Service

The provision of any No Service indication is optional.

8.1.3.2 Call Set Up in Progress (CSUIP)

8.1.3.2.1 CSUIP (Calling)

The provision of a CSUIP (Calling) indication is mandatory. the indication tells the user that his call request is being processed.

CSUIP (Calling) shall commence when the calling user has completed entering the address and call details into the unit, or on the first transmission of the request message (RQS, RQE, RQT, RQQ (not STATUS = 0 or 31 when sent with IDENT1 = TSCI)).

CSUIP (Calling) is cancelled upon receipt of any of the following messages for the call:

- ACKI (QUAL = '0'), if the unit is equipped to indicate Called Party Ringing.
- ACKX
- ACKV
- ACK (QUAL = '0')
- ACKB (QUAL = '0')
- ACKT (QUAL = '0')
- ACKQ, if the unit is equipped to indicate Call Queued
- GTC
- ACK (QUAL = '1') as a result of "User Call Set Up Abort" (sections 8.3.3.)
- Expiry of the timeouts TC, TW, TJ or TI
- AHYX

The audible "Lo Tone" indication shall be:

cadence 0.8s on 1.2s off.

The indication shall be cancelled as a result of "User Call Set Up Abort" (section 8.3.3.) if no call request message has yet been sent by the radio unit.

8.1.3.2.2 CSUIP (Called)

The provision of a CSUIP (Called) indication is mandatory.

The indication shall be audible.

The called unit shall indicate CSUIP (Called) to the user, when the user signals "Called Party Answer" (section 8.3.3.) to the unit following the receipt of AHY (CHECK='1') for an incoming call.

The indication shall be cancelled upon the receipt of any of the following messages:

- GTC
- AHYX for the call
- Expiry of TA
- ACK (QUAL = '1'), if attempting RQX for "Cancel Called Party Answer" (section 8.3.3.)
- ACK (QUAL = '0') for "on-hook" RQQ for "Cancel Called Party Answer" (section 8.3.3.)
- ACKX

The audible "Lo Tone" indication shall be:

cadence 0.8s on 1.2s off.

8.1.3.3. Call Queued

The provision of a Call Queued indication is optional.

A suitably equipped calling unit shall indicate Call Queued upon receipt of an ACKQ message as a result of a call request.

The indication shall be cancelled upon receipt of the following messages:

- ACKX
- ACKV
- ACK (QUAL = '0')
- ACKB (QUAL = '0')
- ACKT (QUAL = '1')
- ACKI (QUAL = '0') if the unit is equipped to indicate "Called Party Ringing"
- GTC
- Expiry of the timeouts TW, TJ or TI
- ACK (QUAL = '1') after attempts to cancel or abort call
- AHYX

The audible "Lo Tone" indication shall be:

cadence 0.8s on 1.2s off.

8.1.3.4. Called Party Ringing

The provision of a Called Party Ringing indication is optional.

A suitably equipped calling unit shall generate a Called Party ringing indication upon receipt of ACKI (QUAL = '0') from the network. The unit shall cancel this indication upon receipt of any of the following messages:

- GTC
- ACKV
- AHYX for the call
- Expiry of the timeouts TW or TI
- ACK (QUAL = '1') as a result of "Call Set Up Abort" (section 8.3.3.)
- ACKX

- ACKT (QUAL = '0')
- ACKB (QUAL = '0')

The audible "Lo Tone" indication shall be:

cadence 0.4s on 0.2s off, 0.4s on 2s off, i.e. 3s cycle repeating.

Where possible this tone shall represent a typical telephone "ring" tone.

8.1.3.5. Call Fail

The provision of a Call Fail indication is mandatory. It can be signalled to both the calling and the called party.

The audible indications are noted against each failure condition.

Message	Indication
ACKX (QUAL = '1')	System Busy
ACKV (QUAL = '0')	Unavailable
ACKV (QUAL = '1')	Called Party Busy
AHYX	Unavailable
ACKT	Unavailable, if the unit is not equipped for call diversion.

The unit shall also give an audible "Unavailable" indication:

- If, when the user initiates a call, the radio unit is not receiving on an acquired channel, and has remained without an acquired control channel for a preceding continuous time TC.

- If, when the user indicates a call, the radio unit is not receiving on an acquired control channel and the time since the unit last commenced the control channel acquisition procedures is less than TC, then the unit shall indicate "unavailable"

if it has still not acquired a control channel at a time TC after it last commenced the control channel acquisition procedures.

- Expiry of the timeouts TA, TI, TJ or TW.

- Expiry of the timeout TC.

The audible tones shall be:

System Busy :	optional, if not implemented to be replaced by "Called Party Busy". Audible "Lo Tone"; cadence 0.4s on, 0.35s off, 0.225s on, 0.525s off, (ie 1.5 second cycle) - for 4 cycles.
Unavailable:	Audible "Lo Tone"; cadence 1.5 sec duration.
Called Party Busy:	Audible "Lo Tone"; cadence 0.375s on 0.375s off for 6 cycles.

The indications shall be truncated by operation of the user "Cancel Indication" (section 8.3.3).

8.1.3.6 Number Unobtainable (NU)

The provision of a NU indication is mandatory.

The calling unit shall signal NU to the user upon receipt of ACKX (QUAL = '0') in response to a call request.

The calling unit shall also signal NU to the user when it rejects a dialled number string which it does not recognise or cannot action.

The audible "Lo Tone" shall be a continuous tone of 5 seconds duration unless truncated by operation of the user "Cancel Indication" (section 8.3.3).

8.1.3.7 Call Diversion

The provision of a call diversion indication is optional. Its purpose is to invite the calling user to initiate a new call to a different address. The form of the indication may include the new number which the calling users is invited to dial, or alternatively this number may be stored in the mobile without being displayed to the user.

The Call Diversion indication shall be initiated by the receipt of ACKT (QUAL = '0').

The audible tone indication shall be "Hi-Lo-Hi": cadence 0.1s on, 0.4s off, 0.1s on, 0.4s off, 0.1s on, 0.4s off.

8.1.3.8 Call Clear Indication

The provision of a call clear indication is mandatory. Call clear shall be indicated whenever the radio unit leaves a traffic channel, except when moving to a different traffic channel as directed by a GTC message received on a traffic channel, or when moving to a different channel after the radio unit has received a "Call End Request" (section 8.3.3).

Audible "Hi-Lo", cadence 0.3s of each tone.

8.1.3.9 Alert

The provision of an Alert indication is mandatory.

The indication shall be audible.

Units shall indicate Alert indication if they receive AHY (POINT = 'O', CHECK='1') with IDENT2=Ident (1 to 8100), INCI, IPFIXI, PSTNGI, or PABXI and if they respond by transmitting ACKI (QUAL = '0').

The Alert Indication shall be cancelled by user "Called Party Answer", (section 8.3.3) or by the expiry of the Called Party Alert State timeout TA, or by receipt of an appropriate AHYX message.

Where the received AHY message has a zero value of the E bit, the audible "Hi Tone" shall be cadence:

0.4s on, 0.2s off, 0.4s on, 2s off, ie. 3s cycle repeating.

Where possible this tone shall represent a typical telephone "alert" tone.

8.1.3.10 Transaction Confirmed

The provision of a Transaction Confirmed indication is mandatory.

Transaction Confirmed is used primarily in non-speech calls:

- RQC
- RQT
- RQQ (not STATUS=0 or 31 when sent with IDENT1 = TSCI)
- Include

The radio unit shall initiate the Transaction Confirmed Indication if ACK (QUAL = '0') is received as a result of any of these request messages. The unit shall also initiate the Transaction Confirmed indication if ACKB (QUAL = '0') is received as a result of an RQS message.

The audible tone indication shall be "Lo-Hi": cadence 0.3s each tone.

8.1.3.11 GTC on Control Channel "Blip" Indication

The provision of a control channel GTC indication is mandatory.

The indication shall be at least audible.

Called radio units shall commence the GTC indication upon receipt of GTC. However if the radio unit has responded to the incoming AHY for that call with ACKI (QUAL = '0') (ie. AHY was CHECK = '1') then the radio unit may optionally omit the GTC indication upon receipt of the GTC.

Calling radio units shall commence the GTC indication upon receipt of GTC. However if the radio unit has previously received ACKI(QUAL ='0') for the call, then the calling radio may optionally omit the GTC indication upon receipt of the GTC.

The GTC indication shall be implemented as a transitory indication, and its duration shall in all circumstances be less than 500 ms.

Where the incoming message for the call had a zero value of the E bit, The audible "Hi Tone" indication shall be 2 short "blips". Where the incoming AHY message for the call had the E bit set to '1', the radio unit may generate any appropriate audible tone for the GTC indication.

8.1.4 Note on use of Tone Sets

The radio unit may employ an optional tone set which differs from this specified tone set, if required for specific user needs. If such a tone set is implemented it shall be as an additional, alternative set to the one specified in this section, and its use shall be agreed by the network operator.

This section covers the provision of dialling facilities to users of radio units. It addresses both the entry and display of call number information. It assumes the provision of a 12 button numerical keypad, although radio units may employ other means of entering numerical information. Throughout this section the terms "mandatory" and "optional" have the following meanings:

Mandatory - Units which are equipped with a means of manually entering numbers for the purposes of calling other parties on the subscriber's network or other services shall implement the specified function.

Optional - Units which are to provide the facility described in the option shall at least implement the option in the manner described.

This convention applies to all radio units operating on Band III, sub-bands 1 and 2 commercial systems. Units which are not equipped with numerical keypads or displays but use functionally specific control buttons need not implement algorithms for the numbering scheme within the unit. However such units shall be identified by numbers which accord with the principles of the call number convention to enable calls to be directed to them from units which are fitted with dialling facilities.

Units which are equipped with a means of manually entering numbers for the purposes of calling parties on the subscriber's network or other services may, optionally and as an alternative, employ a numbering scheme which is not consistent with the requirements of this section provided that the alternative scheme shall only be enabled when selected by network personalisation. Failing such selection, the radio unit shall default to the use of the scheme described in this section, supporting at least the mandatory requirements.

The buttons on the keypad may be arranged in the standard C.C.I.T.T. recommended layout, thus:

1	2	3
4	5	6
7	8	9
*	0	#

Figure 8.2 Keyboard Layout

Any other keyboard layout may be used if found more convenient.

Units which do not employ all 10 numeric keys need not implement the call number convention in the manner described.

All dialled strings, as written in this section, are read from left to right and are dialled in the sequence in which they are read. Throughout this section all representations of dialled strings are underlined. Where MPT 1327 addresses are referred to they are expressed in the decimal form of PFIX/IDENT thus: 34/3456.

The primary use for the keypad is to enable the user to originate speech calls from the radio unit. Calls may be made to other units operating on the network, to extensions on user associated private automatic branch exchanges (PABX) and to subscribers on the public switched telephone network (PSTN). Other services may be added as required.

Codes which commence with an asterisk (*) or a number sign (#) provide secondary uses for the keypad. Functions such as the modification of call requests to originate status messages, and the implementation of other MPT 1327 facilities (data, diversion, etc), are controlled in this manner.

Control of the radio unit's internal functions which affect MPT 1327 related activities also employ similar codes.

Any facility requested by means covered in this section which is not a mandatory requirement of Section 11 need not be incorporated into such a unit. For units which have a numerical keypad any facility which is incorporated into the unit shall be implemented in the manner described in this section. As an option it may be possible to bar access to any call type other than in-fleet calls.

Other uses of the keypad are not prohibited as long as no conflict occurs with the specified use. All dialled strings which the unit does not recognise shall result in the unit rejecting the dialled string and signalling the rejection with a number unobtainable indication (see section 8.1).

8.2.1 Network Numbering Structure

Each unit is allocated an individual network number (unique within the network to which the user subscribes) which bears a fixed relationship with an MPT 1327 address. The network number is in three parts: a number prefix, a fleet number and a unit number. Groups of units are allocated a network group number in a similar manner. A unit may be allocated to more than one group and thus may respond to more than one group number.

A 20 bit MPT 1327 address is divided into a prefix and an identity. The prefix is the first 7 bits of the 20 bit address. The identity is the remaining 13 bits. Fleet organisation shall ensure that most calls between users are made between those who share the same prefix. The identity range is divided into blocks which are allocated to fleets by the network operator. Each fleet user shall be allocated an adequate number of identities to allow for reasonable expansion requirements.

The objective of the scheme is to enable a short dialled string to be used for the more regularly used numbers instead of the long dialled string that the direct decimal representation of the binary prefix and identity would entail. Once this primary objective has been attained the secondary objective of permitting access to other speech and data services completes the scheme. The scheme is expandable to allow the introduction of additional services in the future.

In-fleet individual calls are implemented by allocating a starting number (20 or 200 depending on fleet size) to the lowest identity which is allocated to the fleet. The lowest identity (base ID) used by the fleet for individual calls shall be retained within each radio unit as part of the unit's fleet personality. All units in the fleet are allocated numbers which increment in step with their allocated identities.

In-fleet group calls are similarly implemented by allocating a starting number (in this case 90 or 900 depending on fleet size) to the lowest fleet identity. The lowest identity (base ID) used by the fleet for group calls shall be retained within each radio unit as part of the unit's fleet personality.

In-fleet numbering schemes are thus related to allocated identities by means of an algorithm.

PABX calls also employ an offset to ensure that maximum use is made of the MPT 1327 addressing range of 0 to 8191 when sending extension numbers. As the lowest value of extension number in a four digit numbering scheme will not be less than 1000, all dialled strings are reduced in value by 1000 before transmission. This ensures that numbers up to 8999 may be transmitted in a single codeword call.

Calls require the use of the extended addressing facility when PABX extension numbers, or routing codes plus extension numbers, have five or more digits. If 7, 8 or 0 are used as leading digits within the PABX network then the same network dialling strings may be employed with the radio unit. If other leading digits are used within the PABX network then the most reasonable choice of leading digit from 7, 8 or 0 may be used for PABX access, with appropriate action being taken at the radio network/PABX interface point to ensure that the correct string is offered to the PABX to ensure proper call routing.

PSTN calls are made either by using abbreviated addressing with TSC translation or by entering the full national number. The leading zero of the called number is redundant and is not transmitted to the TSC. This allows all national numbers to be contained within one SAMIS.

8.2.2 Philosophy

8.2.2.1 Relationship with Address

The numerical digits which are dialled by the user are translated into an MPT 1327 specified address. This is transmitted in an address codeword with, if necessary, additional date codewords.

Use is made of MPT 1327 flags and addresses to send relevant signalling information between the radio unit and the TSC as part of the call set-up procedure. Dialled string length is an integral part of the scheme. The length of the dialled string and the leading digit indicate the service which the calling party requires and are both used to set the relevant flags and addresses in the address codeword.

8.2.2.2 Partitioning of Identities

The scheme partitions the identity range used by TSCs into separate blocks, each block being associated with a fleet of users. The numbering scheme for each fleet starts at the partition and uses an algorithm to generate the called identity from the dialled string and the fleet base ident. The fleet base ident has a fixed relationship with the Fleet Individual Number (FIN) or the Fleet Group Number (FGN) respectively. The unit shall have a record of the size of the allocated blocks to ensure that in-fleet calls are not accidentally made outside the block to a unit in some other fleet.

	IDENTS	FIN	Individual Number	Fleet Size
	2269		89	
	.		.	
	.		.	
	2201		21	70
(Base ID)	2200	3100	20	
	2199		395	
	.		.	
	.		.	
	2007		203	
	2006		202	
	2005		201	196
(Base ID)	2004	3002	200	
	2003		41	
	.		.	
	.		.	22
(Base ID)	1982	2291	20	

Figure 8.3 Relationship of Unit Numbers to IDENTS showing blocks of numbers

	IDENTS	FGN	Group Number	Fleet Size
	7099		995	
	.			
	.			
	7006		902	
	7005		901	96
(Base ID)	7004	5502	900	
	7003		97	
	.		.	
	.		.	8
(Base ID)	6996	5498	90	

Figure 8.4 Relationship of Group Numbers to IDENTS showing blocks of numbers

8.2.2.3 Method of Dialling

Pre-origination dialling is used in the radio units. The user indicates completion of entries by the use of the # key. When it is necessary to modify the function of the call set-up, though not the destination, call modifiers may be dialled before the called party number. Modifiers are separated from the called number by use of the * key. See section 8.2.8.

8.2.2.4 User Familiarity

To make the scheme familiar to the user, the numbering scheme attempts to follow normal UK telephony practice in the allocation of numbers. Thus:

- PSTN access commences with 0 and used dialled strings of 8 or more digits; the called subscriber's full national number is dialled,
- network operator services start with a leading 1 and are three digits in length,
- PABX operators may be obtained with a single 0
- Local PABX numbering schemes, four digits, with the leading digit in the range 1 to 8,
- PABX network numbering schemes, dialled strings to 5 to 7 digits, with leading digits 0, 7 and 8,
- PABX network numbering schemes, dialled strings of 8 and 9 digits, with leading digits 7 and 8.

To accommodate the above, dialled strings for calls to radio units have the following constraints:

- the number prefix leading digit is 2 or 3 (dialled strings of 9 and 10 digits),
- the fleet number leading digit is in the range 2 to 6 (dialled strings of 6 and 7 digits),
- the unit number leading digit is in the range 2 to 8 (dialled strings of 2 and 3 digits).

8.2.2.5 Types of Access

The numbering scheme accommodates at least:

- Members of the same fleet
- Members of other fleets with a different prefix
- Access to nominated PSTN subscribers
- Network operator services
- Members of other fleets
- PABX extensions associated with the user's fleet
- Full access to PSTN subscribers
- Data services (to be defined)

8.2.2.6 Use of Display

If the radio unit is fitted with a display and numbers are to be shown then they must be shown in the form in which the user would dial the number when making a call.

8.2.2.6.1 Display of Called Party

Called party numbers shall be entered on the display as the user keys in the called number. If * and # cannot be displayed, either an alternative non-numeric symbol may be displayed (eg -) or the display may be cleared by the input of the non-numeric character.

8.2.2.6.2 Display of Calling Party

Calling party numbers that can be displayed are those from units in the same fleet as the displaying unit and other fleets for which the unit retains appropriate data. Calls where the calling party number cannot be thus shown may have a suitable indicator to show the general type of call which has been received, eg external fleet (common or inter prefix), PABX, PSTN, etc.

8.2.2.6.3 Display of Diversion Number

Numbers that are displayed on receipt of ACKT (diversion numbers) (!!9.2.1.4!!) shall be decoded from the incoming IDENT1 using the methods in 8.2.2.6.2 above. When the ACKT has appended data codewords, the gateway address in the ACKT and the style of the codewords determine the action taken. (!!5.5.2.1!!) Calls where the diversion number can be displayed are those from units in the same fleet as the displaying unit and other fleets for which the unit retains a data base. PABX and PSTN numbers are displayed using the data in the appended data codewords.

PSTN numbers will be received without the leading '0' which shall be added and displayed by the unit. If the diversion address cannot be translated into a displayable number the unit may retain the address and show a general indication of the state of the call, or it may terminate the call action.

8.2.2.7 Technician Access

A facility may be provided to allow technicians to dial full radio unit addresses for test purposes by using the decimal representation of the MPT 1327 address (see 8.2.4.8). It is recommended that the facility is protected to avoid unauthorised access.

8.2.3 Terms, Relationships and Storage Requirements

8.2.3.1 Terms and Relationships

Identity prefix (PFIX): Defined in MPT 1327 (!!2!!)

Base Ident (BI):	Any ident having an even value (lease significant bit = 0) between 0 and 8100 which is the lowest value in the block of identities assigned to the fleet of units. Range is 2 to 8100. 0 is DUMMYI and cannot be used.
Individual Base Ident (IBI):	The Base Ident assigned to the block of identities used Ident for individual calls.

Group Base Ident (GBI): The Base Ident assigned to the block of identities used for group calls.

Number Prefix (NP): NP = PFIX + 200. Range is 200 to 327.

Fleet Number (FN): FN = BI/2 + 2000, where BI is the lowest ident in the block allocated to the fleet. Range is 2001 to 6050. The network operator may restrict the range for his own purposes.

Fleet Individual Number (FIN): An FN which identifies a block of Unit Numbers.

Unit Number (UN): The Unit Number consists of either two or three digits depending on the fleet size and is unique to one unit in any single fleet.

2 digit: UN = Unit individual identity - IBI + 20
Numbering range: 20 to 89 (fleet size up to and including 70).

3 digit: UN = Unit individual identity - IBI + 200
Numbering range: 200 to 899 (fleet size up to and including 700).

Fleet Group Number (FGN): An FN which identifies a block of Group Numbers.

Group Number (GN): The Group Number consists of either two or three digits depending on the fleet size and is allocated to units which have common interests.

2 digit: GN = Group identity - GBI + 90
Numbering range: 90 to 99

3 digit: GN = Group identity - GBI + 900
Numbering range: 900 to 998 (999 reserved for emergency service).

Block Size: The size of the block allocation to a fleet of users for each form of Base Ident used by the members of the fleet. The unit shall store either block size or the maximum value of dialled number in some form to avoid placing calls outside the block.

Numbers shall be written in the form:

	NP	FIN	UN	for individual numbers
e.g.	245 201	3456 3578	23 467	

	NP	FGN	GN	for group numbers

e.g.

245 201	5456 5578	93 967

Numbers are dialled commencing at the most significant block of numbers which differs from the unit's own number.

8.2.3.2 Storage Requirements

8.2.3.2.1 Mandatory Storage Requirements

In order to follow the procedures specified in this section, the radio unit shall provide the following storage requirements (in read-only memory) which are appropriate to the selected network if the unit is equipped with a means of accepting called party numbers from the user:

i. The individual base identity for the fleet of which the unit is a member (own fleet).

ii. The group base identity for the unit's own fleet.

iii. A flag to indicate the choice of own fleet individual number string length, ie 2 or 3 digit strings.

iv. A flag to indicate the choice of own fleet group number string length, ie 2 or 3 digit strings.

v. The highest permitted own fleet individual identity or dialled number.

vi. The highest permitted own fleet group identity or dialled number.

vii. A flag to bar inter-fleet group calls.

8.2.3.2.2 Optional Storage Requirements in read-only memory

i. Ten actual called party identities or numbers for translation. Each is associated with an entry of one of the single digit dialled strings.

ii. A multiplicity of i) to vi) in 8.2.3.2.1 above per fleet, each stored against the two or three leading digits of the five digit calls to units in other fleets.

iii. An address or number to complete call details for the *0# string.

iv. An address or number to complete call details for the *0nn# string.

v. An address or number to complete call details for the *9# string.

8.2.4 Radio Unit and Line Unit Numbering

8.2.4.1 Single Digit Dialled Strings (Optional)

The translation between single digit dialled strings and corresponding identities is not specified. It is recommended that 0 be used either for calls to a despatcher or to a PABX operator (see 8.2.5).

8.2.4.2 Two Digit Dialled Strings (Mandatory)

Two digit dialled strings in the range 20 to 89 inclusive shall be used to call units within the same fleet. The unit shall refer to its individual base ident (IBI) and shall generate the called party identity by the following algorithm from the dialled Unit Number (UN):

Called individual ident = IBI + UN - 20

Two digit dialled strings in the range 90 to 99 inclusive shall be used to call groups of units within the same fleet. The unit shall refer to its group base ident (GBI) and shall generate the called group identity by the following algorithm from the dialled Group Number (GN):

Called group ident = GBI + GN - 90

Two digit group numbers and three digit unit numbers may be used within the same fleet.

The unit shall verify that the dialled UN or GN is not greater than the highest value assigned during network personalisation.

Note: Numbers 00 to 02, 07 to 09 and 10 to 19 are not specified. For use of 03 to 06, see section 8.2.5.

8.2.4.3 Three Digit Dialled Strings (Mandatory)

Three digit dialled strings in the range 200 to 899 inclusive shall be used to call units within the same fleet. The unit shall refer to its individual base ident (IBI) and shall generate the called party identity by the following algorithm from the dialled Unit Number (UN):

Called individual ident = IBI + UN - 200

Three digit dialled strings in the range 900 to 998 inclusive shall be used to call groups of units within the same fleet. The unit shall refer to its group base ident (GBI) and shall generate the called group identity by the following algorithm from the dialled Group Number (GN):

Called group ident = GBI + GN - 900

Three digit group numbers and two digit unit numbers may be used within the same fleet.

The unit shall verify that the dialled UN or GN is not greater than the highest value assigned during network personalisation.

Note: Numbers 000 to 099 are not specified. Certain numbers in the range 100 to 199 and also 999 are used for calls to assistance operators (optional - see section 8.2.7).

8.2.4.4 Four Digit Dialled Strings (Optional)

Four digit dialled strings in the range 1000 to 8999 are used for PABX access, see 8.2.5. Other four digit dialled strings are not specified.

8.2.4.5 Five Digit Dialled Strings. Leading Digit 2 or 9 (Optional)

Five digit dialled strings with leading 2 or 9 may be used to make inter-fleet calls to individual units or groups of units. If both types of call are to be made then the convention of using 2 for individual calls and 9 for group calls shall be adopted wherever possible. Dialled string manipulation depends upon the length of the called party unit number. The first part of the dialled string forms a "routing code" which identifies the fleet of which the called unit is a member. If the called unit number is 2 digits in length then the code is 3 digits in length. If the called unit number is 3 digits in length then the code is 2 digits in length. The unit shall contain a look-up table (translation field) in which the "routing code" is converted to the FN (or its equivalent address) which is appropriate to the called unit. The table shall also contain data on the partition point between the "routing code" and the unit number and whether the call is to a group address. This latter data shall be used before accepting a command to set RQS or RQE, FLAG1 = '1' in a group call.

eg for a call to an individual unit (RC UN): 28 789#

28 is translated by the unit, for example, to fleet Base Address: 34/936

The prefix is used directly and the called IDENT, 1525, is calculated by using the algorithm:

$$ID = IBI - 200 + UN$$

$$1525 = 936 - 200 + 789$$

Either a common prefix call or an extended addressing call follows appropriately.

For a call to a group (RC GN): 984 98#

984 is translated, for example, to Fleet Group Base Address: 34/5936

The prefix is used directly and the called IDENT, 5944, is calculated by using the algorithm:

$$ID = GBI - 90 + GN$$

$$5944 = 5936 - 90 + 98$$

Either a common prefix call or an extended addressing call follows appropriately.

Note: Dialled strings of this length commencing with 1 are not specified. Dialled strings commencing with digits 3, 4, 5, 6, 7, 8 and 0 are used for PABX calls.

8.2.4.6 Six Digit Dialled Strings. Leading Digit 2 to 6 (Mandatory)

A six digit dialled string with a leading digit in the range 2 to 6 shall be used for inter-fleet calls where the call is between units having a common prefix. The first four digits are the called party fleet number (FN) from which the unit shall create a base identity.

$$BI = 2(FN - 2000)$$

Using the created base identity and the rest of the dialled string as a unit number (UN) the unit creates a common prefix call using the procedures specified in 8.2.4.2.

Called individual ident = BI + UN - 20

Group calls, which are identifiable by 9 in the fifth digit, are handled similarly.

Called group ident = BI + GN - 90

It shall be possible to suppress inter-fleet group calls by unit personalisation.

Note: Dialled strings of this length commencing with 0, 7 and 8 are used for PABX calls. Those commencing with 1 are not specified.

8.2.4.7 Seven Digit Dialled Strings. Leading Digit 2 to 6 (Mandatory)

A seven digit dialled string with a leading digit in the range 2 to 6 shall be used for inter-fleet calls where the call is between units having a common prefix. The first four digits are the called party fleet number (FN) from which the unit shall create a base identity.

BI = 2 (FN - 2000)

Using the created base identity and the rest of the dialled string as a unit number (UN) the unit creates a common prefix call using the procedures specified in 8.2.4.3.

Called individual ident = BI + UN - 200

Group calls, which are identifiable by 9 in the fifth digit, are handled similarly.

Called group ident = BI + GN - 900

It shall be possible to suppress inter-fleet group calls by unit personalisation.

Note: Dialled strings of this length commencing with 0, 7 and 8 are used for PABX calls. Those commencing with 1 are not specified.

8.2.4.8 Eight Digit Dialled Strings. Leading Digit 1 (Technician facility - Optional)

When the technician facility is enabled then 8 digit dialled strings with a leading 1, digits 2 to 4 in the range 000 to 127 and digits 5 to 8 in the range 0001 to 8100, shall set up a call to an address of which the last seven digits in the dialled string are the decimal representation.

The dialled string shall be of the form:

1 PFIX IDENT
e.g. 1 012 0246

The unit shall translate the dialled decimal representations of the prefix and identity into their binary equivalents and use these to transmit a single address codeword or extended addressing call request, whichever is appropriate to the radio unit's own address.

Note that although addresses are written in the form 12/246, the leading zeros shall be dialled thus: 012 0246. Idents above 8100 shall be blocked to prevent calls to gateway addresses which may cause potential fault conditions.

Note: Dialled strings of this length commencing with 0 are used for PSTN calls. Dialled strings with other leading digits are not specified.

8.2.4.9 Nine Digit Dialled Strings. Leading Digit 2 or 3 (Mandatory)

A nine digit dialled string with leading digits 2 or 3 shall be used for inter-fleet calls where the call is between units having different prefixes. the first three digits are the called party's Number Prefix (NP), from which the unit shall create a prefix (PFIX).

PFIX = NP - 200

The rest of the dialled string shall be manipulated as specified in 8.2.4.6. An extended addressing call shall be made to IPFIXI and the unit shall respond to an AHYC with a SAMIS containing the called party's address (!!9.2.2.1!!). The unit shall trap the Number Prefix if it corresponds to the unit's own Number Prefix and shall resort to a common prefix, single address codeword call.

Note: Dialled strings of this length commencing with 0 are used for PSTN calls. Dialled strings with other leading digits are not specified.

8.2.4.10 Ten Digit Dialled Strings. Leading Digit 2 or 3 (Mandatory)

A ten digit dialled string with leading digits 2 or 3 shall be used for inter-fleet calls where the call is between units having different prefixes. The first three digits are the called party's Number Prefix (NP), from which the unit shall create a prefix (PFIX).

PFIX = NP - 200

The rest of the dialled string shall be manipulated as specified in 8.2.4.7. An extended addressing call shall be made to IPFIXI and the unit shall respond to an AHYC with a SAMIS containing the called party's address (!!9.2.2.1!!). The unit shall trap the Number Prefix if it corresponds to the unit's own Number Prefix and shall resort to a common prefix, single address codeword call.

Note: Dialled strings of this length commencing with 0 are used for PSTN calls. Dialled strings with other leading digits are not specified.

8.2.5 PABX Numbering (Optional)

MPT 1327 allows the radio unit to transmit numbers between 0 and 8191 with EXT = '1' in an RQS or RQE single address codeword call, in order to indicate that the called identity is an extension number of a PABX which is associated with the radio unit caller (!!5.5.3.1.1!!). FLAG1 and FLAG2 are used to select one from a maximum of four PABXs. The TSC forwards the dialled number to the selected PABX. Extended addressing procedures are required via the PABXI gateway for calls to extensions on exchanges employing five or more digits, or to larger PABX networks.

Most PABXs use fixed length dialled strings whose leading digit is equal to or greater than 1. Thus the largest range of numbers which may be encountered and which can be accommodated in a single address codeword call is 1000 to 8999. However this range may only be accommodated by interposing an off-set in the transmitted request from the calling unit. This off-set is removed by the TSC. The off-set is 1000; thus for dialled extension numbers (EXTN) in the range 1000 to 8999 the unit sends 0 to 7999 in IDENT1.

IDENT1 = EXTN - 1000

Calls to PABXs with dialled strings shorter than four digits shall have dummy digits inserted in the leading digit positions (to be described as a dialling code in the user's directory) to make up the length of the dialled string to four digits. Recommended values are 7, 77, etc. Different codes may be used to route calls to different branch exchanges by arrangement between the network operator and the PABX user. Shorter dialled strings on PABXs with mixed length numbering shall be dealt with in a similar manner.

If access is required to a small group of branch exchanges (a maximum of four), then FLAG1 and FLAG2 in the RQS or RQE address codeword shall be set to indicate to which exchange the required extension is connected. The flags are set in the radio unit by the use of a leading digit before the extension number, which thus requires the user to dial a five digit string.

Access to larger PABX networks uses extended addressing routines. These are set up by dialled string lengths of five to eight digits and with particular leading digits.

8.2.5.1 Single digit Dialled Strings

To call a PABX operator the unit may be set up to call identity 8000 with EXT = '1', FLAG='0' and FLAG2 = '0' when 0 is dialled.

8.2.5.2 Two Digit Dialled Strings

A two digit dialled string in the range 03 to 06 shall be used to select one of four different branch exchange operators. The radio unit shall be set up to call identity 8000 with EXT = '1', and FLAG1 and FLAG2 set according to the following table:

	FLAG1	FLAG2
03	'0'	'0'
04	'0'	'1'
05	'1'	'0'
06	'1'	'1'

8.2.5.3 Three Digit Dialled Strings

Three digit dialled strings are not used for PABX calls.

8.2.5.4 Four Digit Dialled Strings

The radio unit shall accept any four digit dialled string as a call to a PABX and shall set the EXT flag to '1'. FLAG1 and FLAG2 shall be set to '0'. The dialled extension number

(EXTN) shall be decremented by 1000 and the resultant shall be transmitted as the called identity (see 8.2.5).

IDENT = EXTN - 1000

8.2.5.5 Five Digit Dialled Strings. Leading Digit 3 to 6

Five digit dialled strings with a leading digit from 3 to 6 function similarly to four digit dialled strings, but the radio unit shall set FLAG1 and FLAG2 in RQS or RQE, or EXCHANGE in SAMIS, according to the following table:

Leading Digit	FLAG1 !!5.5.3.1.1!!	FLAG2	EXCHANGE (SAMIS) !!5.6.1.2.2!!
3	'0'	'0'	'00'
4	'0'	'1'	'01'
5	'1'	'0'	'10'
6	'1'	'1'	'11'

Having used the leading digit in the five digit dialled string to set FLAG1 and FLAG2, the radio unit shall process the remaining four digits as described in 8.2.5.4.

8.2.5.6 Five to Seven Digit Dialled Strings. Leading Digits 0, 7 or 8

Dialled strings of five to seven digits with leading digits 0, 7 or 8 shall be used to send a call to the PABXI gateway. On receipt of a Mode 1 AHYC with IDENT1 = PABXI and DESC = '010', the radio unit shall respond with a SAMIS containing DESC = '010', and with the full dialled string occupying BCD blocks commencing with BCD1. Unused blocks shall be filled with NULL.

Note: Five digit dialled strings with leading 2 or 9 are used for inter-fleet calls and leading digit 1 is not specified.,

8.2.5.7 Eight or Nine Digit Dialled Strings. Leading Digits 7 or 8

Dialled strings of eight or nine digits with leading digits 7 or 8 shall cause the radio unit to send a call to the PABXI gateway. On receipt of a Mode 1 AHYC with IDENT1 = PABXI and DESC = '010', the radio unit shall respond with a SAMIS containing DESC = '010' and with the full dialled string occupying BCD blocks commencing with BCD1. When the dialled string length is 8 digits the unused block shall be filled with NULL.

8.2.6 PSTN Numbering (Optional)

8.2.6.1 PSTN Abbreviated Dialling

Single address codeword calls and diversions may be made to 15 pre-arranged numbers by using the special idents PSTNSIj. The procedures are defined in section 8.2.8.1.

8.2.6.2 Calls to PSTN Subscribers

Dialled strings of eight or more digits with leading digit 0 shall cause the radio unit to send an RQS or RQE call to the PSTNGI gateway with FLAG1 set to '0' to indicate a dialled

string length of 10 or less digits, or set to '1' to indicate 11 to 32 digits. On receipt of a Mode 1 AHYC with IDENT1 = PSTNGI, DESC = '001' and SLOTS = '01' or '10' as appropriate, the radio unit shall respond with SAMIS, DESC = '001' with the full dialled string, less the leading 0, occupying BCD blocks commencing with BCD1. If SLOTS = '10' and the dialled string has a length of 11 to 21 digits inclusively then the accompanying SAMIS shall have L set to '01' and the radio unit shall append one data codeword which shall contain the digits that cannot be accomodated in the SAMIS. If SLOTS = '10' and the dialled string length is greater than 21 digits then the accompanying SAMIS shall have L set to '10' and the radio unit shall append two data codewords which shall contain the digits that cannot be contained in the SAMIS. Unused BCD groups shall be filled with NULL.

8.2.7 Network Operator Services (3 digit calls) (Optional)

Three digit dialled strings in the table below shall be used to call network services. The table lists dialling strings and the special identities into which they shall be translated by the unit.

Dialled String	Special Ident	Dialled String	Special Ident
100	8170	151	8175
111	8171	161	8176
112	8180	171	8177
121	8172	181	8178
131	8173	191	8179
141	8174	999	8180

Figure 8.5 Table of Special Idents for Operator Services

112 and 999# shall initiate an RQE call request message.

8.2.8 Call Modifiers and Radio Unit Control

Calls are modified from speech calls to other types of call, and the radio unit functions are controlled by, dialled strings commencing with * or #. This section defines codes which directly affect MPT 1327 address codewords. Other functions which the unit is required to perform may use codes of a similar type but the unit manufacturer has choice of code and implementation.

Codes which modify a call precede the dialled number and are separated from the number by use of the * key. Generally, codes which change a function between two states initiate the state by commencing the code with *, and re-set the state by the same code commencing with #.

The # key is always used to signal the end of dialling activity, with the exception of when the unit is alerting for an incoming call.

e.g.
- To make a priority call to a unit dial *8 *234#
- To make a non-prescribed data call to an abbreviated PSTN destination dial *31 **12#
- To make a conference group call dial *1 *923#

As well as the keypad functions, any of the function codes may also be assigned to special function keys which carry out the same action as a code but in a single keystroke.

The radio unit shall set up an RQQ (STATUS = 0) call to the dialled number. The radio unit may default to a pre-arranged number if a number is not dialled, ie the unit may set up an RQQ call to an address which is programmed within the unit if the # key is depressed immediately after the code (!!5.5.3.1.7!!).

Leave Despatcher Queue: Code #0

The radio unit shall set up an RQQ (STATUS = '31') call to the dialled number. The radio unit may default to the last despatcher queue which had been entered if no number is dialled (!!5.5.3.1.7!!).

Send Status: Code *0nn

The radio unit shall set up an RQQ (STATUS = 'nn') call to the dialled number. The radio unit may default to a pre-arranged number if a number is not dialled, ie the unit may set up an RQQ call to an address which is programmed within the unit if the # key is depressed immediately after the code. nn is a single or two digit code without a leading zero and shall be in the range 1 to 30 (!!5.5.3.1.7!!).

8.2.8.2.2 Conference/Broadcast Group Facility

Units which receive group calls may allow the user to reply to the calling party (conference) or the unit may inhibit replies (broadcast) on receipt of a maintenance message on the traffic channel. The unit originating the call sends RQS (FLAG1 = '1') or RQE (FLAG1 = '1') to disable the called units' ability to reply. The calling unit shall only set FLAG1 to '1' if the called address is a group address (!!5.5.3.1.1!!).

Conference and broadcast calls may be specifically requested using the call modifiers described in 8.2.8.2.2.1 and 8.2.8.2.2.2. No default is prescribed for cases where neither call modifier is used; however it is recommended that the default is conference call.

8.2.8.2.2.1 Conference Call Code *1

*1 sets RQS or RQE, FLAG1 to '0'

8.2.8.2.2.2 Broadcast Call Code *11

*11 sets RQS or RQE, FLAG1 to '1'

8.2.8.2.3 Data Facilities

*2 initiates a section 14 Control Channel Short Data Message.Paragraph 8.2.8.2.3.2 specifies the use of the code. Codes of the format "*2n" where "n" is any length string commencing with 1 or 2 are reserved for future definition. Codes where the string commences with any digit from 3 to 9 or 0 are available for customisation.

*31 is specified in this section. Codes of the format "*3n" where "n" is any length string commencing with 2 are reserved for future definition. Codes where the string commences with any digit from 3 to 9 or 0 are available for customisation.

8.2.8.2.3.1 Non-prescribed Data. Code *31

*31 sets RQS (DT = '1') or RQE (D = '1') as appropriate (!!5.5.3.1.1!!). This code requests that a transparent end to end audio path be set up by the network. The user supplies the data communications equipment (DCE) to terminate the audio path. The radio unit's acoustic transducers are inhibited and the audio connection to the DCE is enabled on receipt of GTC. Call maintenance messages are inhibited unless required by the network operator.

8.2.8.2.3.2 Short Data on the Control Channel. Code *2

*2 causes the radio unit to initiate an RQC message. The dialled format is *2*<data>*<called party number>#. The radio unit shall respond to the associated AHYC

from the TSC with the data field of the dialled string in accordance with section 14. The STF field, and MESS field if applicable, may be set in any appropriate manner for the input data.

*2# shall cause the radio unit to send data from an external device to a pre-arranged address.

2<data># shall cause the radio unit to send data from the keyboard to a pre-arranged address.

*2**<called party number># shall cause the radio unit to send data from an external device to the called party number.

8.2.8.2.3.2.1 Use of the data field

If the data field contains no input the radio unit shall substitute data from an external data input device. Any format prescribed in section 14 may be implemented and the GFI field shall be set appropriately. The external device may also originate short data messages without the need for the user to make an entry on the radio unit keyboard. The protocol between the radio unit and the external device is not defined.

8.2.8.2.3.2.2 Use of the number field

Any number defined in section 8.2.4 to 8.2.7 may be dialled.

8.2.8.2.4 Priority Call Code *8

The radio unit shall set up an RQS (LEVEL = '0') call to the dialled number (!!5.5.3.1.5!!). The user may dial, and the unit shall accept, any further suitable modifier which sets other bits in the RQS address codeword. The further modifier shall be dialled with its leading * character, eg *1, *11, *32. The code shall also function with abbreviated dialling codes commencing with **.

8.2.8.2.5 Emergency Call Code *9 (!!10.2!!)

The radio unit shall set up an RQE call to the dialled number (!!5.5.3.1.5!!). The radio unit may default to a pre-arranged number if a number is not dialled, ie the unit may set up an RQE call to an address which is programmed within the unit if the # key is depressed immediately after the code. The user may dial, and the unit shall accept, any further modifier which sets other bits in the RQE address codeword. The further modifier shall be dialled with its leading * character, eg *1, *11, *32. The code shall also function with abbreviated dialling codes commencing with **.

The special Emergency mode (FLAG2 = '1') (!!10.2!!) is entered by dialling an additional string after *9. If the first digit in the additional string is in the range 1 to 4 then FLAG1 and D are set according to the following table:

Digit	FLAG1	D
1	'0'	'0'
2	'0'	'1'
3	'1'	'0'
4	'1'	'1'

The remaining digits are the decimal representation of the 13 bit number which is sent in IDENT1. Leading zeros which result from the binary to decimal conversion are not dialled.

If the first and only digit in the additional string is 9 then the unit expects to receive an input from an external unit to set FLAG1, D and IDENT1.

e.g. *91# sets all bits to '0'
*923# sets D to '1', FLAG1 to '0', and IDENT1 to '0000000000011'

The TSC handles the received RQE by agreement with the user or service provider. No other call modifiers or called party number shall be accepted by the unit in conjunction with this facility.

112# and 999# shall set up an RQE call without the need to dial *9.

8.2.8.3 Radio Unit or Network Control (Optional)

The radio unit may incorporate one or more routines to allow calls to be controlled fully and to modify unit action on receipt of incoming calls etc. MPT 1327 related functions include call diversion, rejection of incoming call interrogations etc.

8.2.8.3.1 Divert Own Calls: Code *41n (!!12.2!!)

*41 shall cause the radio unit to send RQT (DIV = '0', FLAG1 = '0', FLAG2 = '0') (unless FLAG1 is set to '1' by PSTN number string length) to the TSC (!!5.5.3.1.4!!). The RQT instructs the TSC to offer the number which has been dialled after the code to any caller who is attempting to make a call to the originating radio unit as an alternative destination for the call. The number to which calls are to be diverted, and which follows the code, shall be any number which the user is able to dial for a normal speech call (RQS). If no number is dialled after the code then the unit shall not transmit a diversion request.

If n is not dialled, all call types are diverted.
RQT, SD shall be set to '00'.

If n = 1, only speech calls are diverted.
RQT, SD shall be set to '01'.

If n = 2, only data calls are diverted.
RQT, SD shall be set to '10'

e.g. *41 *234# diverts all types of call to unit 234 in the same fleet as the originator of the diversion.

*411 *3456# diverts speech calls to extension 3456 in the PABX which is associated with the diversion originator's fleet.

When unit numbers which would normally result in a single address codeword call are entered as a call diversion request, they shall be sent as IDENT1 in an RQT.

When unit numbers which would normally result in an extended addressing call are entered as a call diversion request, they shall be sent in an RQT with IPFIXI in IDENT1. The dialled number shall be sent in a SAMIS (DESC = '000') in PARAMETERS1 in response to an AHYC with the same address information as contained in the originating RQT.

When calls to PABX extension numbers which would normally result in a single address codeword call are entered as a call diversion request, they shall be sent as an RQT with PABXI in IDENT1 and the dialled number shall be sent in a SAMIS (DESC = '010', SP = '1'). EXCHANGE shall be set to '00' for four digit calls and shall be set as listed in the table in 8.2.5.5 for five digit calls The dialled number is manipulated by the algorithm used for creating IDENT1 in an RQS or RQE and is transmitted in Number. The SAMIS is sent in response to an AHYC with the same address information as contained in the originating RQT.

When called extension numbers which would normally result in an extended addressing call are entered as a call diversion request, they shall be sent as an RQT with PABXI in IDENT1 and the dialled number shall be sent in a SAMIS (DESC = '010', SP = '0'), with the BCD blocks filled in the same manner as for a normal call (8.2.5.7). The SAMIS is sent in response to an AHYC with the same address information as contained in the originating RQT.

When abbreviated calls to PSTN numbers which would normally result in a single address codeword call are entered as a call diversion request, they shall be sent as an RQT with the correct PSTNSIj in IDENT1.

When calls to PSTN numbers which would normally result in an extended addressing call are entered as a call diversion request, they shall be sent as an RQT with PSTNGI in IDENT1. If the dialled string (including the leading 0) is equal to or greater than 11 digits, FLAG1 = '1'. The dialled number shall be sent in a SAMIS (DESC = '001') with the BCD blocks filled in the same manner as for a normal call (See 8.2.6.2). The appended codeword shall also be sent when necessary. The SAMIS is sent in response to an AHYC with the same address information as contained in the originating RQT.

8.2.8.3.2 Cancel Own Diversion: Code #41n#

Upon being dialled the radio unit shall send RQT to the TSC to instruct it to cancel the divert state.

If n is not dialled, all call types shall cease to be diverted.
RQT (SD = '00')

If n = 1, only speech calls shall cease to be diverted.
RQT (SD = '01')

If n = 2, only data calls shall cease to be diverted.
RQT (SD = '10')

Cancellation of divert condition causes the radio unit to transmit RQT (DIV = '1', FLAG1 = FLAG2 = '0') with IDENT1 = IDENT2 (the originating unit's own address).

8.2.8.3.3 Divert Third Party Calls: Code *44n

*44n is followed by the number of the third party whose calls are to be diverted, and then by the diversion destination.

*44 shall cause the radio unit to send RQT (DIV = '0', FLAG1 = '0', FLAG2 = '1') (unless FLAG1 is set to '1' by PSTN number string length) to the TSC. The RQT instructs the TSC to offer the call destination to any caller who is attempting to make a call to the third party number as an alternative destination for the call. The number to which calls are to be diverted shall be any number which the user is able to dial for a normal speech call (RQS). If less than two numbers are dialled after the code then the unit shall not transmit a call diversion request.

If n is not dialled, all call types are diverted.
RQT, SD shall be set to '00'

If n = 1, only speech calls shall be diverted.
RQT, SD shall be set to '01'

If n = 2, only data calls shall be diverted.
RQT, SD shall be set to '10'

e.g. *442 *234 *432# Data calls directed to unit 234 in the same fleet as the diversion originator shall be re-directed to unit 432 in the same fleet.

*441 *234 *3456# Speech calls to unit 234 in the same fleet as the diversion originator shall be re-directed to extension 3456 in the PABX which is associated with the diversion originator's fleet.

Methods of sending the diversion data are specified in 8.2.8.3.1. In addition, the blocked third party address is sent in response to an AHYC with IDENT1 = DIVERTI, PFIX/IDENT2 = requesting unit's address, DESC = '000', SLOTS = '01'. The order in which the two AHYCs are sent is not defined.

8.2.8.3.4 Cancel Third Party Diversions: Code #44n

This code is followed by the number of the third party whose calls are presently diverted.

The radio unit shall send RQT to the TSC to instruct it to cancel the divert state for the nominated third party. If a number is not dialled after the code then the unit shall not transmit a diversion cancellation request.

If n is not dialled, all call types cease to be diverted.
RQT, SD shall be set to '00'

If n = 1, only speech calls cease to be diverted.
RQT, SD shall be set to '01'

If n = 2, only data calls cease to be diverted.
RQT, SD shall be set to '10'

e.g. #441 *234# allows unit 234 in the same fleet as the call request originator to receive speech calls directed to the unit.

Cancellation of the divert condition causes the radio unit to transmit RQT (DIV = '1', FLAG1 = FLAG2 = '0') with IDENT1 = third party identity, or IPFIXI and IDENT2 = the requesting unit's own address. If IDENT1 = IPFIXI, the full address of the third party unit is transmitted in a SAMIS (DESC = '000') in PARAMETERS1, in response to an AHYC with IDENT1 = IPFIXI.

8.2.8.3.5 Cancel Incoming diversions: Code #45n#

This code causes the radio unit to send RQT to the TSC to instruct it to cancel any divert state which may be directing calls to the originating radio unit. Cancellation of incoming diversions causes the radio unit to transmit RQT (DIV = '1', FLAG1 = FLAG2 = '0') with IDENT1 = DIVERTI.

If n is not dialled, all call types cease to be diverted.
RQT, SD shall be set to '00'

If n = 1, only speech calls cease to be diverted.
RQT, SD shall be set to '01'

If n = 2, only data calls cease to be diverted.
RQT, SD shall be set to '10'

8.2.8.3.6 Queue Incoming Calls: Code *48#

This code causes the radio unit to respond to AHY (D='0') messages with ACKB (QUAL = '0') (!!9.1.1.5!!) and place the call details in a call queue. Selection of this state shall cancel any previously entered "Don't Disturb" (8.2.8.3.8) in respect of AHY (D='0') message.

8.2.8.3.7 Cancel Queueing of Incoming Calls: Code #48#

This code causes the radio unit to cease queueing calls and resort to acknowledging all AHY (D='0') messages with any acknowledgement which is appropriate for the radio unit state (!!9.1.1.5!!).

8.2.8.3.8 Don't Disturb: Code *49n#

This code causes the radio unit to acknowledge all appropriate AHY messages with ACKV (QUAL = '1'), thus blocking the call (!!9.1.1.5!!).

If n is not dialled, the unit shall respond ACKV (QUAL = '1') to all appropriate AHYs to the unit. D may be either '0' or '1'.

If n = 1, the unit shall respond ACKV (QUAL = '1') to appropriate AHYs to the unit when D is set to '0' (speech calls).

If n = 2, the unit shall respond ACKV (QUAL = '1') to appropriate AHYs to the unit when D is set to '1' (data calls).

8.2.8.3.9 Cancel Don't Disturb: Code #49n#

This code causes the radio unit to acknowledge all appropriate AHY messages with any acknowledgement which is appropriate for the radio unit state (!!9.1.1.5!!).

If n is not dialled, the unit shall cease to respond ACKV (QUAL = '1') to any appropriate AHYs to the unit. D may be either '0' or '1'.

If n = 1, the unit shall cease to respond ACKV (QUAL = '1') to appropriate AHYs to the unit when D is set to '0' (speech calls).

If n = 2, the unit shall cease to respond ACKV (QUAL = '1') to appropriate AHYs to the unit when D is set to '1' (data calls).

8.2.8.4 Radio Unit Control (Mandatory)

The unit shall incorporate keyboard routines to allow the unit to abandon call attempts, clear calls and accept incoming calls (see section 8.3.3.).

8.2.8.4.1 Call Set-Up Abandon: Call Complete: Code *#

*# may be dialled after digits and a terminator have been entered on the keyboard. If the radio unit has not transmitted a call request, it shall abandon the call and resume an idle state on the control channel.

If the radio unit has started to set up a call, it shall transmit a call cancel request (RQX) (!!9.1.1.8!!).

If *# is dialled whilst the unit is on a traffic channel, the radio unit shall terminate the call by transmitting MAINT (OPER = '011') where appropriate to its call condition (!!9.2.3.5!!).

If *# is dialled whilst the radio unit is indicating call failure or termination by a continuing confidence indication, then the radio unit shall cancel that indication.
Notes:

1. *# may also be used to abandon erroneous keyboard entries.

2. If *# is dialled after an "off-hook" indication has been sent to the TSC to accept an incoming call, but before the radio unit receives GTC, the radio unit shall transmit an "on-hook" indication RQQ (STATUS = 31) to TSCI (!!5.5.3.1.7!!).

8.2.8.4.2 Accept Incoming Call: Code # (Alerting State only)

If # is dialled when the radio unit is alerting the user for an incoming call, the radio unit shall send RQQ (STATUS = 0) to TSCI. In the alerting state the # key is not used as a dialled string terminator. An incoming call shall cause abandonment of a dialling attempt which has not been terminated by the string terminator (!!5.5.3.1.7!!).

8.2.9 Summary of Numbering Convention (Notes)

Single digit dialled strings (Z). Not defined. Proposed use:

Z	0	Associated PABX Operator	(Ident 8000)
Z	1 - 9	Despatcher	(Ident looked up in unit)

Two digit dialled strings (YZ)

Y	0	PABX operator in exchange group, EXT = '1'	
Z	3 - 6	PABX access number for exchange as defined in five digit numbers below (Ident 8000 with FLAGs 1 and 2 set appropriately)	
YZ	20 - 89	Individual number	
YZ	90 - 99	Group number	

Three digit dialled strings (XYZ)

X	1	Network operator services	
YZ	00		(Ident 8170)
	11		(Ident 8171)
	21		(Ident 8172)
	31		(Ident 8173)
	41		(Ident 8174)
	51		(Ident 8175)
	61		(Ident 8176)
	71		(Ident 8177)
	81		(Ident 8178)
	91		(Ident 8179)
XYZ	200 - 899	Individual calls in fleet	
	999	Emergency Operator	(Ident 8180)
X	9	Group call	
YZ	00 - 98	Group number	

Four digit dialled strings (WXYZ)

WXYZ	1000 - 8999	Single addressword calls to single, associated PABX. EXT = '1'. Flags 1 and 2 default to '0'.

Five digit dialled strings (VWXYZ)

V	2, 9	Large fleet short form access
W	0 - 9	Routing code
XYZ	200 - 998	Individual or group number
WX	00 - 99	Routing code
YZ	20 - 99	Individual or group number

V	3 - 6	PABX access number for single addressword calls (value sets FLAGs 1 and 2), EXT = '1'
WXYZ	1000 - 8999	PABX extension number
V	0, 7 or 8	PABX network access number (extended addressing protocol) (PABXI)
WXYZ	NNNN	Exchange routing digits and extension number

Six digit dialled strings (UVWXYZ)

UVWX	2001 - 6050	Fleet number
YZ	20 - 99	Individual or group number
U	0, 7 or 8	PABX network access number (PABXI)
VWXYZ	NNNNN	PABX routing digits and extension number

Seven digit dialled strings (TUVWXYZ)

TUVW	2001 - 6050	Fleet number
XYZ	200 - 998	Individual or group number
T	0, 7 or 8	PABX network access number (PABXI)
UVWXYZ	NNNNNN	PABX routing digits and extension number

Eight digit dialled strings (STUVWXYZ)

S	1	Service technician's access only
TUV	000 - 127	Transpose keyboard entry to binary and send in PFIX as part of inter-prefix call
WXYZ	0001 - 8100	Transpose keyboard entry to binary and send in IDENT1 as part of inter-prefix call
S	0	PSTN access number (PSTNGI)
TUVWXYZ	NNNNNNN	PSTN routing digits and subscriber number
S	7 or 8	PABX network access number (PABXI)
TUVWXYZ	NNNNNNN	PABX routing digits and extension number

Nine digit dialled strings (RSTUVWXYZ)

RST	200 - 327	Number prefix
UVWXYZ	-	For details see six digit numbers, inter-fleet numbers
R	0	PSTN access number (PSTNGI)
STUVWXYZ	NNNNNNNN	PSTN routing digits and subscriber number
R	7 or 8	PABX network access number (PABXI)
STUVWXYZ	NNNNNNNN	PABX routing digits and extension number

Ten digit dialled strings (PRSTUVWXYZ)

PRS	200 - 327	Number prefix
TUVWXYZ	-	For details see seven digit numbers, fleet numbers
P	0	PSTN access number (PSTNGI)
RSTUVWXYZ	NNNNNNNN	PSTN routing digits and subscriber number

Eleven or more digit dialled strings (NPRSTUVWXYZ)

N	0	PSTN access number

PRSTUVWXYZ NNNNNNNNNN Routing digits and subscriber number

8.2.10 Summary of Control Codes

**nn	Abbreviated dialling codes nn = 1 to 15. PSTN abbreviated numbers prescribed method nn = 16 to 49. Network operator specified abbreviated dialling
*#	Call set-up abandoned, call complete
*0	Despatcher queue
*0nn	Status 'nn' to despatcher
*1	Conference call
*11	Broadcast call
*1981#	Priority voice system-wide call
*1982#	Emergency voice system-wide call
*1983#	Priority np data system-wide call
*1984#	Emergency np data system-wide call
*1985#	Short data system-wide call
*1987#	Standard voice system-wide call
*2	Short Data on the Control Channel.
*3	*31 is prescribed. other codes are either reserved for future definition or are available for customisation.
*31	Non-prescribed data call

If "n" is dialled in the following codes, the function is restricted to speech calls if n = 1, or data calls if n = 2.

*41n	Divert own calls, ie calls directed to originator of diversion
*44n	Divert third party calls, ie calls directed to a nominated party
*48	Queue incoming calls (speech calls only)
*49n	Don't disturb
*8	Priority call
*9	Emergency call, RQE
*9xxx#	Special emergency facility by arrangement with network operator

#	End dialled string, accept call if radio unit is alerting
#0	Leave despatcher queue
#41n	Cancel own diversions, ie allow calls to a unit for which previously a call diversion was in force
#44n	Cancel third party diversions, ie allow calls to a nominated third party for which previously a call diversion was in force
#45n	Cancel incoming diversions
#48	Cancel queueing of incoming calls (speech calls only)
#49n	Cancel Don't Disturb.

8.2.11 Glossary of Terms Specific to Section 8.2

Base Indent:	The lowest value of ident allocated to a "fleet" of units
Block:	An allocation of contiguous idents to a user "fleet"
Dialled String:	The numbers dialled by a caller on the keypad of his radio unit to call any other party. Pre-origination dialling is employed and the end of the dialled string is indicated by the user dialling #
Fleet:	All or a sub-set of a user's vehicles which are equipped with radio units, and which require direct communication between users by means of two or three digit dialling
Fleet Number:	The dialled digits which identify the identity "block" for the fleet containing the called unit (digits 4 to 7 of the "Network Number"). Directly related to the "Fleet Base Ident"
Fleet Individual Number:	A "Fleet Number" via which calls to individual units may be made
Fleet Group Number:	A "Fleet Number" via which calls to groups of units may be made
Group Base Ident:	The lowest value of ident allocated to a "fleet" of units for group addresses
Group Ident:	An ident used to call a group of users
Group Number:	The last group of digits in the "Network Group Number" which identifies the group of unit within the "fleet". Related to the "Group Ident" via the "Group Base Ident".
Individual Ident:	An ident used to call an individual user

Network Number: The number by which a unit or group may be identified in a directory, all or part of which is dialled by a caller wishing to communicate with the identified party or parties. It consists of the "Number Prefix", the "Fleet Number" and the "Unit Number"

Network Individual Number: The number which identifies an individual unit in a "fleet"

Network Group Number: The number which identifies a group of units in a "fleet"

Number Prefix: The three leading digits of the "Network Number". Directly related to the prefix Unit Number: The last group of digits in the "Network Individual Number" which identifies the unit within the "fleet". Related to the "Individual Ident" via the "Fleet Base Ident"

8.3 Ready for Communication Control

8.3.1 Readiness for Communication

In the signalling standard MPT 1327 the terms "off-hook" and "on-hook" are used to designate the state of user readiness for communication. These terms have been used to reflect a parallel with the fixed telephone network where removal of the telephone handset from the switch cradle indicates a readiness for communication (off-hook). When the handset is resting in the switch cradle the user is assumed to be not ready for communication.

An indication of the state of readiness of a party to a call is necessary to enable the following functions, applicable to commercial networks in Band III:

(a) To enable the user to instruct the radio unit to attempt to transmit a call request for a called party address indicated by pre-origination dialling or other appropriate method (calling party off-hook).

(b) In systems which employ full off-air call set up, to enable the user to indicate to the radio unit readiness to accept an incoming call (called party off-hook). This function is not applicable to group calls.

(c) To enable the user to instruct the radio unit to attempt to cancel a previously made request during the call set up phase or to request clear-down of a call in progress (calling party on-hook).

(d) To enable the user to instruct the radio unit to attempt to cancel a called party off-hook instruction during the call set up phase or to request clear-down of a call in progress (called party on-hook).

(e) To enable the user to cancel any confidence indication generated by the radio unit for a failed call attempt (calling or called party on-hook).

For convenience these functions are regarded as being fulfilled by a single control that shall be able to be activated on all radio units, although it is permissible to use more than one control for these purposes. This control, or group of controls, is designated the "Ready for Communication Control" (RFCC).

The RFCC must be capable of providing a real indication of the state of user readiness to the radio unit in order to support these functions. Accordingly, deliberate arrangements which allow the RFCC to be set by the user in an off-hook mode, and which do not reflect the true state of user readiness, shall not be permitted.

8.3.2 The Form of the Ready for Communications Control

It is not the intention of this specification to restrict unduly the scope for individual design of radio units. Consequently no requirements for the physical form that the RFCC shall take are prescribed. However, the following general comments are offered to assist the designer of radio units.

Failure to request traffic channel clear-down at the end of communication is a potentially serious cause of wasted air-time. RFCC devices which do not solely rely on user discipline in this matter are to be preferred to those, such as an ordinary switch-hook, which do.

RFCC devices which are designed to allow a means of acceptance of incoming full off-air call set up calls even when the user did not take the correct action to clear down the previous calls are to be preferred (eg, a unit left off-hook from a previous call shall be capable of signalling an on-hook to off-hook transition for a new incoming call).

A switch-hook type design is generally not applicable to hand portables and may not be the most suitable design in many other applications.

The design of the RFCC control shall take due account of the effects of normal operation upon road safety.

8.3.3 Control Requirements

The RFCC control, or group of controls, shall permit the user to signal the following to the radio unit, which shall then initiate the appropriate action prescribed elsewhere in the specification:

- an instruction for a call request to a called party address indicated by pre-origination dialling, or other appropriate method; "call request initiate",

- a called party answer instruction following receipt of AHY(CHECK='1'); "called party answer" (see MPT 1327 section 13.1.2.1),

- a call clear-down instruction for an individual call to which the user is a party; "call end request" (see MPT 1327 section 9.2.3.5),

- a calling party call cancellation instruction at any time prior to the receipt of a GTC message for the requested call; "call set-up abort"
  (see MPT 1327 section 9.2.1.7),

- an instruction to a radio unit, which is indicating call failure or termination by a continuing confidence indication, to cancel that indication; "cancel indication" (see 8.1).

The RFCC controls, or group of controls, may in addition permit the user to signal the following to the radio unit:

- an instruction to reject an incoming call; "incoming call reject" (see MPT 1327 section 13.1.2.1),

- an instruction to cancel a previously signalled called party off-hook state; "cancel called party answer" (see MPT 1327 section 13.1.2.6).

9. CONTROL CHANNEL ACQUISITION AND RETENTION

9.1 Introduction

When not assigned to a traffic channel (including immediately after switch-on), the radio unit shall attempt to find a control channel appropriate to the selected network. This requirement, the discipline for radio units whilst on a control channel and the circumstances which result in a search for a new control channel are the subjects of !!6.2.1!! of MPT 1327. However the protocol standard therein designates areas where system-dependent requirements may be specified, in particular:

- the method by which the radio unit searches for an appropriate control channel,

- the criteria which a control channel must satisfy to be considered appropriate by the radio unit,

- additional rules, other than those specified in !!6.2.1.2!!, for returning to the control channel acquisition procedures.

Accordingly, this section of the air-interface specification covers these system-dependent requirements.

The methods specified in this section recognise that designers of commercial trunked networks operating in Band III sub-bands 1 and 2 may choose from a variety of control channel strategies, including:

- dedicated control channels,
- dedicated control channels with load sharing,
- time-shared control channels,
- non-dedicated control channels.

These methods may result in the radio unit encountering a variety of control channel situations, including:

- receiving a control channel which suffers short-term interruptions (time-shared control channels),

- suffering long-term interruptions to control channel reception during which no appropriate control channel can be received by the radio unit (non-dedicated control channels, or moving out of range of the network),

- being in a location where it is possible for more than one control channel to be received from the selected network, involving the unit in a choice,

- being instructed to leave a control channel to enable that channel to be used as a traffic channel (non-dedicated control channels),

- being instructed to leave or being barred from access to, a control channel as a result of a network load sharing arrangement.

The procedures specified in this section have been devised as far as possible to cater for this range of situations, although the diversity of operational requirements represented by these situations necessitates some restriction on the tolerance to achieve efficient operation. In particular it should be noted that a non-dedicated control channel strategy may be inefficient in a multi-site situation where the radio unit is required to hunt through more than a small number of channels, but that this technique may be appropriate for small networks using only a few channels.

The mandatory procedures have also been devised to bias radio units to retain their current control channel for as long as possible, consistent with the requirement for a satisfactory quality of service for the user of the radio unit. In addition a radio unit searching for a new control channel is biased towards systems which will not result in a need to register. These two qualities of the procedures are designed to minimise control channel loading.

Notwithstanding this bias, optional procedures have been included which will allow a radio unit to leave the current control channel when an alternative, preferred control channel is available. These options are intended to improve spectral efficiency, increase the availability of radio units for a group call and give improved quality of service to the user.

Radio units may employ proprietary control channel hunting procedures which do not conform with the requirements of this section provided that:

- The proprietary scheme shall only be enabled when selected by radio unit personalisation. When the proprietary scheme is not enabled, the radio unit shall default to the use of the procedures in this section.

- The documentation describing the algorithms and procedures used in the proprietary scheme have been provided by the radio unit Manufacturer to the Network Operator. The standard of the documentation shall be at least to the same depth as this section.

- The proprietary scheme has been authorised by the Network Operator.

9.2 Radio Unit Storage Requirements

9.2.1 Mandatory Storage Requirements

In order to follow the procedures specified in this section the radio unit shall provide the following storage requirements appropriate to the selected network:

(a) In read-only memory:

i the control category of the radio unit for the selected network (see 9.5.2). Only one control category shall be stored per network;

ii. the channel numbers applicable to a "normal hunt sequence" for the selected network (see 9.3.3.4). The radio unit shall have the capability to enable up to 32 values of channel number defining the scope of the "normal hunt sequence" to be stored, and shall provide for the scope of the "normal hunt sequence" to be set to any value from 1 to 32 channel numbers, depending on the number of channel numbers held in read-only memory (this may be achieved by storing, as a separate parameter, the number of channels in the "normal hunt sequence" or by using a zero(null) value for the

channel number as a null value in unused locations in the 32 value store). For each of the channel numbers stored the radio unit shall carry a record of whether or not it should expect to encounter a time-shared control channel on that channel number;

iii. the lowest and highest channel number which may be used by the selected network;

iv. acquisition authorisation data for the selected network (see 9.3.4.2.3);

v. a flag which shall indicate whether the "comprehensive hunt sequence" shall be suppressed for the selected network (see 9.3.3.5).

(b) In Type B memory (see section 6.2):

i. One value of the AREA sub-field of a received system identity code (or a NULL value) relating to the most recent registration attempt on the selected network in accordance with the registration procedures specified in section 10.

Note: It is permissible for data to be held in unprotected read/write memory whilst operational and transferred to protected memory on power down or equivalent.

The radio unit shall discard any data held in protected read/write memory, unless its validity is reasonably assured.

(c) In read/ write memory:

i. the channel number of the control channel on which the radio unit is currently confirmed or, if the radio unit is not currently confirmed on a control channel but has been confirmed on a control channel since switch on, the channel number of the control channel on which it was most recently confirmed;

ii. A minimum of 8 records of denied registrations in accordance with the registration procedures specified in section 10.

9.2.2 Optional Storage Requirements

In addition the radio unit may provide the following storage requirements:

(a) In read/write memory:

i. the channel number (CHAN), time-shared indicator (TSI) and system identity code (SYS) contained in any BCAST(SYSDEF = '00000') messages (announce control channel) received from the selected network (see 9.3.3.4);

ii. the channel number (CHAN) and system identity code (SYS) contained in any BCAST(SYSDEF = '00001') messages (withdraw control channel) received from the selected network (see 9.3.3.4);

iii. the channel number (CHAN), time-shared indicator (TSI) and adjacent site serial number (ADJSITE), optionally also with system identity code (SYS), contained in any BCAST(SYSDEF = '00100') messages (broadcast adjacent site control channel number) and BCAST (SYSDEF = '00101') messages (vote now advice) received from the selected network. If the announced channels have been examined by the radio unit, the signal strength of the new channel may also be recorded (see 9.3.3.3 and 9.3.3.6);

Note: since data relevant to the selected network stored under (a)i to iii above may be varied by subsequent BCAST messages it is recommended that this data is discarded at sometime between the radio unit being switched off and being made ready for service after being switched on subsequently. For these purposes a user initiated change of selected network should be regarded as being equivalent to switching-off the radio unit.

iv. the channel number of the control channel on which the radio unit was last confirmed for each registration area for which a successful registration is recorded in the radio unit's read/write memory. If the radio unit is currently confirmed on a control channel then it is that channel which is regarded as the one on which it was last confirmed;

v. the channel number , system identity code (SYS) and signal strength parameter of prospective control channels gleaned from the optional "background search sequence" (see 9.3.3.7);

vi. (NA-1) values of the AREA sub-field of received system identity codes (or NULL values) relating to registration attempts in accordance with the registration procedures specified in section 10.3.

(b) In read-only memory:

i. the channel number of an unspecified number of channels which are not used by the selected network and may therefore be omitted from the "comprehensive hunt sequence" (see 9.3.3.5);

ii. NDD preference data for the selected network (see 9.3.4.2.3);

iii. a parameter TH to set the maximum time a radio unit, which implements the optional "background search sequence", is permitted to leave the currently confirmed control channel when sampling alternative control channels on which it may prefer to operate (see 9.3.3.7.3);

iv. a parameter TL to set the minimum time interval between successive departures from the currently confirmed contrl channel by a radio unit, which implements the optional "background search sequence", when sampling alternative control channels on which it may prefer to operate (see 9.3.3.7.1);

v. four parameters LM1, LM2, LM3 and LM4 to define the margin between the level of a sampled control channel, and the level of either the confirmed control channel or L.0., which must be exceeded before a radio unit, which implements the optional "background search sequence", may identify it as a prospective control channel (see 9.3.3.7.6);

vi. a parameter NS to define the number of consecutive sampling activities, carried out by a radio unit which implements the "background search sequence", over which the criteria relating to signal strength measurement should be satisfied for a particular channel before that channel may be identified as a prospective control channel (see 9.3.3.7.6).

9.3 Control Channel Acquisition Procedures

9.3.1 Entry into Control Channel Acquisition Procedures

The control channel acquisition procedures enable a radio unit which is not assigned to a traffic channel to attempt to select a control channel. Control channel acquisition is a procedure which consists of hunting for candidate control channels and attempting to confirm that any candidate channels are appropriate to acquire.

The radio unit shall enter into the control channel acquisition procedures specified in this section under the following circumstances:

- immediately after switch-on or a user-initiated change of selected network;

- when it has relinquished the current control channel under the mandatory procedures specified in section 9.4;

- when it has received a CLEAR message on a traffic channel (see !!9.2.3.8!!);

- when it has sent disconnect messages (MAINT (OPER = '011')) or timed-out on a traffic channel (see !!9.2.3.5!! and !!9.2.3.6!!);

- when it has received a call maintenance message MAINT (OPER = '110') on a traffic channel which requires it to vacate that channel (see !!9.2.3.7!!).

Also a radio unit which implements the optional "background search sequence" shall enter into the control channel acquisition procedures described in this section:

- when it has identified one or more prospective control channels during a "background search sequence" which meet the parameters LM1, LM2, LM3, and LM4 as applicable.

In addition the radio unit may enter the control channel acquisition procedures under the following circumstances:

- when the radio unit has timed-out on a random access attempt due to NR or NE being reached or TC being exceeded (see !!7.3.8!!);

- when the radio unit has received "system overload" (ACKX(QUAL='1')) as a result of sending a random access request message, except RQR;

- at any time whilst the radio unit is in fall-back mode to enable the radio unit to search for an alternative control channel. The procedures to be adopted by a radio unit exercising this option, including the points of entry and exit from the hunting procedures, are not specified and are, accordingly, not included in the procedural descriptions of the hunting sequences in 9.3.3.

At all times during the control channel acquisition procedures the radio unit shall mute its received audio and refrain from transmission.

9.3.2 Receiver Sensitivity During Control Channel Acquisition

The radio unit shall not attempt to become active on any channel for which the received signal level is less than the specified acquisition threshold.

The acquisition threshold L.2. shall be set to a signal level within the range -88 dBm to -106 dBm at the input of the receiver. The level within this range shall be determined by the manufacturer and shall be set at the lowest value possible consistent with achievable manufacturing tolerances and stability of adjustment under service conditions. When the radio unit is set to an acquisition threshold of L.2., or above, it shall not confirm the channel until the threshold L.2. is exceeded continuously for a minimum of 100ms. The time period shall be concurrent with receiving a decodable control channel system codeword with the value of SYS field selected for verification (see 9.3.4.2.1).

L.O. shall be set at a level determined by the radio unit manufacturer which enables the hunt to be successfully completed as quickly as possible, for example by rejecting channels on which the received signal is inadequate for data to be detected.

Portable radio units may operate with a single acquisition threshold L.1. which shall be set to a signal level of -98 dBm ± 6 dBm at the input of the receiver. The radio unit shall not confirm the channel until the threshold L.1. is exceeded continuously for a minimum of 100 ms. The time period shall be concurrent with receiving a decodable control system codeword with the value of SYS field selected for verification (see 9.3.4.2.1).

9.3.3 Control Channel Hunting Procedures

9.3.3.1 Introduction

In order to find and acquire a control channel emanated by the selected network it is necessary for the radio unit to hunt through candidate forward control channel frequencies until an appropriate control channel is located and confirmed. This control channel hunting may involve a variety of hunting sequences depending on the circumstances of the hunt.

The Control Channel Hunting Procedure stages described are:

(a) "Resuming a Control Channel Sequence" or "Single Channel Hunt Sequence". These are both mandatory hunts limited to a single channel number.

The "resuming a control channel sequence" allows a radio unit, after a period of activity on a traffic channel, to resume the control channel on which it was last confirmed prior to the traffic channel activity.

The "single channel hunt sequence" is employed when a radio unit is directed by the TSC to a particular control channel (indicated by a CONT field value in a MOVE or CLEAR message) or seeks to regain a control channel after a period of inactivity on the selected network (due to being switched off or a user-initiated change of selected network when details of the last confirmed control channel number have been retained by the radio unit in accordance with 9.2.1).

or

- a control channel which satisfies the signal strength parameters LM1, LM2, LM3, or LM4 as applicable.

The optional procedures are mainly designed to increase the efficiency of the hunting sequence by allowing the radio unit initially to sample channels on which it has recorded a successful and current registration, followed by control channels radiated by base station sites within the vicinity (as gleaned from broadcast messages received from the selected network). In addition, the optional procedures allow the scope of the hunting sequence to be increased or decreased on the basis of broadcast messages received from the selected network or as a result of a radio unit implementing a "background search sequence" (see 9.3.3.7).

(c) "Normal Hunt Sequence". A mandatory hunting sequence, with optional procedures, which covers all channel numbers likely to be employed as control channels by the selected network and allows the radio unit to acquire a control channel, even if a need to register will result. The optional procedures allow the scope of the hunting sequence to be increased or decreased on the basis of broadcast messages received from the selected network.

(d) "Comprehensive Hunt Sequence". A mandatory hunting sequence, which may be suppressed for the selected network by radio unit personalisation. It covers all possible channel numbers in use by the network, including those normally only used for traffic channels. This hunting sequence provides a contingency to allow control channels to be acquired even when channel numbers not normally employed for this purpose are in use (in emergency reconfiguration situations, for example). An optional procedure allows the "comprehensive hunt sequence" to be temporarily suspended in favour of the "normal hunt sequence".

When "resuming a control channel" or carrying out a "single channel hunt sequence" the hunting sequence shall be considered complete when the radio unit has tuned directly to the radio channel and has carried out the appropriate confirmation procedures specified in 9.3.4.

Other hunting sequences involve hunting through channel numbers appropriate to the hunting sequence. Hunting is carried out in one or more stages. For each hunt stage the radio unit shall set its receiver acquisition threshold to a particular level and examine any signals received on the sampled channels which exceed that threshold. The radio unit shall then apply the control channel confirmation tests specified in 9.3.4 (the "control

channel confirmation procedure"). The hunting sequence may be considered complete when either:

- a channel is found which satisfies the control channel confirmation tests specified in 9.3.4. The hunting sequence is successfully complete;
- all channel numbers within the scope of the hunting sequence have been tested, at all appropriate acquisition threshold levels, without a channel being found which satisfies the control channel confirmation tests specified in 9.3.4. The hunting sequence is unsuccessfully complete.

The radio unit shall carry out the hunting sequences in the order described in this section. If a hunting sequence is unsuccessfully complete, then the radio shall start the next hunting sequence. The final hunting sequence is the "comprehensive hunt sequence". This hunting sequence cannot be unsuccessfully completed. The radio shall stay in this hunting sequence until a control channel is confirmed. However, the foregoing provisions of this paragraph may be relaxed in the following circumstances:

- the "comprehensive hunt sequence" may be suppressed by radio unit personalisation for a network (see 9.3.3.5);
- a radio unit in a "comprehensive hunt sequence" may elect to perform complete hunting sequences of any other type, returning to the "comprehensive hunt sequence" in the event of failure to confirm an appropriate control channel (see 9.3.3.5);
- a radio unit in the fall-back mode, searching for an alternative control channel immediately after receiving ALHF on its last confirmed control channel, and which fails to find and confirm a normal operation mode control channel whilst hunting (all prescribed hunt sequences shall be completed), shall return to its fall-back channel and attempt to confirm the fall-back channel;
- a radio unit which is in the fall-back mode and is on a fall-back channel and elects to undertake control channel hunting may do so in a non-prescribed manner (see 13.5).

Where a hunting stage involves more than one channel the order in which channels are sampled is generally not specified. However, in order to guard against bias towards certain channels, radio units shall, in the absence of any requirements of this specification which prescribe otherwise, ensure a degree of randomness in the order in which channels are sampled by one of the following:

- hunting channel numbers sequentially (eg, from lowest to highest number) but beginning the hunting stage at a random position in the sequence of channel numbers;
- hunting channel numbers in a random fashion;
- any other suitable randoming method.

The mandatory procedures as defined in this specification are intended to provide a comprehensive range of methods which shall be used as a basis for the design of radio units.

The mandatory procedures specified are a minimum requirement for radio units. The use of additional procedures is not prohibited provided that they are compatible with the mandatory procedures. Note that, for example, a radio unit finding a channel which satisfies the control channel confirmation tests specified in 9.3.4 may continue the hunt in the hope that an alternative control channel may be found with a higher received signal level. Also, radio units need not limit the hunting procedures to the receiver sensitivity threshold levels specified and may conduct additional hunts at other levels.

Whilst employing the hunting procedures specified in this section, radio units are permitted to sample any received signal obtained by tuning to any frequency required by the application of the procedures. It is conceivable that this may involve sampling of private-user channels or channels in use by commercial networks in Band III other than the selected network. Accordingly, it an express condition of this permission to sample any channel that the radio unit shall not permit any intelligence received during hunting procedures to be made available to the user, nor shall it transmit at any time during hunting procedures.

9.3.3.2 Direction to a Control Channel

In certain circumstances the radio unit may receive direction from a TSC regarding the control channel number on which the radio unit should seek to confirm, or the direction may be implicit in the protocol. Two procedures are specified. The procedure which the radio unit shall employ is dependent upon the circumstances of the direction to a control channel number.

9.3.3.2.1 Resuming a Control Channel Sequence

When "resuming a control channel" the radio unit shall retune to the channel number of the control channel on which it was last confirmed, irrespective of registration area, as recorded in its read/write memory (see 9.2). The radio unit shall be capable of receiving on the forward control channel which it is resuming within 34ms of the following instants:

- the end of any CLEAR message which, in accordance with the provisions of section 11.9.2.3.8, requires the radio unit to cease activity on the channel to which it is currently tuned, provided that the value of the CONT field in the CLEAR message is 0;

- the end of the last disconnect message (MAINT (OPER='011')) sent by the radio unit on a traffic channel, or the expiry of time-out TN;

- the end of the last pressel off message (MAINT (OPER='001')) sent by the radio unit on a traffic channel following the expiry of time out TT or the maximum call duration timer, where no disconnect messages (MAINT (OPER='011')) are to be sent by the radio unit (see !!9.2.3.5!!, !!9.2.3.6!! and 11.9.2.3.6);

- the end of any call maintenance message (MAINT (OPER='110')) received on a traffic channel which satisfies the criteria given in !!9.2.3.7!!;

- the operation of the RFCC control "call end request" by the user (8.3.3) during a group call when the radio unit is not the call originating unit (see !!9.2.3.5!!).

Before confirming the control channel the radio unit shall verify any system identity code received on the channel in accordance with the procedures of 9.3.4.2. In the event of the system identity code not meeting the verification procedures the hunting sequence shall be considered unsuccessfully completed. Upon unsuccessful completion of the "resuming a control channel sequence" the radio unit shall enter the "preferential hunt sequence".

9.3.3.2.2 Single Channel Hunt Sequence

A "single channel hunt" shall apply when the radio unit is directed by the TSC to a control channel other than the one on which it was last confirmed, irrespective of registration area, or when it is switched on whilst still retaining valid information from previous activity on the selected network or the user initiates a change of selected network and the radio unit still retains valid information of previous activity on the new selected network, provided in either case that the radio unit is not equipped to implement the "preferential NDD sub-set hunt stage" or that the "preferential NDD sub-set hunt stage" has been suppressed by personalisation (i.e the radio unit holds only zero-length values of PREFERRED NDD sub field data). The receiver shall be tuned to receive the nominated channel within 35ms of the following instants:

- the end of any CLEAR message which,in accordance with the provisions of section 11.9.2.3.8 requires the radio unit to cease activity on the channel to which it is currently tuned, provided that the value of the CONT field in the CLEAR message is not 0;

- the end of any MOVE message that is applicable to the radio unit and in which the value of the CONT field is not 0 (see !!7.4.2!!).

The receiver shall tune immediately to the nominated channel after the following events, but need not be on channel within 35ms:

- the radio unit being switched on, provided that the unit holds a valid record of the channel number on which the radio unit was most recently confirmed and the radio unit does not implement the optional "preferential NDD sub-set hunt stage", or holds only zero-length values of PREFERRED NDD sub-field in its network personalisation data (see 9.3.4.2.2);

- a change of selected network being initiated by the user, provided that the radio unit holds a valid record of the channel number on which the radio unit was most recently confirmed on the new selected network and the radio unit does not implement the optional "preferential NDD sub-set hunt stage", or holds only zero-length values of PREFERRED NDD sub-field in its network personalisation data (see 9.3.4.2.2).

The nominated channel shall be:

- the channel number indicated in the CONT field of the CLEAR message, when CONT is not equal to 0 (see !!5.5.4.3!!);

or

- the channel number indicated in the CONT field of the MOVE message, when CONT is not equal to 0 (see !!5.5.4.4!!);

or

- the channel number held in the radio unit's read/write memory as the control channel on which the unit was most recently confirmed on the selected network.

The radio unit shall not make any transmissions on a control channel until it has confirmed the channel in accordance with the procedure specified in 9.3.4 (including the error checking procedure specified in 9.3.4.4). In the event of a failure of the control channel to meet the channel confirmation criteria the hunting sequence shall be considered unsuccessfully completed. Upon unsuccessful completion of the "single channel hunt sequence" the radio unit shall enter the "preferential hunt sequence".

9.3.3.3 Preferential Hunt Sequence

The "preferential hunt sequence" encompasses three hunt stages which are intended to ensure that the radio unit acquires a control channel which is preferred against selected criteria. These are the "preferential area hunt stage", which is a mandatory stage, and two optional stages, the "preferential NDD sub-set hunt stage" and the "preferential sampled hunt stage".
The mandatory "preferential area hunt stage" is intended to ensure that a hunting radio unit acquires, wherever possible, a control channel bearing an AREA sub-field in the SYS field which relates to a currently valid successful registration record held by the radio unit. Accordingly, the "preferential area hunt stage" should assist in reducing the overall registration message load on the network.

The optional "preferential NDD sub-set hunt stage" is designed to bias the radio unit to a control channel where the relevant portion of the system identity code matches a value of the PREFERRED NDD sub-field held in the radio unit's personalisation data. This hunting stage, if employed, is designed to improve spectral efficiency and increase the availability of radio units for a group call.

The optional "preferential sampled hunt stage" enables radio units implementing the optional "background search sequence" to acquire a control channel on the basis of the PREFERRED NDD sub-field or, where this is not applicable, acquire a control channel on the basis of signal strength from a pre-sampled list of channels.

Either or both of the optional hunt stages may be implemented. In any one "preferential hunt sequence" only one of the optional hunt stages may be carried out (depending upon the reason for entry into the sequence) and shall be completed in advance of the "preferential area hunt stage".

Each hunting stage, except the "preferential sampled hunt stage", shall encompass the control channels held in the radio unit's read-only memory as being applicable to a "normal hunt sequence". The radio unit may modify the compass of the hunting sequence from information held in its read/write memory as follows:

- by adding to the compass of the hunting sequence channel numbers received in BCAST (SYSDEF = '00000') messages from the selected network,

- by removing from the compass of the hunting sequence channel numbers received in BCAST (SYSDEF = '00001') messages from the selected network,

- by adding to the compass of the hunting sequence channel numbers received in BCAST (SYSDEF = '00100') messages from the selected network,

- by adding to the compass of the hunting sequence channel numbers received in BCAST (SYSDEF = '00101') messages from the selected network,

- by adding to the compass of the hunting sequence the channel numbers on which the radio unit was last confirmed on a control channel of the selected network for each registration area for which a successful registration is recorded in the radio unit's read/write memory (see 9.2).

Channel numbers which are covered by more than one of the above categories need only be added once to the compass of the hunting sequence.

In the case of the "preferential sampled hunt stage" the compass of the stage shall consist of all the prospective control channels identified during the "background search sequence" completed immediately prior to entering into the control channel hunting procedures (see 9.3.3.7).

The radio unit shall not make any transmissions on a control channel located during the "preferential hunt sequence" until it has confirmed the channel in accordance with the procedures specified in 9.3.4 (including the AREA sub-field check specified in 9.3.4.2.6 or the NDD sub-field check specified in 9.3.4.2.7, as appropriate).

A radio unit may implement the optional "background search sequence" (see 9.3.3.7) in which case it must also implement the "preferential sampled hunt stage" in the "preferential hunt sequence".

The radio unit may independently implement the optional "preferential NDD sub-set hunt stage" in the "preferential hunt sequence".

If the radio unit is carrying out the "background search sequence" and finds one or more prospective control channels it enters the "preferential hunt sequence" via the "preferential sampled hunt stage". If the radio unit enters the "preferential hunt sequence" for any other reason and implements the "preferential NDD sub-set hunt stage" it shall commence the "preferential hunt sequence" with the "preferential NDD sub-set hunt stage" provided that at least one of the preferred NDD sub-sets held in its network personalisation data has a length greater than zero.

In all other cases the radio unit commences the "preferential hunt sequence" with the "preferential area hunt stage".

9.3.3.3.1 Preferential NDD Sub-set Hunt Stage

The "preferential NDD sub-set hunt stage" is an optional hunting stage which allows a radio unit to acquire, wherever possible, a control channel bearing a sub-set of the NDD sub-field in the SYS field equal to the highest priority preferred sub-set held by the radio unit. The

bit positions from the PREFERRED NDD sub-field which are utilized in each preferred NDD sub-set and the priority of that preferred NDD sub-set are determined by network personalisation (see 9.3.4.2).

Accordingly, the "preferential NDD sub-set hunt stage" should assist, for instance, in availability of a radio unit for group calls and optimisation of spectral efficiency.

A radio unit which implements the optional procedures described in this section shall enter the "preferential NDD sub-set hunt stage" when any of the conditions of entry listed below have been satisfied, providing that the length of at least one of the values of PREFERRED NDD sub-field held in its network personalisation data is non-zero (see 9.3.4.2).

- A "resuming a control channel sequence" has been unsuccessfully completed.
- A "single channel hunt sequence" has been unsuccessfully completed.
- The radio unit is switched on.
- The user initiates a change of selected network.
- The radio unit has left its current control channel due to failure to receive a valid system identity code (SYS) in accordance with the provisions of 9.4.1 b) and c).
- An Aloha, or, additionally in the case of radio units which are equipped to employ the MARK message, a MARK message is received in which CHAN4 does not match the least significant four bits of the ten bit binary representation of the channel number of the control channel on which the message was received and there is no match also in the next decodable Aloha or MARK message (see !!6.2.1.1!!).
- The radio unit has left its current control channel due to application of the codeword error criteria in 9.3.4.3 and 9.4.
- A MOVE message is received that is applicable to the radio unit and in which the value of the CONT field is 0 (see !!7.4.2!! and 11.5.5.4.4).
- A control channel system codeword is received on the current control channel in which the value of the LAB sub-field in the system identity code indicates that the control category of the radio unit for the selected network is not permitted access on that control channel and this condition is repeated in the next decodable control channel codeword.
- A GTC message with CHAN = current channel is received which is not applicable to the unit when the radio unit is not in the fallback mode.
- An ALHF message is received on the current control channel and the radio unit is not in the fall-back mode (see 13.3).
- An ACKX (QUAL = '0') message is received as a result of a registration attempt by the radio unit following a demand from the TSC for the radio unit to attempt registration (see !!8.3.2.2!!).

- The radio unit has timed-out after a random access registration (RQR) attempt due to NR being reached or TC being exceeded (see !!7.3.8!!) at any time other than prior to a successful registration being achieved on a newly-confirmed control channel.

- The radio unit has timed-out due to TJ being exceeded whilst waiting for signalling relevant to the transmission of an RQR message at any time other than prior to a successful registration being achieved on a newly-confirmed control channel.

In addition, radio units may enter the "preferential hunt sequence" at the "preferential NDD sub-set hunt stage" when any of the following conditions of entry are satisfied provided that the length of at least one of the values of PREFERRED NDD sub-field held in its network personalisation data is non-zero (see 9.3.4.2):

- At any time during the "comprehensive hunt sequence", at the radio unit's discretion.

- When the radio unit has timed out after a random access attempt, except RQR, due to NR or NE being reached or TC being exceeded (see !!7.3.8!!).

- When the radio unit has received ACKX (QUAL = '1') as a result of sending a random access message, except RQR.

One "preferential NDD sub-set hunt stage" shall be carried out, at least, with the receiver acquisition threshold set to a level of L.O. (L.1. for a single acquisition threshold portable).

Whilst engaged in a "preferential NDD sub-set hunt stage", a radio unit shall sample all channels within the compass of the hunt for the purposes of subsequent confirmation, and rank them in order of preferred NDD sub-set with the highest priority first before seeking to confirm any channel. The radio unit shall seek to confirm the control channel bearing the highest priority preferred NDD sub-set first. If it fails to confirm this channel it shall seek to confirm the channel bearing the next highest priority preferred NDD sub-set and so on in descending order of priority. Where channels bear preferred NDD sub-sets of equal priority then the radio unit may seek to confirm any of these channels before other channels of lower priority, provided that the above requirements are satisfied.

The radio unit shall not make any transmissions on a control channel located during the "preferential NDD sub-set hunt stage" until it has confirmed the channel in accordance with the procedures specified in 9.3.4 (including the NDD sub-field check specified in 9.3.4.2.7).

In the event that a "preferential NDD sub-set hunt stage" at level L.0. (L.1. for a single acquisition threshold portable) is completed without a channel being found which satisfies the control channel confirmation tests specified in 9.3.4 (including the NDD sub-field check specified in 9.3.4.2.7), or if no relevant NDD preference data exists (see 9.3.4.2.2), then the "preferential NDD sub-set hunt stage" shall be considered unsuccessfully completed and the radio unit shall enter the "preferential area hunt stage" (see 9.3.3.3.3).

9.3.3.3.2 Preferential Sampled Hunt Stage

The "preferential sampled hunt stage" is an optional hunting stage which allows a radio unit, wherever possible, to acquire a pre-sampled control channel bearing a sub-set of the NDD sub-field in the SYS field equal to the highest priority preferred sub-set held by the

radio unit. The bit positions from the PREFERRED NDD sub-field which are utilized in each preferred NDD sub-set and the priority of that preferred NDD sub-set are determined by network personalization (see 9.3.4.2). If the lengths of the values of PREFERRED NDD sub-field held in its network personalization data are zero or if no pre-sampled control channels bearing a preferred NDD sub-set are available the "preferential sampled hunt stage" allows a radio unit to acquire a pre-sampled control channel of increased signal strength. Accordingly, the "preferential sampled hunt stage" should assist, for instance, in the optimisation of spectral efficiency or the increase of call quality.

A radio unit which implements the optional procedures described in this section shall enter the "preferential sampled hunt stage" when

- it has entered the "preferential hunt sequence" as a result of leaving its current control channel having identified one or more prospective control channels (see 9.4.1 (q)).

Whilst engaged in a "preferential sampled hunt stage", a radio unit shall sample all channels identified as prospective control channels during the preceding "background search sequence" (see 9.3.3.7.6). Additionally the radio unit shall obey the requirement to sample and seek to confirm any channel numbers recorded as a result of the "background search sequence" in the radio unit's read/write memory in the following specified order. Firstly, in order of priority, highest priority first, those control channels bearing a preferred NDD sub-set and secondly, in order of signal level, highest signal level first, those control channels not bearing a preferred NDD sub-set.

Prior to confirmation the radio unit shall check that the control channel bears the same system identity code which was recorded against the channel at identification during the "background search sequence" (see 9.3.3.7.6). The radio unit shall not seek to confirm any control channel where this check is not satisfied.

The radio unit shall not make any transmissions on a control channel located during the "preferential sampled hunt stage" until it has confirmed the channel in accordance with the procedure specified in 9.3.4. Note that in the case of a pre-sampled control channel which does not bear a preferred NDD sub-set, the check specified in 9.3.4.2.7 is not carried out.

In the event that a "preferential sampled hunt stage" at level L.O. (L.1. for a single acquisition threshold portable) is completed without a channel being found which satisfies the control channel confirmation tests specified in 9.3.4 then the "preferential sampled hunt stage" shall be considered unsuccessfully completed and the radio unit shall enter the "preferential area hunt stage" (see 9.3.3.3.3).

9.3.3.3.3 Preferential Area Hunt Stage

The "preferential area hunt stage" is a mandatory stage which is intended to ensure that a hunting radio unit acquires, wherever possible, a control channel bearing an AREA sub-field in the SYS field which relates to a currently valid successful registration record held by the radio unit. Accordingly, the "preferential area hunt stage" should assist in reducing the overall registration message load on networks.

A radio unit shall enter the "preferential area hunt stage" when

- a "preferential NDD sub-set hunt stage" has been unsuccessfully completed;

- a "preferential sampled hunt stage" has been unsuccessfully completed.

In addition a radio unit which does not implement the "preferential NDD sub-set hunt stage" or holds only zero-length values of PREFERRED NDD sub-field in its network personalisation data (see 9.3.4.2.2) shall enter the "preferential area hunt stage" when:

- a "resuming a control channel sequence" has been unsuccessfully completed;

- a "single channel hunt sequence" has been unsuccessfully completed;

- the radio unit is switched on and valid information of previous activity on the selected network is still retained in the radio unit's read/write memory, but the information does not include the channel number on which the radio unit was last confirmed on the selected network (see 9.2.1);

- the user initiates a change of selected network and valid information of previous activity on the selected network is still retained in the radio unit's read/write memory, but the information does not include the channel number on which the radio unit was last confirmed on the selected network (see 9.2.1);

- the radio unit has left its current control channel due to failure to receive a valid system identity code (SYS) in accordance with the provisions of 9.4.1.b) and c);

- an Aloha, or, additionally in the case of radio units which are equipped to employ the MARK message, a MARK message is received in which CHAN4 does not match the least significant four bits of the ten bit binary representation of the channel number of the control channel on which the message was received and there is not match also in the next decodable Aloha or MARK message (see !!6.2.1.1!!);

- the radio unit has left its current control channel due to application of the codeword error criteria in 9.3.4.3 and 9.4;

- a MOVE message is received that is applicable to the radio unit and in which the value of the CONT field is 0 (see !!7.4.2!! and 11.5.5.4.4);

- a control channel system codeword is received on the current control channel in which the value of the LAB sub-field in the system identity code indicates that the control category of the radio unit for the selected network is not permitted access on that control channel and this condition is repeated in the next decodable control channel codeword;

- a GTC message with CHAN = current channel is received which is not applicable to the unit when the radio unit is not in the fallback mode;

- an ALHF message is received on the current control channel and the radio unit is not in the fall-back mode (see 13.3);

- an ACKX (QUAL = '0') message is received as a result of a registration attempt by the radio unit following a demand from the TSC for the radio unit to attempt registration (see !!8.3.2.2!!);

- the radio unit has timed-out after a random access registration (RQR) attempt due to NR being reached or TC being exceeded (see !!7.3.8!!) at any time other than prior to a successful registration being achieved on a newly-confirmed control channel;

- the radio unit has timed-out due to TJ being exceeded whilst waiting for signalling relevant to the transmission of an RQR message at any time other than prior to a successful registration being achieved on a newly-confirmed control channel.

In addition, the radio unit may enter the "preferential area hunt stage":

- at any time during the "comprehensive hunt sequence", at the radio unit's discretion;

- when the radio unit has timed out after a random access attempt, except RQR, due to NR or NE being reached or TC being exceeded (see !!7.3.8!!);

- when the radio unit has received ACKX (QUAL = '1') as a result of sending a random access message, except RQR.

One "preferential area hunt stage " shall be carried out, at least, with the receiver acquisition threshold set to a level of L.0. (L.1. for a single acquisition threshold portable).

Whilst engaged in a "preferential area hunt stage" a radio unit shall obey the requirement to sample channels in a random manner as specified in 9.3.3.1, save that it may implement either or both of the following optional procedures to allow selected channels to be sampled prior to a random sampling of the remainder:

- Sample before all other channels any channel numbers recorded in its read/write memory as a control channel of the selected network for registration areas for which successful registrations are recorded (see 9.2). The order in which these channels are sampled is not specified.

- Sample before all other channels any channel numbers recorded in the radio unit's read/write memory which have been gleaned from BCAST (SYSDEF = '00100') or BCAST (SYSDEF = '00101') messages received from the selected network (see 9.2 and 9.3.3.6). The order in which these channels are sampled is not specified.

When both of these optional procedures are implemented the radio unit should sample all channels recorded in registration data before sampling any other channels gleaned from BCAST messages.

The radio unit shall not make any transmissions on a control channel located during the "preferential area hunt stage" until it has confirmed the channel in accordance with the procedures specified in 9.3.4 (including the AREA sub-field check specified in 9.3.4.2.6).

In the event that no valid AREA sub-field data relevant to the selected network is held in the radio unit's read/write memory or in the event of a "preferential area hunt stage" at level L.0. (L.1. for a single acquisition threshold portable) being completed without a channel being found which satisfies the control channel confirmation tests specified in 9.3.4 (including the AREA sub-field check specified in 9.3.4.2.6) then the "preferential hunt sequence" shall be considered unsuccessfully completed. Upon unsuccessful completion of the "preferential hunt sequence" the radio unit shall enter the "normal hunt sequence", unless the "preferential hunt sequence" was entered from the "comprehensive hunt sequence" in which case the radio unit shall return to the "comprehensive hunt sequence".

9.3.3.4 Normal Hunt Sequence

The initial stage of the "normal hunt sequence" shall be carried out with the receiver acquisition threshold set to a level of L.2 (L.1. for a single acquisition threshold portable), or above, and shall encompass the control channels held in the radio unit's read-only memory as being applicable to a "normal hunt sequence". The radio unit may modify the compass of the hunting sequence from information held in its read/write memory as follows:

- by adding to the compass of the hunting sequence channel numbers received in BCAST (SYSDEF = '00000') message from the selected network;

- by removing from the compass of the hunting sequence channel numbers received in BCAST (SYSDEF = '00001') messages from the selected network.

A radio unit shall enter the "normal hunt sequence":

- when a "preferential hunt sequence" has been unsuccessfully completed;

- immediately after switch-on, provided that the radio unit holds no valid information of previous activity on the selected network in its memory and, in addition, that the memory contains no value of NDD preference data with a field length which is greater than zero;

- when the user indicates a change of selected network, provided that the radio unit holds no valid information of previous activity on the selected network in its memory and, in addition, that the memory contains no value of NDD preference data with a field length which is greater than zero.

The radio unit may enter the "normal hunt sequence"

- at any time during the "comprehensive hunt sequence", at the radio unit's discretion.

The radio unit shall not make any transmissions on a control channel located during the "normal hunt sequence" until it has confirmed the channel in accordance with the procedures specified in 9.3.4.

In the event that a "normal hunt stage" at level L.2. or above is completed without a channel being found which satisfies the control channel confirmation tests specified in 9.3.4, then a "normal hunt stage" may be repeated at other levels. However, before the "normal hunt sequence" may be unsuccessfully completed, a "normal hunt stage" shall have been completed at least twice; once with the receiver acquisition threshold set to L.2.

and once with the threshold set to L.O. (This does not apply for a single acquisition threshold portable).

Upon unsuccessful completion of the "normal hunt sequence" the radio unit shall enter the "comprehensive hunt sequence", except when the "comprehensive hunt sequence" has been suppressed by radio unit personalisation for a network (see 9.3.3.5).

9.3.3.5 Comprehensive Hunt Sequence

The initial stage of the "comprehensive hunt sequence" shall be carried out with the receiver acquisition threshold set to a level of L.2. (L.1. for a single acquisition threshold portable) or above and shall normally encompass every channel within the range set by the lowest and highest channel numbers set by the network operator, held in the radio unit's read-only memory. However, it is permissible for radio units to be configured to omit channel numbers within the range of the "comprehensive hunt" by arrangement with the operator of the selected network and by network personalisation.

A radio unit shall enter the "comprehensive hunt sequence" when

- a "normal hunt sequence" has been unsuccessfully completed.

In the event that a "comprehensive hunt stage" at level L.2, or above, is completed without a channel being found which satisfies the control channel confirmation tests specified in 9.3.4, then a "comprehensive hunt stage" may be repeated at other levels. In the event that no channels are found which satisfy the control channel confirmation tests during subsequent hunts and, providing that a comprehensive hunt stage has been completed with the receiver acquisition threshold set to a level L.2, then the radio unit shall revert to a "comprehensive hunt stage" with the receiver acquisition threshold set to a level L.O. and shall repeat the "comprehensive hunt stage" until such a time as a channel which satisfies the control channel confirmation tests specified in 9.3.4 is found, except when the radio unit entered the "comprehensive hunt sequence" via the "preferential hunt sequence" as a result of receiving ALHF, and the radio unit is in the fall-back mode, when the action taken in the "comprehensive hunt sequence" is prescribed in section 13.

For a single acquisition threshold portable completing a "comprehensive hunt stage" without a channel being found which satisfies the control channel confirmation tests specified in 9.3.4, then the portable radio unit shall repeat the "comprehensive hunt stage" until such a time as a channel which satisfies the control channel confirmation tests specified in 9.3.4 is found except when the radio unit entered the "comprehensive hunt sequence" via the "preferential hunt sequence" as a result of receiving ALHF, and the radio unit is in the fall-back mode, when the action taken in the "comprehensive hunt sequence" is prescribed in section 13.

The radio unit shall not make any transmissions on a control channel located during the "comprehensive hunt sequence" until it has confirmed the channel in accordance with the procedures specified in 9.3.4.

At any time during the "comprehensive hunt sequence" a radio unit may undertake a "preferential hunt sequence" or "normal hunt sequence", returning to the "comprehensive hunt sequence" in the event that the "preferential hunt sequence" or "normal hunt sequence" is unsuccessfully completed. It shall be possible to suppress the

"comprehensive hunt sequence" by radio unit personalisation for a network. In this case the radio unit shall remain in the "normal hunt sequence" with the acquisition threshold set to a level L.O. (L.1. for a single acquisition threshold portable) until such time as a channel which satisfies the control channel confirmation tests specified in 9.3.4 is found, unless the radio unit is in the fall-back mode, when the action taken in the "normal hunt sequence" is prescribed in section 13.

9.3.3.6 The Use of Adjacent Site Data

When confirmed on a control channel a radio unit may make use of information gleaned from BCAST (SYSDEF = '00100') and BCAST (SYSDEF = '00101') messages. These messages may be transmitted by the selected network and contain information on the control channels in use by sites in the vicinity of the transmitting site (adjacent site data) to assist radio units to acquire an appropriate control channel after leaving the current control channel.

The broadcast message contains both the channel number and SYS code which is being transmitted by the announced site and may also have a local serial number allocated (ADJSITE) to specify site location irrespective of control channel number and SYS code. The way in which ADJSITE information may be used by the radio unit is not prescribed in this specification.

The action to be taken by the radio unit upon receipt of any BCAST (SYSDEF = '00101') message or any BCAST (SYSDEF = '00100') message is not prescribed by this specification but the following comments are offered for the benefit of designers implementing schemes which utilise these facilities.

In storing the data received in the broadcast messages the unit may pre-filter the data for suitability of use by examining the SYS code contained in the announcement. In the case of BCAST (SYSDEF='00101') the unit may use the next slot to examine the announced channel and make a record of the received signal strength without incurring the risk of losing relevant call data on the control channel on which it is confirmed.

The unit constructs a 15 position table which contains relevant data on each announced site. This data may include any signal strength information which might be gathered by examination of the announced channel. The data is used to modify each of the control channel searches in favour of channels which are more likely to provide a satisfactory service than other channels which the search parameters may require. As the ADJSITE field is peculiar to the transmitting site any table using ADJSITE may only be refreshed with data received from the same site. A new table should be started when a new control channel is acquired. According to the unit design the old table may be stored, its data may be used by reference to the SYS code, or the table may be destroyed when the unit acquires a new control channel.

9.3.3.7 Background Search Sequence

The "background search sequence" is an optional hunting sequence which is intended to allow the radio unit, while confirmed on a control channel, to gain information about alternative control channels. Where the "background search sequence" indicates that one or more alternative control channels are available which may offer greater spectral

efficiency (by virtue of bearing a preferred NDD sub-set) or may offer a stronger signal giving improved quality of service to the user, the radio unit leaves the current control channel and enters the control channel hunting procedures (providing that certain criteria are satisfied).

The "background search sequence", if implemented, shall be carried out as a background activity whilst the radio unit is confirmed on a control channel and is in the idle state. At all other times the "background search sequence" shall be suspended.

The sampling of control channels within the "background search sequence" takes place during discrete periods, each such period being referred to as either a "timed sampling activity" or an "elected sampling activity" (see 9.3.3.7.3).

The maximum duration of a "timed sampling activity" and the minimum time between successive timed sampling activities are set by network personalisation (see 9.3.3.7.1 and 9.3.3.7.3).

The signal strength criteria, by which alternative control channels are identified, must be satisfied for a number of consecutive timed sampling activities, set by network personalisation, immediately preceding confirmation.

The methods employed to sample channels during either sampling activity are not prescribed by this specification save that the purpose of sampling is to determine for each sampled channel whether it is a prospective control channel and to record, for all such prospective control channels, the received signal level of the channel (see 9.3.3.7.6) and a value of system identity code received in a control channel system codeword.

These techniques are most appropriate for systems using continuous control channels because of difficulties in reliably determining the signal strength of time-shared control channels, although their use on such systems is not disallowed.

9.3.3.7.1 Performing a Sampling Activity

Sampling activities are carried out whilst confirmed on a control channel. The radio unit may leave the confirmed control channel to perform a sampling activity to search for alternative control channels subject to the following conditions.
For the "timed sampling activity":

a) The radio unit shall have been confirmed on the channel for at least a period TL, where TL is network dependent;

b) The radio unit shall not carry out a further sampling activity until timer TL has expired since the completion of any previous sampling activity.

For the "elected sampling activity":

c) The radio unit shall have decoded an address codeword from the forward control channel which is not addressed to it (ie PFIX/IDENT 1 does not match any of its designated addresses for the system and is not the system-wide, all-call ident ALLI) and which indicates that one or more following forward control channel slots will be occupied by the message of which the address codeword is the first codeword. If the radio unit exercises this option the maximum duration of the sampling activity

shall not be TH (see 9.3.3.7.3) but shall be the number of slots following the address codeword which that codeword indicates will be occupied by the message.

For both sampling activities:

d) The radio unit shall suspend all sampling activity whilst waiting for signalling or whilst tuned to a traffic channel and shall resume when it returns to the idle state;

e) Whilst preparing to leave the control channel as a result of 9.4.1 (b), (c), (d), or (g) the radio unit shall suspend all sampling activity;

f) Both of TL and TH (see 9.3.3.7.3) are non-zero. If either or both TL and TH are zero the radio unit shall not perform any sampling activities.

9.3.3.7.2 Actions Prior to Performing a Sampling Activity

Prior to leaving the currently confirmed control channel for the purposes of performing a sampling activity the radio unit shall suspend any codeword error count in progress and retain any error counts to allow error checking to resume when the sampling activity is completed (see 9.3.3.7.5).

9.3.3.7.3 Actions During a Sampling Activity

Whilst carrying out any sampling activities the radio unit shall continue to indicate service to the user where this option is implemented.

Provided that the conditions of 9.3.3.7.1 are met, the radio unit may commence a "timed sampling activity" at any time after a decodable address codeword has been received.

For the purposes of counting NS samples, where NS is network dependent (see 9.3.3.7.6), the radio unit shall not sample any channel more than once during a single "timed sampling activity".

The radio unit shall complete the "timed sampling activity" and return to receiving the confirmed forward control channel in sufficient time to be capable of decoding an address codeword in the next slot after TH continuous slots (where TH is network dependent) following the one in which the last address codeword was received prior to the "timed sampling activity" being commenced.

The number of channels sampled during each sampling activity will be dependent on the radio unit design.

9.3.3.7.4 Scope of the Background Search Sequence

The "background search sequence" shall encompass all control channels held in the radio unit's read-only memory as being applicable to a "normal hunt sequence". The radio unit may modify the compass of the "background search sequence" from information held in its read/write memory as follows:

- by adding to the compass of the search sequence channel numbers received in BCAST (SYSDEF = '00000') messages from the selected network;

- by removing from the compass of the search sequence channel numbers received in BCAST (SYSDEF = '00001') messages from the selected network;

- by adding to the compass of the search sequence channel numbers received in BCAST (SYSDEF = '00100') messages from the selected network;

- by adding to the compass of the search sequence channel numbers received in BCAST (SYSDEF = '00101') messages from the selected network;

- by adding to the compass of the search sequence the channels numbers on which the radio unit was last confirmed on a control channel of the selected network for each registration area for which a successful registration is recorded in the radio unit's read/write memory (see 9.2).

9.3.3.7.5 Actions Following a Sampling Activity

After completing a sampling activity, the radio unit shall resume any codeword error count in progress prior to the sampling activity at the values of the retained results, unless the requirements of 9.4.1(q) have been met. Note that a sampling activity shall only be considered complete when the radio unit has entered a "preferential sampled hunt stage" in accordance with the provisions of 9.4.1 (q) or has returned to the confirmed control channel and is capable of decoding forward control channel address codewords.

9.3.3.7.6 Criteria for Identification of Prospective Control Channels

The radio unit shall not identify any channels as prospective control channels until it has sampled all the channels detailed in 9.3.3.7.4 at least once since the current control channel was confirmed.

Note that during the last "timed sampling activity" immediately prior to identification of prospective control channels, the radio unit may sample more than one channel for subsequent identification, as shown below, providing the requirements of 9.3.3.7.3 are met. Those which satisfy criteria (a) and one of (b), (c), (d) and (e) as shown below, shall be identified as prospective control channels.

a) The sampled channel bears a system identity code for the selected network which the radio unit is authorised to acquire (see 9.3.4.2.4 and 9.3.4.2.5).

b) The confirmed control channel bears a preferred NDD sub-set in the PREFERRED NDD sub-field of the system identity code, and the sampled channel bears a higher priority preferred NDD sub-set and exceeds L.0, by a margin LM4, where LM4 is network dependent.

c) The confirmed control channel bears a preferred NDD sub-set in the PREFERRED NDD sub-field and is less than or equal to L.2. and the sampled channel bears an equal priority preferred NDD sub-set and exceeds the confirmed control channel by a level margin LM2, where LM2 is network dependent.

d) The confirmed control channel does not bear a preferred NDD sub-set in the PREFERRED NDD sub-field of the system identity code, but the sampled channel

bears a preferred NDD sub-set and exceeds L.0. by a level margin LM3, where LM3 is network dependant.

e) The confirmed control channel does not bear a preferred NDD sub-set in the PREFERRED NDD sub-field and is less than or equal to L.2., and the sampled channel does not bear a preferred NDD sub-set but exceeds the confirmed control channel by a level margin LM1, where LM1 is network dependent.

See table 9-1.

All criteria relating to signal strength, ie. level margin parameters LM1-LM3, shall be satisfied for NS consecutive timed sampling activities immediately prior to the relevant channel being identified as a prospective control channel. Note that any signal strength measurements carried out during an "elected sampling activity" shall not be treated as one of the NS samples.

The channel number, system identity code and signal strength (if appropriate) of each prospective control channel shall be stored once identified. Following any completion of the confirmation procedures in 9.3.4, the radio unit shall discard all information obtained from sampling activities.

TABLE 9-1 CRITERIA FOR IDENTIFICATION OF PROSPECTIVE CONTROL CHANNELS

<table>
<tr><td colspan="2" rowspan="2">Criteria for prospective control channel identification</td><td colspan="2">CONFIRMED CONTROL CHANNEL</td></tr>
<tr><td>Has SYS field with preferred NDD sub-set</td><td>Has SYS field with non-preferred NDD sub-set</td></tr>
<tr><td rowspan="3">SAMPLED

CONTROL

CHANNEL</td><td rowspan="2">Has SYS field with prefered NDD sub-set</td><td><u>Sampled has lower priority.</u>
Prospective control channel is not identified.

(sampled signal strength - confirmed signal strength) >LM.2 and confirmed signal strength ≥L.2</td><td rowspan="2">Sampled signal strength
>
(L.0. + LM.3)</td></tr>
<tr><td><u>Sampled has higher priority.</u>
Sampled signal strength >(L.0. + LM4)</td></tr>
<tr><td>Has SYS field with non-prefered NDD sub-set</td><td>Prospective control channel is not identified</td><td>Sampled signal strength - confirmed signal strength) > LM.1 and confirmed signal strength ≤ L.2.</td></tr>
</table>

9.3.4 Control Channel Confirmation

9.3.4.1 Identifying a Candidate Control Channel

During any of the hunting procedures specified in section 9.3.3 the radio unit shall examine any signal detected for conformity with control channel structure. The radio unit shall accept as a candidate control channel any channel on which a control channel codeword synchronisation sequence is detected.

The method by which the radio unit identifies candidate control channels during hunting is not detailed in this specification. In particular no maximum time allowance for this procedure is specified, although attention is drawn to the necessity of completing tests as quickly as possible, notably on channels which can be easily rejected as control channel candidates (eg, no FFSK data is detected), since the overall speed of the hunt (and thus efficiency of service to the user) depends on the rapidity with which these tests can be carried out. However, if the channel number of the channels being sampled is identified as one on which a time-shared control channel may be expected in the store of channel numbers held in the radio unit's read-only memory as applicable to a "normal hunting sequence" (see 9.2.1) or in the store of data received from BCAST messages held in read/write memory (see 9.2.2) or in the TSI field of a received MOVE or CLEAR message, then the radio unit shall sample the channel for at least a period TS before rejecting the channel on the grounds of failure to detect a control channel codeword synchronisation sequence.

Following the receipt of a MOVE or CLEAR message where TSI='0', it is recommended that enough time is allowed for the radio unit to sample the channel in order to decode a valid codeword that may otherwise be corrupted due to fading or other degradation in the received signal. Allowing extra sampling time may reduce the delay in acquiring a channel following the receipt of a MOVE or CLEAR message

9.3.4.2 Checking the System Identity Code

9.3.4.2.1 Requirement to Verify System Identity Code

When the radio unit has identified a candidate control channel in accordance with section 9.3.4.1, it shall examine the values of the system identity code fields (SYS) of the control channel system codewords received on the channel.

When NV control channel system codewords have been received consecutively with the same value of SYS field, the radio unit shall attempt to verify that value.

The radio unit shall hold two alternative values of NV as follows:

- one value of NV shall be utilised when monitoring a channel for the purpose of selecting a value of SYS field for verification when the channel number is identified as one on which time-shared control channels may be expected in the store of channel numbers held on the radio unit's read-only memory as applicable to a "normal hunting sequence" (see section 9.2.1), or in the store of data received from BCAST messages held in read/write memory (see section 9.2.2), or in the TSI field of a received MOVE or CLEAR message;

- the other value of NV shall be utilised when monitoring a channel for the purpose of selecting a value of SYS field for verification when the channel

number is not identified in the data stores or fields specified above as one on which time-shared control channels may be expected.

If the channel number is identified, as above, as one on which a time-shared control channel may be expected, and the radio unit fails to select a value of SYS field for verification before a period TS from the instant of first receiving the channel has expired, the radio unit shall reject the channel as a candidate control channel and resume the hunting sequence.

If the channel number is not identified, as above, as one on which a time-shared control channel may be expected, the time which the radio unit may continue to search for a value of SYS field for verification is not specified. However attention is drawn to the necessity to ensure that this period is as short as possible to be consistent with the requirement to minimise hunting time in 9.3.4.1, but that it is long enough to allow the possibility of receiving NV consecutive control channel system codewords.

When the radio unit has selected a value of SYS field for verification, it shall decide if it is authorised to acquire the control channel (see 9.3.4.2.3 to 9.3.4.2.6). If acquisition is permitted then the radio unit shall become active on the control channel. Additionally, if the hunting stage is being undertaken at an acquisition threshold level less than L2, the radio unit shall start the error checking procedure specified in 9.3.4.4 immediately after verification.

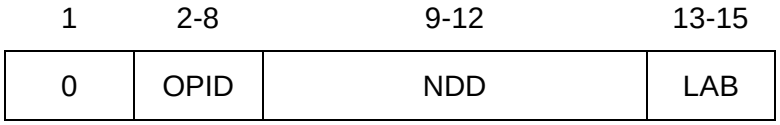
Note that in the case of a "resuming a control channel sequence", the error checking procedure specified in 9.3.4.4 is not carried out.

Whilst active on a control channel, after verification but prior to confirmation, the radio unit shall not transmit any random access messages, but it shall obey any applicable messages received, as required, provided that to do so does not involve transmitting on the control channel.

9.3.4.2.2 Structure of the System Identity Code

In order to assist radio units to check acquisition authorisation for system identity codes and to facilitate the geographical sub-division of subscription service offered by network operators, the use of the system identity field within commercial trunked networks operating in Band III sub-bands 1 and 2 shall be structured as follows:

With bit 1 of the SYS field set to '0':

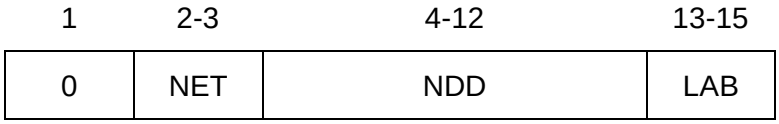


OPID - Network operator identity
To be allocated by the Radiocommunications Agency (RA)

NDD - Network dependent data
(see below)

LAB - Label for multiple control channels
(see 9.5.3)

With bit 1 of the SYS field set to '1':



NET - Network operator identity

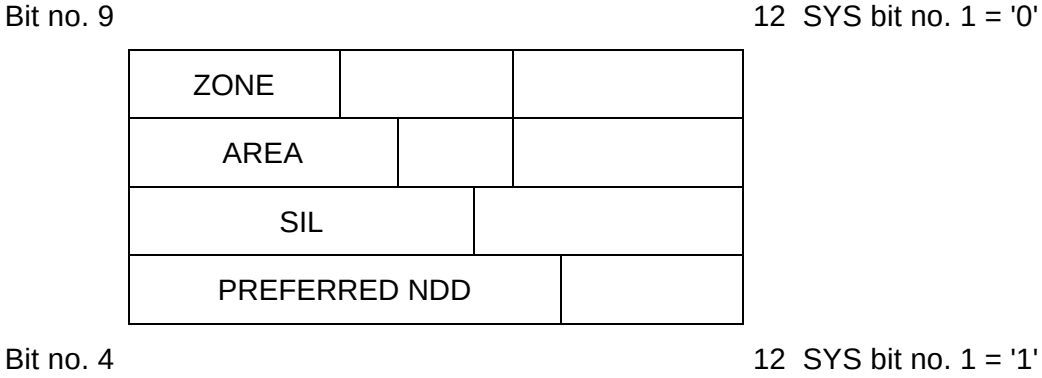
'00' National network no. 1
'01' National network no. 2
'10' Reserved
'11' Reserved

NDD - Network dependent data
(see below)

LAB - Label for multiple control channels
(see 9.5.3)

Format of the network dependent data

The network operator is free to utilise the network dependent data sub-field in any way which conforms to the following general structure and requirements:



ZONE - A sub-field with length set by the network operator, starting at bit 9 (SYS bit no. 1 = '0') or bit 4 (SYS bit no. 1 = '1') which indicates the subscription zone to which the system identity code belongs.

AREA - A sub-field with length set by the network operator, starting at bit 9 (SYS bit no. 1 = '0') or bit 4 (SYS bit no. 1 = '1') which indicates the registration area to which the system identity code belongs.

FREE - A sub-field with length set by the network operator ending at bit 12 of the SYS field which may be used for any control channel identification purpose which the network operator specifies.

SIL - A sub-field with length set by the network operator (minimum 3), starting at bit 9 (SYS bit no. 1 = '0') or bit 4 (SYS bit no. 1 = '1') which indicates the sub-field to be used when checking the source of

MAINT or CLEAR messages (see 11.9.2.3.3, 11.9.2.3.7 and 11.9.2.3.8).

PREFERRED NDD - A sub-field with length set by the network operator starting at bit 9 (SYS bit no. 1 = '0') or bit 4 (SYS bit no. 1 = '1') which indicates the sub-field of the network dependent data which is to be preferred during hunting.

Zero bits is a valid length of any sub-field, in which case that sub-field has no relevance to acquisition authorisation or hunting procedures.

9.3.4.2.3 Acquisition Authorisation Data and NDD Preference Data

The radio unit shall provide facilities for acquisition authorisation data to be implanted during network personalisation to enable the radio unit to carry out the verification process specified in 9.3.4.2.1 for each possible selected network (see 9.2). This acquisition authorisation data shall consist of the following information for each possible selected network:

- the length of the ZONE sub-field (LZ),
- the length of the AREA sub-field (LA).

In addition, the acquisition authorisation storage shall provide for any combination of the following three classes of acquisition data for at least eight total entries:

- zone identity: a binary number of length equal to LZ, which authorises acquisition of control channels conveying system identity codes bearing that zone value;
- area identity: a binary number of length equal to LA, which authorises acquisition of control channels conveying system identity codes bearing that area value;
- full identity: a binary number of length 4 bits (SYS bit no. 1 = '0') or 9 bits (SYS bit no. 1 = '1') which authorises acquisition of control channels conveying the single identity code in the network which bears that value in bits 9 to 12 (SYS bit no. 1 = '0') or bits 4 to 12 (SYS bit no. 1 = '1').

Each zone, area or full identity entry in memory shall include an identifier to distinguish the three classes of data (the form to be taken by this identifier is not specified).

The radio unit may provide facilities for NDD preference data to be implanted during network personalisation to enable the radio unit to carry out the verification process specified in 9.3.4.2.7 for each possible selected network (see 9.2). This NDD preference data shall consist of the following information for each possible selected network:

- At least four values of PREFERRED NDD sub-field, each value referred to as a preferred NDD sub-set, which identify preferred system identity codes as ones bearing these values in the PREFERRED NDD sub-field.

- For each preferred NDD sub-set a number from 0-9 indicating the length of the PREFERRED NDD sub-field in bits to which the value refers.

- For each preferred NDD sub-set, a number from 1 to 10, inclusive, indicating the order of priority (1 is highest priority, 10 lowest) in a "preferential NDD sub-set hunt stage", "preferential sampled hunt stage" or "background search sequence". The same priority may apply to more than one preferred NDD sub-set.

9.3.4.2.4 Use of Acquisition Authorisation Data

The radio unit shall apply the following procedures when checking a system identity code selected for verification against its acquisition authorisation data for the selected network.

If bit 1 of the selected SYS is '1', the radio unit shall check that the selected network is a national network and that a match exists between the NET field in the selected SYS and that authorised for the selected network.

If bit 1 of the received SYS is '0', the radio unit shall check that the selected network is a regional network and that a match exists between the OPID field in the selected SYS and that authorised for the selected network.

- If the radio unit holds no data for zone, area or full identity acquisition authorisation for the selected network, then it may acquire any control channel belonging to that network.

- If the radio holds data for zone, area or full identity acquisition authorisation for the selected network, then the following precedence shall apply:

  (a) The radio unit shall first check for a match between any zone identity acquisition authorisation data and the selected system identity code. If a match is found then acquisition is authorised.

  (b) Failing acquisition authorisation at the zone identity level, the radio unit shall check for a match between any area identity acquisition authorisation data and the selected system identity code. If a match is found then acquisition is authorised.

  (c) Failing acquisition authorisation at the zone or area identity level, the radio unit shall check for a match between any full identity acquisition authorisation data and the selected system identity code. If a match is found then acquisition is authorised.

If acquisition authorisation testing fails at all three levels, then the radio unit shall assume that it is not authorised to acquire the control channel under test.

9.3.4.2.5 Checking the LAB Sub-field

If the radio unit has successfully verified the system identity code against its acquisition authorisation data for the selected network it shall examine the LAB sub-field in the light of its control category held in read-only memory (see 9.2).

If control channel confirmation is being carried out during a "preferential NDD sub-set hunt stage", or, where specified, during a "preferential sampled hunt stage" (see 9.3.3.3.2), the radio unit shall examine the PREFERRED NDD sub-field of the system identity code being verified against the NDD preference data for the selected network held in the radio units read-only memory. If no match can be found between any item of NDD preference data and the selected system identity code then the radio unit shall assume that it is not authorised to acquire the control channel under test on this basis.

9.3.4.3 Error Checking on a Control Channel

Whilst receiving a control channel a radio unit shall monitor the codeword error rate and count the codewords received with errors (after the application of any error corrections procedures which may be adopted) in successive samples of NC1 or NC2 codewords (values are network dependent). Samples of length NC1 codewords shall be taken when monitoring the channel for the purpose of final checking prior to confirmation (9.3.4.4) and of length NC2 after confirmation. In this context a "codeword" shall be considered as the contents of the first or second half of a slot on the forward control channel (see !!3.3.3.1!!) irrespective of the contents of that slot. Any codeword which is not decodable shall be regarded as a codeword with errors.

The radio unit shall also count as codewords with errors all errors from, and including, the first CCSC received with a value of SYS field different to that selected for verification, until the first CCSC received with a value of SYS field the same as that selected for verification

If, in any sample of NC1 codewords, the count of codewords received with errors exceeds NX1 (network dependent), or in any sample of NC2 codewords, the count of codewords received with errors exceeds NX2 (network dependent), then a codeword sample error event shall be recorded by the radio unit. The radio unit shall hold two alternative values of NC1/NX1 and NC2/NX2 as follows:

- one set of values of NC1 and NX1 shall be utilised when monitoring a channel for the purpose of final checking prior to confirmation when the channel number is identified as one on which time-shared control channels may be expected in the store of channel numbers held in the radio unit's read-only memory as applicable to a "normal hunting sequence" (see 9.2.1) or in the store of data received from BCAST messages held in read/write memory (see 9.2.2) or in the TSI field of a received MOVE or CLEAR message;

- the other set of values of NC1 and NX1 shall be utilised when monitoring a channel for the purpose of final checking prior to confirmation when the channel number is not identified in the data stores or fields specified above as one on which time-shared control channels may be expected;

- one set of values of NC2 and NX2 shall be utilised when monitoring a channel after confirmation when the channel number is identified as one on which time-shared control channels may be expected in the store of channel numbers held in the radio unit's read-only memory as applicable to a "normal hunting sequence" (see 9.2.1) or in the store of data received from BCAST messages held in read/write memory (see 9.2.2), or in the TSI field of a received MOVE or CLEAR message;

- the other set of values of NC2 and NX2 shall be utilised when monitoring a channel after confirmation when the channel number is not identified in the data stores or fields specified above as one on which time-shared control channels may be expected.

Whilst waiting for signalling on a control channel (eg, after transmitting a random access message) a radio unit shall suspend the count of codewords received with errors. Any count in progress at the time that a radio unit enters this waiting state shall be aborted and the result discarded.

When a radio unit leaves the control channel as a result of the circumstances specified in 9.4.1 parts (b), (c), (d), (f), (g), or (m), or (h) when due to a demanded registration, it shall resume error checking. When it acquires and verifies a new channel it shall confirm the channel (9.3.4.4) and shall then suspend error checking until it is no longer waiting for signalling.

9.3.4.4 Final Checking Prior to Access

If a control channel, which satisfies the procedures of 9.3.4.1 and 9.3.4.2, was sampled during a hunt at a level less than L.2., then it shall not be finally confirmed until the error checking procedure specified in 9.3.4.3 has produced NZ1 samples of NC1 codewords. Further if any of the NZ1 samples of NC1 codewords has produced a codeword sample error event then the radio unit shall reject the channel and resume hunting.

When a sampled control channel has passed all the appropriate tests in 9.3.4.1, 9.3.4.2 and 9.3.4.3 then the radio unit shall regard the current hunting sequence as complete and shall consider the control channel as confirmed.

9.4 Leaving a Control Channel

9.4.1 Reasons for Leaving a Control Channel Whilst Not Waiting for Signalling

Whilst active on a control channel, either prior to acquisition being confirmed or during activity subsequent to control channel confirmation, the radio unit shall monitor conditions on that channel and be prepared to leave the control channel and return to the control channel hunting procedures. This monitoring shall continue when the radio unit is waiting for signalling from the TSC, but the circumstances which result in the radio unit leaving the control channel are reduced and are prescribed in 9.4.2 below.

When not in the state of waiting for signalling from the TSC the radio unit shall leave the current control channel and enter the control channel hunting stage prescribed when:

(a) After confirmation, a codeword sample error event has been recorded in a sample of NC2 codewords (see 9.3.4.3) and codeword sample error events are recorded in each of NZ2 further successive samples of NC2 codewords. In this case the radio unit shall enter the "preferential hunt sequence".

(b) The value of bits 1 to 12 of the SYS recovered from decodable control channel system codewords received differs from the value of the bits verified during acquisition authorisation (see 9.3.4.2.1) for a continuous period TS and the next decodable control channel system codeword received after the expiry of TS also yields a value of SYS different to the verified value (see !!6.2.1.2!!). The radio unit shall remain active on the channel after the first mismatch but shall not transmit any random access message until a valid SYS value has been received, in which case it may resume normal operation (see !!6.2.1.2!!). After leaving a control channel in these circumstances, the radio unit shall enter the "preferential hunt sequence", unless it is prior to confirmation when it shall resume hunting procedures.

(c) No decodable control channel system codewords are received over a continuous period in excess of TS (see !!6.2.1.2!!). In this case the radio unit shall enter the "preferential hunt sequence", unless it is prior to confirmation when it shall resume hunting procedures.

(d) An Aloha or, in the case of radio units which are equipped to employ the MARK message, a MARK message is received in which the value of CHAN4 does not match the least significant four bits of the channel number of the control channel and there is also no match in the next decodable Aloha or MARK message. The radio unit shall remain active on the channel after the first mismatch but shall not transmit any random access message and shall leave the channel immediately after the second mismatch, unless a valid CHAN4 value has been received in the interim in which case it may resume normal operation (see !!6.2.1.2!!). After leaving a control channel in these circumstances the radio unit shall enter the "preferential hunt sequence", unless it is prior to confirmation when it shall resume hunting procedures.

(e) The user initiates a change of selected network. In this case the radio unit shall assume control channel acquisition procedures on the new selected network with the "single channel hunt sequence", the "preferential hunt sequence", or the "normal hunt sequence" depending on what valid information of previous activity on the new selected network is held in the radio unit's read/write memory.

(f) A MOVE message applicable to the radio unit is received (see !!7.4.2.!!). In this case the radio unit shall note the value of the TSI field and enter either the "single channel hunt sequence" or the "preferential hunt sequence" depending on the value of the CONT field in the MOVE message.

(g) A control channel system codeword is received in which the value of the LAB sub-field in the system identity code indicates that the control category of the radio unit for the selected network is not permitted access on the current control channel and the LAB value in the next decodable control channel system codeword also indicates that the radio units control category is not acceptable. The radio unit shall remain active on the channel after the first failure but shall not transmit any random access message and shall leave the channel immediately after the second failure, unless a value of LAB sub-field is received in the interim which does permit access by the unit, in which case it may resume normal operation (see 9.5.3). After leaving a control channel in these circumstances the radio unit shall enter the "preferential hunt sequence", unless it is prior to confirmation when it shall resume hunting procedures.

(h) The radio unit receives ACKX(QUAL='0') as a result of sending a random access registration (RQR) message (see !!8.2.2.3!!), or as a response to an RQR sent in reply to a registration demand by the TSC (see !!8.3.2.2!!). In the case of a random access registration request (not permitted prior to confirmation) or a registration demand received whilst the radio unit is seeking to make a random access registration request, the radio unit shall assume the hunt stage that it was last engaged in prior to the registration attempt. It may either resume the hunt stage at the channel number it would have sampled next or commence the hunt stage anew. In the case where a registration demand was received at any other time, the radio unit shall enter the "preferential hunt stage", unless it is prior to confirmation when it shall resume hunting procedures.

(j) After confirmation, the radio unit receives ACKX(QUAL='1') as a result of sending a random access registration request (RQR) message (see !!8.2.2.3!!). In this case the radio unit shall assume the hunt stage that it was last engaged in prior to the registration attempt. It may either resume the hunt stage at the channel number it would have sampled next or commence the hunt stage anew.

(k) After confirmation, the radio unit has timed out after a random access registration (RQR) attempt due to NR being reached or TC being exceeded (see !!7.3.8!!). In this case if the registration attempt is being carried out prior to a successful re-registration being achieved on a newly-confirmed control channel the radio unit shall assume the hunt stage that it was last engaged in prior to the registration attempt. It may either resume the hunt stage at the channel number it would have sampled next or commence the hunt stage anew. If the registration attempt is being carried out at any other time the radio unit shall enter the "preferential hunt sequence".

(l) When the radio unit receives an ALHF message or equivalent (see 13.6) and the radio unit is not in the fall-back mode (see 13.3). In this case the radio unit shall

enter the "preferential hunt sequence". If the radio unit is equipped with the fall-back option it shall obey the procedures of section 13.

(m) When the radio unit receives a GTC message which it has not obeyed in which the designated traffic channel is the control channel on which the message was received and the radio unit is not in the fallback mode (see !!9.2.2.5!!). In this case the radio unit shall enter the "preferential hunt sequence".

In addition to these mandatory conditions a radio unit may leave the current control channel and enter the control acquisition procedures when:

(n) After confirmation, the radio unit receives ACKX(QUAL='1') as a result of sending a random access request message, except RQR. If the radio unit leaves the control channel as a result of exercising this option it shall enter the "preferential hunt sequence".

(p) After confirmation, the radio unit has timed-out after a random access attempt, except RQR, due to NR or NE being reached or TC being exceeded (see !!7.3.8!!). If the radio unit leaves the control channel as a result of exercising this option it shall enter the "preferential hunt sequence".

(q) After confirmation, the radio unit has identified one or more prospective control channels as a result of carrying out a "background search sequence" (see 9.3.3.7). If the radio leaves the control channel as a result of exercising this option it shall enter the "preferential hunt sequence".

In addition a radio unit may leave the current control channel, temporarily, when:

(r) It has received a BCAST (SYSDEF ='00101') message. In this case the radio unit shall switch to the channel indicated by the CHAN field in the message and shall return to the confirmed control channel in sufficient time to be able to decode any address codeword which may be transmitted in the forward direction in the second slot following the slot containing the BCAST (SYSDEF ='00101') message.

(s) In the course of implementing a "background search sequence" it initiates a sampling activity in accordance with the requirements of section 9.3.3.7.

9.4.2 Leaving a Control Channel Whilst Waiting for Signalling

A radio unit waiting for signalling shall leave the control channel on which it is currently active when any of the following events as listed in 9.4.1 above occur: (b), (c), (d), (f), (g), (h) due to a demanded registration, and (m). In such circumstances the radio unit shall retain its state of waiting for signalling during any hunting procedures and subsequent control channel confirmation tests. Any timers relevant to the waiting state shall be maintained.

In addition, a radio unit which times-out on the expiry of timer TJ whilst waiting for signalling relevant to the transmission of an RQR message shall:

i. If the registration attempt is being carried out prior to a successful re-registration being achieved on a newly-confirmed control channel, assume the hunt stage that it was last engaged in prior to the registration attempt. It may either resume the hunt

stage at the channel number it would have sampled next or commence the hunt stage anew.

ii. If the registration attempt is being carried out at any other time, enter the "preferential hunt sequence".

A radio unit which enters the control channel acquisition procedures whilst in the waiting state shall obey the hunting procedures specified in 9.3.3 and the control channel confirmation procedures specified in 9.3.4. In addition, whilst in the waiting state, the radio unit shall only confirm a control channel in which the value of bits 1-12 of the system identity code (SYS) being examined under the procedure specified in 9.3.4.2 matches bits 1-12 of the system identity code which was examined to authorise acquisition of the control channel on which the radio unit was last confirmed. A radio unit which, having entered the control channel acquisition procedure whilst in the waiting state, times out on any of the timers TA, TC, TJ or TW as appropriate to its condition, shall continue to search for a control channel but shall resume the control channel acquisition procedures, but without the application of the additional SYS code check specified above.

A radio unit waiting for signalling which leaves the control channel on which it is currently active due to events (e) or (l) listed in the foregoing 9.4.1 shall cancel its waiting for signalling state upon entering the control channel acquisition procedures. It should be noted that events (a), (h) for a random access registration request, (j), (k), (n), (p), (q), (r) and (s) are not applicable to a radio unit in the state of waiting for signalling.

9.5 Multiple Control Channels

9.5.1 Introduction

Commercial networks in Band III sub-bands 1 and 2 may operate with multiple control channels at a single site and may require the subdivision of the radio unit population to allow load sharing between control channels. This facility is provided by the LAB sub-field in the system identity code (see 9.5.3) and by control categorisation of radio units (see 9.5.2).

9.5.2 Control Categorisation of Radio Units

At the time of network personalisation the radio unit shall be allocated a control category (CCAT) and this category shall be stored in the radio unit's read-only memory. Four control categories are available, which are designated A, B, C and D for convenience.

The control category governs acquisition and retention of a control channel, since the LAB sub-field in the system identity code indicates which radio unit control categories are allowed to use a control channel (see 9.3.4.3 and 9.4).

9.5.3 The LAB Sub-field

The LAB sub-field occupies bits 13 to 15 of the system identity code (see 9.3.4.2.2). The meanings assigned to the eight possible values of LAB shall be:

'000'	Reserved (future definition in MPT 1343)
'001'	All categories permitted
'010'	Categories A and B only permitted
'011'	Categories C and D only permitted
'100'	Category A only permitted
'101'	Category B only permitted
'110'	Category C only permitted
'111'	Category D only permitted

10 REGISTRATION

10.1 General

10.1.1 Introduction

Registration is a method of recording the area or group of areas where a radio unit is likely to be located within a network. This information avoids searching for radio units throughout the whole network, consequently reducing call set-up time and control channel loading.

A secondary feature is that it provides a means of restricting the service of individual radio units by allowing the network to deny registration requests.

The registration strategy enables networks to operate single or multiple registration. It is mandatory for radio units to support single registration, and multiple registration is a standard option. On networks which employ multiple registration, single registration radio units may make more registration requests than multiple registration radio units. Since the single registration radio unit is registered in only one area however, it is likely that fewer AHOY messages from the network would be required to locate it. Registration strategy is determined by the network and may be broadcast to radio units to allow them to take appropriate actions.

The registration strategy describes two types of registration. The first of these is explicit registration, where registration is achieved by means of an RQR message (either random access or demanded). The second is implicit registration, appropriate to multiple registration type radio units, where registration is achieved by means of messages exchanged during call set-up. Only messages that terminate control channel signalling are used for implicit registration.

It is possible that due to a failure the network may not be able to maintain registrations, but will want radio units to use the network as if they are registered. The network may broadcast a message to indicate that a temporary registration mode is in operation. Radio units which receive this message will recognise the temporary registration mode, and may be required to re-register on receipt of a further broadcast message indicating that the network is in a normal registration mode.

10.2 Single Registration

10.2.1 Procedure

The single registration procedure specified in this section enables a network to record the likely area in which a radio unit is located.

10.2.1.1 The Principle

The principle of registration requires that the radio unit shall only retain a valid registration record where it has received confirmation that it is the same record as that currently held within the network. If there is any doubt that the record is correct, then a NULL indicator

must be written against the record. If a radio unit fails to receive a response to a registration request, this could be due to:

- the request not being received by the network, in which case the network will regard the previous successful registration by the unit as the currently-valid registration record;

- the request being accepted by the network but the acknowledgement not being received by the radio unit, in which case the network will regard the unsuccessful registration by the unit as the currently-valid registration record;

- the request being denied or failed by the network but the acknowledgement not being received by the radio unit, in which case the network may either regard the previous successful registration by the unit as the currently-valid registration record or record a NULL registration for the calling unit.

Accordingly, in such cases the radio unit is not able to confirm whether the network holds a valid record for the unit and if it does, whether it is the previous registration or the present registration. It shall therefore, when making a registration attempt, write the registration record into its memory at the time of making the registration attempt but, at the same time, write a NULL indicator against the record. When the successful registration is confirmed by a suitable acknowledgement from the system the radio unit shall then cancel the NULL indicator.

10.2.2 Storage and Timing requirements

10.2.2.1 Requirements

In order to follow the procedures specified in this section the radio unit shall provide the following storage requirements appropriate to the selected network:

a) In Type 'B' read/write memory (see section 6.2):

The registration record applicable to the selected network. The registration record shall include the value of the verified AREA code and may include the channel number of the control channel on which that explicit registration attempt was carried out. The registration record shall also include a flag to indicate whether the registration record is normal or temporary. Until the radio unit is switched off, or equivalent, the flag shall also be capable of indicating an undefined state prior to being set.

The radio unit shall discard any data held in protected read/write memory unless its validity is reasonably assured. Also it should be noted that the values described in 10.2.2.1(a) may be held in unprotected RAM while operational and transferred to protected RAM on switch off or equivalent.

The registration records used by a single registration radio unit are indicated in Table 6.1 as "Prime registration" records.

i. At least 8 different values of AREA sub-field of the received system identity code verified when acquiring the control channel on which a registration attempt by the radio unit has been denied. These shall be managed as a FIFO list: when the radio unit has a full list of entries, any further addition to the list shall displace the earliest entry.

ii. The latest value of the REG parameter received on the control channel to indicate whether the control channel is in the normal or temporary registration mode (an undefined state shall be indicated prior to receipt of REG within a session).

c) In read-only memory, which shall be set by network personalisation:

A value of the ZONE field which shall be designated as the 'home' ZONE of the radio unit.

Note: A single registration type radio unit shall ignore the NA field advised by any BCAST (SYSDEF='00011') messages successfully decoded during activity on the selected network.

10.2.2.2 Action on Switch-off or Switch-on or equivalent

Data held under 10.2.2.1 b) shall be discarded at some time between the radio unit being switched off and being made ready for service after being subsequently switched on. For these purposes a user-initiated change of selected network shall be regarded as being equivalent to switching off the radio unit.

If, at switch-off (or equivalent), the registration record is currently labelled as undefined (see sections 10.2.4.1.1 and 10.2.4.2.1), then at some time between the radio unit being switched off and being made ready for service after being subsequently switched on, the registration record shall be labelled as normal.

10.2.3 Action on confirmation of a control channel

A radio unit shall not make any attempt at random access until control channel confirmation has been achieved, see 9.3.4.4.

When a radio unit confirms a control channel it shall then:

i. If the verified AREA code is zero, or the radio unit is personalised with a zero length AREA field, or the radio unit is in fall-back mode, the radio unit shall not seek to register by random access nor shall it create or alter any registration record. The radio unit shall note that registration is not required and that it is free to initiate calls.

Otherwise:

ii. If the verified area code is in the list of denied registrations, the radio unit shall resume hunting (see section 9).

Otherwise:

iii. If the radio unit does not hold a successful registration record for the verified AREA code, the radio unit shall attempt to register by random access (see section 10.2.4) according to normal rules (see !!7.3!!).

Otherwise:

iv. If the radio unit holds a successful registration record for the verified AREA code it shall not attempt to register. If the radio unit is of a type which stores the relevant channel number in the registration record and, if the stored channel number is different from the current number, then the radio unit shall replace the stored channel number in the record by the current channel number without otherwise affecting the registration record.

Once confirmed on a control channel, the radio unit shall not transmit any message other than RQR, or an acknowledgement in response to an Ahoy with IDENT1 = REGI (!!8.2.2.4!!), until it holds a successful registration record relating to the verified AREA code (unless the verified AREA code is zero, or the radio unit is personalised with a zero length AREA field, or the radio unit is in the fall-back mode) with the exception regarding a request for the radio unit security number detailed in the next paragraph. If at any time whilst active on a control channel the radio unit ceases to hold a successful registration record relating to the verified AREA code, it shall refrain from transmitting any message other than RQR, or an acknowledgement in response to an Ahoy with IDENT1 = REGI (!!8.2.2.4!!), until a successful registration record relating to the verified AREA code is held (unless the verified AREA code is zero, or the radio unit is personalised with a zero length AREA field, or the radio unit is in the fall-back mode). Whilst restricted in its transmissions due to not holding an appropriate registration record the radio unit shall obey any applicable messages received, as required, provided that to do so does not involve transmitting on the control channel (other than RQR or an ACK to an AHY with IDENT1 = REGI).

Having transmitted an RQR with the "Security Number Flag" set to '1', the radio unit shall be prepared to respond to a request from the TSC consisting of an AHYC, Mode 2 IDENT2=TSCI, DESC='000') with a SAMIS containing the radio unit security number (see Section 7 item 8) before expecting an acknowledgement to the registration request. (Note: In earlier versions of MPT1343, the INFO field of the RQR has a 3 bit RSVD field. Bit 3 of this field is now assigned to the "Security Number Flag". Annex AN2 illustrates these fields)

At any time that the radio unit holds a successful registration record relating to the verified AREA code, it is free to transmit any message conforming to the requirements of this specification.

10.2.4 Registration Procedures

10.2.4.1 Registration by Random Access

When a radio unit determines that it is required to register, it shall attempt to do so by random access using the procedures defined in MPT 1327 section 8.2.2. Note that if the registration is occasioned by the receipt of BCAST (SYSDEF = '00011'), then the actions prescribed in section 10.2.7 c) or d) shall be performed prior to those defined below.

If the random access timeout TC expires and the radio unit has not sent a registration request (!!8.2.2.2!!), the radio unit shall enter the control channel acquisition procedures (section 9).

Immediately upon sending the registration request by random access, the radio unit shall write into memory the AREA code for the system to which it is making the request together with a NULL indicator and delete the AREA code retained from its previous registration. The action after transmitting a random access registration request shall be as specified in sections 10.2.4.1.1 to 10.2.4.1.5.

10.2.4.1.1 Registration accepted

The registration attempt shall be considered successful on receipt of ACK(QUAL = '0'). The radio unit shall:

a) convert the NULL record to a successful registration record by removing the NULL indicator and

b) if the radio unit has received a REG parameter (see 10.2.7) since commencing the session, it shall label the registration record as either normal or temporary, corresponding to the latest received value of REG. If the radio unit has not received a REG parameter (see 10.2.7) since commencing the session, it shall label the registration record as undefined (see also 10.2.2.2 and 10.2.7).

10.2.4.1.2 Registration Denied

The registration attempt shall be considered denied on receipt of ACKX(QUAL = '0'). The radio unit shall:

a) write the AREA code in the list of denied registration records (see section 10.2.2),

and

b) enter the control channel acquisition procedures (see section 9).

10.2.4.1.3 Registration Failed

The registration attempt shall be considered to have been unsuccessful upon receipt of ACKX(QUAL='1').

The radio unit shall resume hunting, see 9.4.1(j), and after confirmimg a control channel and receiving a suitable Aloha message, shall re-commence a random access registration attempt in accordance with section 8.2.2 of MPT1327.

Note that, until a successful registration is achieved, the radio unit shall not attempt to transmit other than RQR messages, or an acknowledgement in response to an Ahoy with IDENT1 = REGI (!!8.2.2.4!!), or a SAMIS in response to an AHYC Mode 2 demanding its security number, but shall continue to obey any received messages, provided that to do so does not involve transmitting on the control channel (other than RQR, or an ACK to an Ahoy with IDENT1 = REGI).

10.2.4.1.4 Registration Attempt Times Out

If the radio unit times out from waiting for further signalling for the registration (!!8.2.2.4!!), or cancels its wait state as defined in section 9.4.2, it shall enter the control channel acquisition procedures (section 9).

10.2.4.1.5 Registration Demand Received During a Random Access Registration Transaction

If, while waiting for a response to a random access registration request message, the radio unit receives an ALHR message individually addressed to it, the radio unit shall send a registration request RQR in accordance with MPT 1327 section 8.3.2.1 a2 (the radio unit shall not send an emergency request RQE).

The action shall then be as defined in sections 10.2.4.1.1 to 10.2.4.1.4, and in sections 7.3 and 8.2.2.2 of MPT 1327.

10.2.4.2 Registration on Demand

If, whilst confirmed on the control channel and not attempting to register by random access, a radio unit receives an applicable individually addressed ALHR, it shall write a NULL record against the existing registration record for the currently verified AREA code and shall attempt to register, complying with the procedures defined in MPT 1327 section 8.3.2.

The radio unit action after transmitting RQR upon demand, whilst not attempting to register by random access, shall be as defined in sections 10.2.4.2.1 to 10.2.4.2.3.

10.2.4.2.1 Registration Accepted

On receipt of ACK(QUAL='0') the registration shall be considered accepted and the radio unit shall:

a) convert the NULL record to a successful registration record by removing the NULL indicator, and

b) if the radio unit has received a REG parameter (see 10.2.7) since commencing the session, it shall label the registration record as either normal or temporary, corresponding to the latest received value of REG. If the radio unit has not received a REG parameter (see 10.2.7) since commencing the session, it shall label the registration record as undefined (see also 10.2.2.2 and 10.2.7).

10.2.4.2.2 Registration Denied

Registration is denied if ACKX(QUAL='0') is received. On receipt of this message the radio unit shall:

a) write the AREA code in the list of denied registration records, and

b) enter the control channel acquisition procedures (section 9).

10.2.4.2.3 No Acknowledgement Received

If no response is received within WAIT+1 slots, the radio unit shall make no consequential changes to its registration record. If, as a result of the action prescribed in 10.2.4.2, the radio unit has no registration record for the verified AREA code, then it shall attempt to register by random access.

10.2.5

This paragraph is not used.

10.2.6

This paragraph is not used.

10.2.7 Action on receiving broadcast registration parameters

a) The radio unit shall not make use of the NA field.

b) If the radio unit holds an undefined registration record for the verified AREA code, the record shall be labelled as either normal or temporary corresponding to the value of REG received.

c) If the radio unit receives REG ='0' while active on a control channel, it shall record that the channel is in the normal registration mode.

   If the radio unit holds a temporary registration record for the verified AREA code, it shall delete that record and attempt to register by random access.

d) If the radio unit receives REG ='1' while active on a control channel, it shall record that the channel is in the temporary registration mode.

   If the radio unit holds a normal registration record (not temporary) for the control channel, and the ZONE value of the verified system identity code differs from the 'home' ZONE of the radio unit, the radio unit shall label the registration record as temporary.

Note that b), c) and d) shall apply to all registration records held by the radio unit, not only the prime records.

10.2.8 Fall-back Mode

Any radio unit (whether or not it implements the fall-back mode option) which receives an ALHF message on a control channel for which the verified AREA code corresponds to a registration record, but for which the verified ZONE code does not match its home zone, shall label the registration record as temporary.

10.2.8.1 Entering Fall-back Mode

Upon entering fall-back mode (see 13.3) a radio unit shall continue to maintain registration records. Whilst in the fall-back mode and confirmed on the fall-back channel, the radio unit shall not attempt to register by random access; the radio unit is free to initiate and receive calls even if the unit does not have a registration record for the verified AREA code.

10.2.8.2 Leaving Fall-back Mode

Upon leaving the fall-back mode the radio unit shall attempt to register if required to by sections 10.2.3 or 10.2.7.

10.3 Multiple Registration

10.3.1 Introduction

As a radio unit travels within range of more than one registration area, it may be advisable to guard against frequent re-registration, otherwise excessive registration request signalling may be generated. The multiple registration procedure specified in this section aims to minimise this problem. It provides a mechanism whereby the radio unit may be registered in more than one area simultaneously and so can move freely between the areas for which it has valid registrations without re-registering

To minimise the number of radio units simultaneously registered in more than one area (thereby minimising the amount of Ahoy signalling), there is a time-out mechanism whereby 'old' registrations expire if the radio unit does not make any calls in the area for a specified time. The specification defines the time-out in the radio unit; the network may operate a corresponding time-out.

Although old registrations in the radio unit expire after a time-out, the most recent, or prime, registration does not expire, in order to avoid periodic re-registration.

It is important that the registration records stored in the radio unit and in the network correspond. If a radio unit believes it is registered in a particular area, but the network does not, then the radio unit will not receive any calls while in that area. Much of the specification serves to maintain this correspondence as closely as possible, despite corruption of signalling. Any discrepancy must be 'fail-safe', ie the network may hold a record of registration that the radio unit does not hold, but the radio unit must not believe that it is registered in an area that the network has not recorded.

10.3.1.1 The Principle

The multiple registration procedure is described with reference to the examples below which show, for triple registration, what happens as a radio unit travels between different registration areas.

Figure 10.3 illustrates the basic operation. Initially the radio unit is registered in area A and is in the normal registration mode. When it travels to area B it must register before accessing the network. Registration information from area A is retained both in the radio unit and the network for a time determined by the network operator. The radio unit now returns to area A and does not need to re-register. However, since B was the most recent (prime) registration area, the radio unit registration for A will time-out. In such an event the radio unit is immediately aware that it is no longer registered in the area corresponding to the control channel currently received and so attempts to register. As a result, B becomes a timed registration and will eventually time-out in the radio unit and network.

Figure 10.3 shows what happens if there is no response to a registration attempt as the radio unit travels. It will be seen that the radio unit record and the network record no longer correspond, but by inserting a null record at the radio unit no ambiguity arises. It also shows how the registration records are updated by implicit registration when the radio unit makes a call in an area for which a registration record already exists.

	Location of radio unit	A	B	A	A	A
	Radio unit action	Registers on A	Registers on B	Does not re-register	Times-out of A and registers	Times out of B
radio unit records	Prime reg record	A	B	B	A	A
	Timed reg records	NULL NULL	A NULL	A NULL	B NULL	NULL NULL
Network records	Prime reg records	A	B	B	A	A
	Timed reg records	NULL NULL	A NULL	A NULL	B NULL	NULL NULL

FIGURE 10.3 - EXAMPLE 1

	Location of radio unit	A	B	C	A	A
	Radio unit action	Registers on A	Attempts to register on B - response not received	Registers C	Does not register	Makes a call - implicit registration on A
radio unit records	Prime reg record	A	NULL	C	C	A
	Timed reg records	NULL NULL	A NULL	NULL A	NULL B	C NULL

Network records	Prime reg records	A	B	C	C	A
	Timed reg records	NULL NULL	A NULL	B A	B A	C B

FIGURE 10.3 - EXAMPLE 2

10.3.2 Storage and Timing Requirements

10.3.2.1 Requirements

In order to follow the procedures specified in this section the radio unit shall provide the following storage requirements appropriate to the selected network:

a) In Type 'B' read/write memory (see section 6.2):

i. The latest value of NA (the maximum number of registration records which the radio unit shall hold concurrently) appropriate to the selected network as advised by any BCAST (SYSDEF='00011') messages successfully decoded during activity on the selected network. In the event that no valid data of the appropriate value of NA is held then the radio unit shall assume a default value of NA = 1 until such time as a BCAST (SYSDEF ='00011') message is successfully decoded from the selected network.

ii. The prime registration record applicable to the selected network. The registration record shall include the value of the verified AREA code (together with a NULL indicator if applicable) and may include the channel number of the control channel on which that explicit or implicit registration attempt was carried out. The registration record shall also include a flag to indicate whether the prime registration record is normal or temporary. Until the radio unit is switched off, or equivalent, the flag shall also be capable of indicating an undefined state prior to being set.

Note: The radio unit shall discard any data held in protected read/write memory unless its validity is reasonably assured. Also it should be noted that the values described in a)i, and a)ii may be held in Type 'A' memory while operational and transferred to Type 'B' memory on switch off or equivalent.

b) In read/write memory:

i. (NA-1) timed registration records which, together with the prime registration record specified in a)ii above, form the NA registration records applicable to the selected network. Each record shall include the verified AREA code (together with a NULL indicator if applicable) and a flag to indicate whether the registration record is normal or temporary (the flag shall also be capable of indicating an undefined state, prior to being set). Each record may include the channel number of the control channel on which the explicit or implicit registration attempts were carried out. The radio unit shall discard

any timed registration record held in read/write memory when a time TD has elapsed since the registration record was written to read/write memory.

ii. At least 8 different values of AREA sub-field of the received system identity code verified when acquiring the control channel on which a registration attempt by the radio unit has been denied. These shall be managed as a FIFO list: when the radio unit has a full list of entries, any further addition to the list shall displace the earliest entry.

iii. The latest value of the REG parameter received on the control channel to indicate whether the control channel is in the normal or temporary registration mode (an undefined state shall be indicated prior to receipt of REG within a session).

c) In read-only memory, which shall be set by network personalisation:

i. A value of the ZONE field which shall be designated as the 'home' ZONE of the radio unit.

10.3.2.2 Action on Switch off or Switch on or equivalent

Data held under 10.3.2.1 b) shall be discarded at some time between the radio unit being switched off and being made ready for service after being subsequently switched on. For these purposes a user-initiated change of selected network shall be regarded as being equivalent to switching off the radio unit.

If, at switch-off (or equivalent), the prime registration record is currently labelled as undefined (see sections 10.3.4.1.1, 10.3.4.2.1, 10.3.5.1.1 and 10.3.5.2.1), then at some time between the radio unit being switched off and being made ready for service after being subsequently switched on, the prime registration record shall be labelled as normal.

10.3.2.3 Value of a NULL record

A NULL record contains the AREA code and a NULL indicator.

10.3.3 Action on confirmation of a control channel

A radio unit shall not make any attempt at random access until control channel confirmation has been achieved, see 9.3.4.4.

When a radio unit confirms a control channel it shall then:

i. If the verified AREA code is zero, or the radio unit is personalised with a zero length AREA field, or the radio unit is in fall-back mode, the radio unit shall not seek to register by random access nor shall it create or alter any registration record. The radio unit shall note that registration is not required and is free to initiate calls.

Otherwise:

ii. If the verified area code is in the list of denied registrations, the radio unit shall resume hunting (see section 9).

Otherwise:

iii. If the radio unit does not hold a successful registration record for the verified AREA code, the radio unit shall attempt to register by random access (see section 10.3.4) according to normal rules (see !!7.3!!).

Otherwise:

iv. If the radio unit holds a successful registration record for the verified AREA code it shall not attempt to register. If the radio unit is of a type which stores the relevant channel number in each registration record and, if the stored channel number is different from the current number, then the radio unit shall replace the stored channel number in the record by the current channel number without otherwise affecting the registration record or associated timer.

Once confirmed on a control channel, the radio unit shall not transmit any message other than RQR, or an acknowledgement in response to an Ahoy with IDENT1 = REGI (!!8.2.2.4!!), until it holds a successful registration record relating to the verified AREA code (unless the verified AREA code is zero, or the radio unit is personalised with a zero length AREA field, or the radio unit is in the fall-back mode) with the exception regarding a request for the radio unit security number detailed in the next paragraph. If at any time whilst active on a control channel the radio unit ceases to hold a successful registration record relating to the verified AREA code, it shall refrain from transmitting any message other than RQR, or an acknowledgement in response to an Ahoy with IDENT1 = REGI (!!8.2.2.4!!), until a successful registration record relating to the verified AREA code is held (unless the verified AREA code is zero, or the radio unit is personalised with a zero length AREA field, or the radio unit is in the fall-back mode). Whilst restricted in its transmissions due to not holding an appropriate registration record the radio unit shall obey any applicable messages received, as required, provided that to do so does not involve transmitting on the control channel (other than RQR or and ACK to an AHY with IDENT1 = REGI).

If, having transmitted an RQR with the "Security Number Flag" set to '1', the radio unit shall be prepared to respond to a request from the TSC consisting of an AHYC, Mode 2 IDENT2=TSCI, DESC='000') with a SAMIS containing the radio unit security number (see Section 7 item 8) before expecting an acknowledgement to the registration request. (Note: In earlier versions of MPT1327, RQR has a 3 bit RSVD field. Bit 3 of this field is now assigned to the "Security Number Flag".)
At any time that the radio unit holds a successful registration record relating to the verified AREA code, it is free to transmit any message conforming to the requirements of this specification.

10.3.4 Registration Procedures

10.3.4.1 Registration by Random Access

When a radio unit determines that it is required to register, it shall attempt to do so by random access using the procedures defined in MPT 1327 section 8.2.2. Note that if the registration is occasioned by the receipt of BCAST (SYSDEF = '00011'), then the actions prescribed in section 10.3.7 c) or d) shall be performed prior to those defined below.

If the random access timeout TC expires and the radio unit has not sent a registration request (!!8.2.2.2!!), the radio unit shall enter the control channel acquisition procedures (section 9).

Provided that the prime registration record is not already a NULL containing the same AREA code as the currently verified AREA code, then immediately the radio unit transmits its first registration request message by random access it shall:

a) change the prime registration record, whether or not it has a NULL indicator appended to it, into a timed registration record with a newly started timer, deleting, if necessary, the timed registration record closest to expiry (see section 10.3.6), and then,

b) write into its prime registration record the AREA code for the system to which it is making the request together with a NULL indicator.

Note that the requirements of this paragraph shall not apply to repeat transmissions of the request message within the same registration attempt.

The action after transmitting a random access registration request shall be as specified in sections 10.3.4.1.1 to 10.3.4.1.5.

10.3.4.1.1 Registration Accepted

The registration attempt shall be considered successful on receipt of ACK(QUAL = '0'). The radio unit shall:

a) convert the NULL prime record to a successful prime registration record by removing the NULL indicator, and

b) if the radio unit has received a REG parameter (see 10.3.7) since commencing the session, it shall label the registration record as either normal or temporary, corresponding to the latest received value of REG. If the radio unit has not received a REG parameter (see 10.3.7) since commencing the session, it shall label the registration record as undefined (see also 10.3.2.2 and 10.3.7).

10.3.4.1.2 Registration Denied

The registration attempt shall be considered denied on receipt of ACKX(QUAL = '0'). The radio unit shall:

a) write the AREA code in the list of denied registration records (see section 10.3.2),

and

b) enter the control channel acquisition procedures (see section 9).

10.3.4.1.3 Registration Failed

The registration attempt shall be considered to have been unsuccessful upon receipt of ACKX(QUAL='1').

The radio unit shall resume hunting, see 9.4.1(j), and after confirmimg a control channel and receiving a suitable Aloha message, shall re-commence a random access registration attempt in accordance with section 8.2.2 of MPT1327.

Note that, until a successful registration is achieved, the radio unit shall not attempt to transmit other than RQR messages, or an acknowledgement in response to an Ahoy with IDENT1 = REGI (!!8.2.2.4!!), or a SAMIS in response to an AHYC Mode 2 demanding its security number, but shall continue to obey any received messages, provided that to do so does not involve transmitting on the control channel (other than RQR, or an ACK to an Ahoy with IDENT1 = REGI).

10.3.4.1.4 Registration Attempt Times Out

If the radio unit times out from waiting for further signalling for the registration (!!8.2.2.4!!), or cancels its wait state as defined in section 9.4.2, it shall enter the control channel acquisition procedures (section 9).

10.3.4.1.5 Registration Demand Received During a Random Access Registration Transaction

If, while waiting for a response to a random access registration request message, the radio unit receives an ALHR message individually addressed to it, the radio unit shall send a registration request RQR in accordance with MPT 1327 section 8.3.2.1 a2 (the radio unit shall not send an emergency request RQE).

The action shall then be as defined in sections 10.3.4.1.1 to 10.3.4.1.4, and in sections 7.3 and 8.2.2.2 of MPT 1327.

10.3.4.2 Registration on Demand

If, while confirmed on a control channel and not attempting to register by random access, a radio unit receives an applicable individually addressed ALHR, it shall write a NULL record against the existing registration record for the currently verified AREA code and shall attempt to register, complying with the procedures defined in MPT 1327 section 8.3.2.

Provided that the prime registration record is not now a NULL containing the same AREA code as the currently verified AREA code, then upon making a registration attempt (as a result of a demand) the radio unit shall:

a) change the prime registration record, whether or not it has a NULL indicator appended to it, into a timed registration record with a newly-started timer, deleting, if

necessary, the timed registration record closest to expiry (see section 10.3.6), and then,

b) write into its prime registration record the AREA code for the system to which it is making the request together with a NULL indicator.

The radio unit action after transmitting RQR upon demand, whilst not attempting to register by random access, shall be as defined in sections 10.3.4.2.1 to 10.3.4.2.3.

Refer to Annex AN5 for more information regarding system compatibility issues.

10.3.4.2.1 Registration Accepted

On receipt of ACK(QUAL='0') the registration shall be considered accepted and the radio unit shall:

a) convert the NULL prime record to a successful registration record (by removing the NULL indicator), and

b) if the radio unit has received a REG parameter (see 10.3.7) since commencing the session, it shall label the registration record as either normal or temporary, corresponding to the latest received value of REG. If the radio unit has not received a REG parameter (see 10.3.7) since commencing the session, it shall label the registration record as undefined (see also 10.3.2.2 and 10.3.7).

10.3.4.2.2 Registration Denied

Registration is denied if ACKX(QUAL='0') is received. On receipt of this message the radio unit shall:

a) write the AREA code in the list of denied registration records, and

b) enter the control channel acquisition procedures (section 9).

10.3.4.2.3 No Acknowledgement Received

If no response is received within WAIT+1 slots, the radio unit shall make no consequential changes to its registration record. If, as a result of the action prescribed in 10.3.4.2, the radio unit has no registration record for the verified AREA code, then it shall attempt to register by random access.

10.3.5 Implicit Registration

When a radio unit participates in a signalling transaction on a control channel for which it holds a timed registration record then, in the circumstances defined in this section, the radio unit is implicitly re-registered, and a prime registration record is created for the verified AREA code. Note that the requirements of this section apply only when the radio unit is tuned to a control channel for which it holds a timed successful registration record and only when the radio unit is in the normal operation mode (not in the fall-back mode).

10.3.5.1 Implicit Registration of Calling Radio Unit

Transmission of a random access message, other than RQR, or RQQ hook signalling, may result in implicit registration, as defined in sections 10.3.5.1.1 to 10.3.5.1.4.

10.3.5.1.1 Implicit Registration is Successful

Implicit registration shall be considered successful if any of the following messages applicable to the call are received:

- ACK(QUAL='0')
- ACK(QUAL='1') if cancellation of the call is requested
- ACKV
- ACKE(QUAL='0')
- ACKT(QUAL='0')
- ACKB(QUAL='0')
- GTC

On receipt of any of these messages (unless the prime registration record now corresponds to the verified AREA code) the radio unit shall:

a) Delete the timed registration record corresponding to the verified AREA code (if the record still exists), and

b) Convert the prime registration record to a timed registration record with a newly started timer, and

c) Create a prime registration record for the verified AREA code, and

d) If the radio unit has received a REG parameter (see 10.3.7) since commencing the session, it shall label the new prime registration record as either normal or temporary, corresponding to the latest received value of REG. If the radio unit has not received a REG parameter (see 10.3.7) since commencing the session, it shall label the registration record as undefined (see also 10.3.2.2 and 10.3.7).

If the prime registration record is a NULL for the verified AREA code, then on receipt of these messages the radio unit shall convert the prime record to a successful registration record (by removing the NULL indicator).

10.3.5.1.2 Implicit Registration Failed

Implicit registration shall be considered failed if ACKX applicable to the call is received. On receipt of ACKX the radio unit shall make no consequential changes to the registration records and shall return to the idle state.

10.3.5.1.3 Implicit Registration Times Out

If the radio unit times out from waiting for further signalling for a call (timeouts TA, TJ or TW), or cancels its wait state due to entering the control channel acquisition procedures (see 9.4.2), then (unless the prime registration record now corresponds to the verified AREA code, including if NULL) the radio unit shall:

a) Convert the existing prime registration record to a timed registration record with a newly-started timer, deleting, if necessary, the timed registration record closest to expiry, and

b) Create a NULL record as the prime registration record.

If the radio unit timed out from waiting (ie did not cancel its wait state), it shall then either return to the idle state or enter the control channel acquisition procedures (section 9).

10.3.5.1.4 Action at Switch-off or Equivalent

If, while the radio unit is waiting for further signalling for its call, the radio unit is switched off (or equivalent), or the user selects a different network, the radio unit shall (unless the prime registration record now corresponds to the verified AREA code, including if NULL) create a NULL record as the prime registration record (note that the radio unit may be designed so that no processing is required after switch-off has been initiated).

10.3.5.2 Implicit Registration of Called Radio Unit

Transmission by the radio unit of ACK(QUAL ='0') in response to an AHY message for an incoming traffic channel call (!!9.2.2.2A!!) may result in implicit registration as defined in sections 10.3.5.2.1 to 10.3.5.2.4.

10.3.5.2.1 Implicit Registration is Successful

Implicit registration shall be considered successful if a GTC or AHYX message applicable to the incoming call is received.

On receipt of either of these messages (unless the prime registration record now corresponds to the verified AREA code) the radio unit shall:

a) Delete the timed registration record corresponding to the verified AREA code (if the record still exists and irrespective of whether the record is normal or temporary), and

b) Convert the prime registration record to a timed registration record with a newly-started timer, and

c) Create a prime registration record for the verified AREA code, and

d) If the radio unit has received a REG parameter (see 10.3.7) since commencing the session, it shall label the new prime registration record as either normal or temporary, corresponding to the latest received value of REG. If the radio unit has not received a REG parameter (see 10.7) since commencing the session, it shall label the registration record as undefined (see also 10.3.2.2 and 10.3.7).

10.3.5.2.2 Implicit Registration Failed

If, while waiting for further signalling for an incoming traffic channel call, the radio unit receives an AHY message for a different incoming traffic channel call and sends

ACK(QUAL ='0') or ACKI(QUAL ='0'), the radio unit shall make no consequential changes to the registration records and shall apply the procedures of 10.3.5.2 to the new AHY.

10.3.5.2.3 Implicit Registration Times Out

If the radio unit times out from waiting for further signalling for an incoming traffic channel call (timeout TA) or cancels its wait state due to entering the control channel acquisition procedures (see 9.4.2), then (unless the prime registration record now corresponds to the verified AREA code, including if NULL) the radio unit shall:

a) change the prime registration record, whether or not it has a NULL indicator appended to it, into a timed registration record with a newly started timer, deleting, if necessary, the timed registration record closest to expiry, and then,

b) write into its prime registration record the AREA code for the system on which it is verified together with a NULL indicator.

If the radio unit timed out from waiting (ie did not cancel its wait state), it shall then return to the idle state.

10.3.5.2.4 Action on Switch-off or Equivalent

If, while the radio unit is waiting for further signalling for an incoming traffic channel call, the radio unit is switched off (or equivalent), or the user selects a different network, the radio unit shall (unless the prime registration record now corresponds to the verified AREA code, including if NULL) create a NULL record as the prime registration record (note that the radio unit may be designed so that no processing is required after switch-off has been initiated).

10.3.6 Registration Record Timeout

The timer for a registration record (timeout value TD) shall be started when the record is displaced from being prime registration record.

The radio unit shall delete any registration record (even a NULL record) displaced from being the prime registration record for which the time period TD has expired.

If the deletion on timeout occurs while the radio unit is active on a control channel, and results in the radio unit having no successful registration record corresponding to the received confirmation AREA code, the unit shall attempt to explicitly register by random access, see section 10.3.4.1.

10.3.7 Action on receiving broadcast registration parameters

a) If the received value of NA is smaller than the number of registration records currently stored, the radio unit shall delete the excess number of records, retaining only the prime registration record and (NA-1) most recently created timed registration records.

b) If the radio unit holds an undefined registration record for the verified AREA code, the record shall be labelled as either normal or temporary corresponding to the value of REG received.

c) If the radio unit receives REG ='0' while active on a control channel, it shall record that the channel is in the normal registration mode.

If the radio unit holds a temporary registration record for the verified AREA code, it shall delete that record and attempt to register by random access.

d) If the radio unit receives REG ='1' while active on a control channel, it shall record that the channel is in the temporary registration mode.

If the radio unit holds a normal registration record (not temporary) for the control channel, and the ZONE value of the verified system identity code differs from the 'home' ZONE of the radio unit, the radio unit shall label the registration record as temporary. Note that b), c) and d) shall apply to all registration records held by the radio unit, not only the prime records.

10.3.8 Fall-back Mode

Any radio unit (whether or not it implements the fall-back mode option) which receives an ALHF message on a control channel for which the verified AREA code corresponds to a registration record, but for which the verified ZONE code does not match its home zone, shall label the registration record as temporary.

10.3.8.1 Entering Fall-back Mode

Upon entering fall-back mode (see 13.3) a radio unit shall continue to maintain registration records. Whilst in the fall- back mode and confirmed on the fall-back channel, the radio unit shall not attempt to register by random access or make use of control channel messages to implicity register; the radio unit is free to initiate and receive calls even if the unit does not have a registration record for the verified AREA code.

10.3.8.2 Leaving Fall-back Mode

Upon leaving the fall-back mode the radio unit shall attempt to register if required to by sections 10.3.3 or 10.3.7.

11. CALL PROCESSING

In this section, the section numbers have been formed by prefixing the section numbers of MPT 1327 by "11.". Thus sub-sections here refer directly to, and should be read in parallel with, sections of MPT 1327. The requirements of MPT 1327 are also mandatory requirements of this specification. Each sub-section below defines the requirements for the facilities and functions relevant to the radio unit for call processing. These requirements are categorised as follows:

Mandatory	The radio unit shall implement the function or facility.
Standard Option	If the radio unit implements the function, then it shall be implemented at least in the specified manner.
Available for Customisation	If the TSC implements such a customised function, then if the radio unit implements the function it shall operate in the manner specified by the network operator of that TSC. Such functions will not modify existing standardised functions. If the radio unit does not understand the customised function in the context of system it is currently using, then it shall ignore that function. The radio unit shall not infringe any of the requirements of section 5 of MPT 1327.
Optional	The radio unit may use the information or implement the facility at the discretion of the manufacturer.
Informative	The corresponding section within MPT 1327 is primarily informative or related only to TSC specification, with no requirements on the radio unit arising directly from the contents. Related requirements may be included in other sections, however.

The radio unit shall ignore those fields of received messages which it does not understand.

11.1 Introduction

Informative.

11.1.1 User Facilities

Informative.

11.1.1.1 Types of Call

Informative.

11.1.1.2 Making Calls

It shall be mandatory for the radio unit to be able to make calls to individual radio units and line connected units. The ability to make calls to the other destinations listed is a standard option.

It shall be mandatory for the radio unit to be able to make interprefix speech calls, although this does not necessarily require prefix number entry by the user (see section 8.2).

The requirements on the radio unit for the use of call progress information sent by the TSC for confidence indication is defined in section 8.1.

11.1.1.3 Receiving Calls

The requirement to respond to correctly addressed incoming calls that are received is mandatory. This requirement includes interprefix calls. The response may, however, be a rejection if, for example, a radio unit does not have a particular non-mandatory facility, or if the user has indicated that certain calls are to be rejected.

The implementation of a busy control is a standard option.

The implementation of a call back control is a standard option.

The implementation of a "ready for communication control" (RFCC) is mandatory.

Confidence indication requirements are specified in section 8.1.

11.1.1.4 Diverting Calls

Diversion of calls is a standard option. Automatic re-dial to the diversion IDENT is optional.

11.1.2 System Features and Facilities

11.1.2.1 System Dimensions

It shall be mandatory for the radio unit to be able to store in its personality any one of the addresses in the full addressing range as its individual address. In addition it shall be mandatory for the radio unit to be able to store in its personality up to 4 of the addresses in the full addressing range as its group addresses (see section 6).

11.1.2.2 System Control

Informative. See section 13 of this specification for details of fall-back operation, which is a standard option.

11.1.2.3 Call Handling

Informative. The requirements for security are defined in section 11.15.

11.1.2.4 Multi-site Systems

Informative. The registration procedures are defined in Section 10 of this specification.

11.1.3 Guide to Some Key Protocol Aspects

Informative.

11.1.3.1 Control Channel Signalling Structure

Informative.

11.1.3.2 Control Channel Signalling Messages

Informative.

11.1.3.3 Random Access Protocol

11.1.3.3.1 Principle of Operation

Informative.

11.1.3.3.2 Features of the Random Access Protocol

Informative.

11.1.3.4 Addressing

Informative. The use of extended addressing is mandatory for a radio unit making a simple call to a radio unit or line unit with a different prefix.

11.1.3.5 Examples of Signalling Sequences

Informative.

11.1.3.5.1 Example: Radio Unit Calls a Group

The ability to make group calls is a standard option.

11.1.3.5.2 Example: Radio Unit Calls a Unit with the Same Prefix

The ability for the radio unit to make such calls is mandatory.

11.1.3.5.3 Example: Radio Unit Calls a Unit with a Different Prefix

The ability for the radio unit to make such calls is mandatory.

11.1.3.5.4 Example: Radio Unit Sends a Short Data Message

The ability for the radio unit to make such calls is a standard option.

11.2 Definitions

The definitions listed in section 2 of MPT 1327 are consistent with those listed in section 3 of this specification.

11.3 Signalling Formats

Informative. The requirements listed in this section apply only to prescribed signalling. Non-prescribed signalling is not covered by this specification.

11.3.1 Basic Format

Mandatory as specified.

11.3.1.1 LET

Mandatory as specified.

11.3.1.2 Preamble

Mandatory as specified.

11.3.1.3 Message

Mandatory as specified.

11.3.1.4 Hang-over Bit, H

Mandatory as specified.

11.3.2 Message Format

Mandatory as specified.

11.3.2.1 Codeword Synchronisation Sequence

Mandatory as specified.

11.3.2.1.1 Control Channel Codeword Synchronisation Sequence

Mandatory as specified.

11.3.2.1.2 Traffic Channel Codeword Synchronisation Sequence

Mandatory as specified.

11.3.2.2 Codewords

Mandatory as specified.

11.3.2.3 Encoding and Error Checking

The encoding is mandatory as specified.

The radio unit shall not accept any codeword from which the derived syndrome and parity bit indicate that 3 or more hard errors have occurred in an error burst of length 6 bits or greater.

The radio unit shall reject any codeword if it does not correct potential bit errors indicated by the coset leader for the syndrome.

The radio unit need not perform error correction, although error correction may simplify receiver and modem design requirements in meeting the error performance requirements of the receiver specified in Appendix A.

11.3.3 Signalling Transmission Variants

The radio unit shall be designed to cope with the variants specified.

11.3.3.1 Single Message Format

Mandatory as specified.

11.3.3.2 Multiple Message Format on the Traffic Channel

Mandatory as specified.

11.3.3.3 Forward Control Channel Format

11.3.3.3.1 Basic Control Channel Format

Mandatory as specified.

11.3.3.3.2 Data Codeword Displacement

Mandatory as specified.

11.4 Addressing

The radio unit shall understand those special IDENTS and DUMMYI that are required by the mandatory call procedures, and also those required by any standard options that are implemented.

11.5 Codeword Structures

The standardised messages which the radio unit shall understand are defined in the following sections.

Standardised Fields

Mandatory as specified.

Reserved Fields

Mandatory as specified.

Spare Fields and Codewords

Available for Customisation in the manner specified.

11.5.1 System Codewords

11.5.1.1 Control Channel System Codeword (CCSC)

Mandatory to make use of the CCSC for slot synchronisation.

The use of the DCSC is a standard option.

11.5.1.2 Data Channel System Codeword (DCSC)

The use of the DCSC is a standard option.

11.5.2 General Address Codeword Structures

Informative.

11.5.3 List of Address Codewords

Messages received by the radio unit which it shall understand and take any mandatory action required:

GTC
ALH, ALHS, ALHX, ALHR, ALHF
ACK, ACKI, ACKQ, ACKX, ACKV, ACKT, ACKB
ACKE (if configured to send RQE messages)
AHY, AHYX, AHYQ, AHYC
MAINT, MOVE, CLEAR, BCAST

Messages received by the radio unit which it shall understand and take any mandatory action required if the unit is individually addressed, and for which it is a standard option for the radio unit to use if not individually addressed:

ALHD, ALHE

Messages received by the radio unit which it is a standard option for the radio unit to understand:

AHYD
DACK +DAL, DACK+DALG, DACK+DALN, DACK+GO, DACKD, DACKZ, DAHY, DAHYX, DAHYZ
GTT, MARK, HEAD
RLA, SACK, SITH

Messages for which the functions are not yet defined (informative):

SAMO

Messages which the radio unit shall be required to send by the protocol (mandatory):

ACKI (QUAL = '0')
ACK, ACKX
RQS, RQX, RQR, RQQ (indicating hook status)
MAINT (see section 11.5.5.4.2 for applicable messages)
SAMIS

Messages which the radio unit may send in the standardised format if permitted by the protocol (standard option):

ACKV, ACKB
RQT, RQE, RQC, RQQ (other than for hook status)
DACK+GO, DACKD, DACKZ
DRQG, DRQX, DRQZ, DRUGI
RLA, RQD, SACK, SITH
HEAD

Messages for which the functions are not yet defined (informative):

SAMIU

Reserved and spare message fields shall be as specified.

11.5.4 Go To Traffic Channel Message, GTC

Mandatory as specified.

11.5.5 Category '000' Messages

11.5.5.1 Aloha Messages (Type '00')

It is mandatory that the radio unit shall use the following received messages in making random access attempts:

ALH, ALHS, ALHX, ALHR

It is a standard option that the radio unit shall use the following received messages in random access attempts:

ALHD, ALHE

It is mandatory for the radio unit to understand the ALHF message; it is a standard option for the radio unit to implement fall-back mode (see section 13).

Use of the WT, M, CHAN4 and N fields shall be mandatory when making use of any Aloha message. The CHAN4 bits correspond to the least significant four bits of the 10 bit binary representation of the channel number of the control channel on which the message was received(see section 5.1).

It is mandatory that the radio unit shall respond to all individually addressed Aloha messages (ie those addressed to that specific unit, see !!7.4.1!!).

11.5.5.2 Acknowledgement Messages (Type '01')

Messages received by the radio unit which it shall understand and take any mandatory action required:

ACK, ACKI, ACKQ, ACKX, ACKV, ACKT, ACKB

Messages received by the radio unit which it shall understand and take any mandatory action required if the radio unit is configured to send RQE messages:

ACKE

Messages which the radio unit shall send where required by the protocol (mandatory):

ACK, ACKX, ACKI (QUAL = '0')

Messages which the radio unit may send in the standardised format if permitted by the protocol (standard option):

ACKV, ACKB

11.5.5.2.1 Acknowledgement Messages Sent by the TSC

Messages received by the radio unit which it shall understand and take any mandatory action required:

ACK, ACKI, ACKQ, ACKX, ACKV, ACKT, ACKB
ACKE (if configured to send RQE messages)

Use of the QUAL field of the received message is a standard option except where:

i. mandatory confidence indications are required in section 8.1;

ii. the protocol of MPT 1327 requires a different mandatory action based on the QUAL field.

Use of the diversion address or number of data codewords appended to ACKT (QUAL = '0') is optional. If IDENT1=PSTNGI in ACKT (QUAL='0') then the BCD digits in the appended data codeword (s) shall contain the full dialled string, less the leading 0.

ACKT (QUAL = '1') is reserved.

11.5.5.2.2 Acknowledgements Sent by Radio Units

Messages which the radio unit shall send where required by the protocol (mandatory):

ACK (QUAL = '0' and QUAL = '1'), ACKX (QUAL = '0'), ACKI (QUAL = '0')

Messages which the radio unit may send in the standardised format if permitted by the protocol (standard option):

ACKV (QUAL = '1'), ACKX (QUAL = '1'),
ACKB (QUAL = '0' and QUAL = '1')

11.5.5.3 Type '10' Messages (Requests and Ahoys)

Informative.

11.5.5.3.1 Request Messages (Type '10')

Messages which the radio unit shall send where required by the protocol when making calls (mandatory):

RQS, RQX, RQR
RQQ (for hook status)

Messages which the radio unit may send in the standardised format if permitted by the protocol (standard option):

RQT, RQE, RQC
RQQ (other than hook status)

11.5.5.3.1.1 Request "Simple" Call Message, RQS

Mandatory for RQS containing:

(IDENT1 = Ident or IPFIXI) and
DT = '0' and
LEVEL = '1' and
EXT = '0' and
FLAG1 = '0' and
FLAG2 = '0'

Standard option for other combinations. For calls other than group calls or a shot addressing call to a PABX extension, FLAG2 is se to zero, unless permittd by the network.

11.5.5.3.1.2 Request Codeword Free for Customisation

Section deleted in MPT 1327.

11.5.5.3.1.3 Call Cancel/Abort Transaction Request Message, RQX

Mandatory as specified.

Informative.

11.5.5.3.2.3 Cancel Alert State Message, AHYX

Mandatory as specified.

11.5.5.3.2.4 Reserved Section

Informative.

11.5.5.3.2.5 Reserved Section

Informative.

11.5.5.3.2.6 Reserved Section

Informative.

11.5.5.3.2.7 Status Ahoy Message, AHYQ

Mandatory as specified.

11.5.5.3.2.8 Short Data Invitation Message, AHYC

Mandatory as specified.

11.5.5.4 Miscellaneous Control Messages (Type '11')

Messages received by the radio unit which it shall understand and take any mandatory action required:

MAINT, MOVE, CLEAR, BCAST

Messages received by the radio unit which it is a standard option for the mobile to understand:

MARK

Messages which the radio unit shall send where required by the protocol (mandatory):

MAINT (see section 11.5.5.4.2 for applicable messages)

11.5.5.4.1 Control Channel Marker, MARK

It is a standard option whether the radio unit makes use of the MARK message.

The CHAN4 bits correspond to the least significant four bits of the 10 bit binary channel representation of the channel number of the control channel on which the message was received(see section 5.1).

11.5.5.4.2 Call Maintenance Message, MAINT

Messages received by the radio unit which it shall understand and take any mandatory action required:

MAINT (OPER = '110', '111')

Messages which the radio unit shall send where required by the protocol (mandatory):

MAINT (OPER = '000', '001', '010', '011')

For OPER = '110' or OPER = '111' the message format is as follows:

1	PFIX	IDENT1	1	CAT 000	TYPE 11	FUNC 001	CHAN	OPER	RSVD	STI	SIL3	P
1	7	13	1	3	2	3	10	3	1	1	3	16

Field definitions are as for MPT 1327 with the addition of:

STI - Site Indicator Flag. If non-zero then SIL3 holds the three least significant bits of the SIL sub-field of the system identity code (SYS) currently being propagated by the system originating the message.

SIL3 - The three least significant bits of the SIL sub-field of the system identity code (SYS) currently being propagated by the system originating the message.

For STI = '0' then SIL3 = RSVD (RSVD = '000')

It is mandatory for the radio unit to understand and act on the messages:

MAINT (OPER = '110') (See also 11.9.2.3.7)

MAINT (OPER = '111') (See also 11.9.2.3.3)

It is mandatory for the radio unit to send these messages where required by the protocol:

MAINT (OPER = '000', '001', '010', '011')

For OPER = '110' or OPER = '111', the STI and SIL3 fields are reserved and shall be set to zero for MAINT messages transmitted by radio units.

11.5.5.4.3 Clear-Down Message, CLEAR

Mandatory as specified.

If the radio unit receives a CLEAR message with the CONT field set to '0000000000' then the radio unit shall either return to the last active control channel, or remain on the nominated fall-back channel if in fall-back mode (see Sections 9 and 13). The message format is as follows:

1	CHAN	CONT	1	CAT 000	TYPE 11	FUNC 010	STI	SIL3	TSI	SPARE	REVS 101010101010	P
1	10	10	1	3	2	3	1	3	1	1	12	16

Field definitions are as for MPT 1327 with the addition of:

STI - Site Indication Flag. If non-zero then SIL3 holds the three least significant bits of the SIL sub-field of the system identity code (SYS) currently being propagated by the system originating the message.

SIL3 - The three least significant bits of the SIL sub-field of the system identity code appropriate to the system originating the message.

For STI = '0' then SIL3 = RSVD (RSVD = '000')

TSI - Time-shared control channel indicator. See section 9.

'0' - Time-shared control channels are not expected on channel number CONT.

'1' - Time-shared control channels may be encountered on channel number CONT.

11.5.5.4.4 Move to Control Channel, MOVE

Mandatory as specified.

The radio unit shall enter a "preferential hunt" if it receives a MOVE message with the CONT field set to '0000000000' (see section 9).

The message format is as follows:

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

Field definitions are as for MPT 1327 with the addition of:

TSI - Time-shared control channel indicator. See section 9.

'0' - Time-shared control channels are not expected on channel number CONT.
'1' - Time-shared control channels may be encountered on channel number CONT.

11.5.5.4.5 Broadcast Message, BCAST

Mandatory for the following SYSDEF value:

'00010' Specify call maintenance parameters
'00011' Specify registration parameters

Standard option for the following SYSDEF values:

'00000' Announce control channel
'00001' Withdraw control channel
'00100' Broadcast adjacent site control channel number
'00101' Vote now advice

11.5.5.4.5(a) Announce Control Channel (SYSDEF = '00000')

Standard option.

The message format is as follows:

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

Field definitions are as for MPT 1327 with the addition of:

TSI - Time-shared control channel indicator. See section 9.

'0' - Time-shared control channels are not expected on channel number CHAN.

'1' - Time-shared control channels may be encountered on channel number CHAN.

11.5.5.4.5(b) Withdraw Control Channel (SYSDEF = '00001')

Standard option.

11.5.5.4.5(c) Specify Call Maintenance Parameters (SYSDEF = '00010')

The message format is as follows:

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

All facilities listed in MPT1327 are mandatory. Field definitions are as for MPT1327 with the addition of:

TSCLIM - Specifies the maximum traffic channel call duration for non-emergency calls. The binary values used are as follows:

'00000000': Duration to be CLIM

'00000001 to '00001001': Duration to be the decimal equivalent of the binary field value in minutes plus 4 minutes. '00001010' to '11111110': Duration to be the decimal equivalent of the binary field value in seconds.

'11111111': Call timer infinite.

11.5.5.4.5(d) Specify Registration Parameters (SYSDEF = '00011')

It is mandatory for the radio unit to understand and act on this message.

The message format is as follows:

1	SYSDEF 00011	SYS	1	CAT 000	TYPE 11	FUNC 100	RSVD	NA	REG	SPARE	RFFD	P
1	5	15	1	3	2	3	4	2	1	5	6	16

Field definitions are as for MPT 1327 with the addition of:

NA - Specifies the maximum number of registration records which a radio unit shall store (see section 10):

'00' reserved for future definition in MPT 1343
'01' one registration record
'10' two registration records
'11' three registration records

REG - Specifies registration mode (see section 10):

'0' normal

'1' temporary

RFFD - Reserved for future definition in MPT 1343.

Default value = '000000'.

11.5.5.4.5(e) Broadcast Adjacent Site Control Channel Number (SYSDEF = '00100')

Standard option.

The message format is as follows:

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

Field definitions are as for MPT 1327 with the addition of:

TSI - Time-shared control channel indicator. See section 9.

'0' - Time-shared control channels are not expected on channel number CHAN.
'1' - Time-shared control channels may be encountered on channel number CHAN.

11.5.5.4.5(f) Vote Now Advice (SYSDEF = '00101')

Standard option.

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

Field definitions are as for MPT 1327 with the addition of:

TSI - Time-shared control channel indicator. See section 9.

'0' - Time-shared control channels are not expected on channel number CHAN.
'1' - Time-shared control channels may be encountered on channel number CHAN.

11.5.6 Category '001' Messages

11.5.6.1 Single Address Messages (Type '0')

11.5.6.1.1 Outbound Single Address Messages, SAMO

The basic word format is informative.

11.5.6.1.2 Inbound Single Address Messages

11.5.6.1.2.1 Inbound Unsolicited Single Address Message, SAMIU

The basic word format is informative.

11.5.6.1.2.2 Inbound Solicited Single Address Message, SAMIS

Mandatory for Mode 1, DESC = '000' (Interprefix calls).
Mandatory for Mode 2, DESC = '000' (Serial number transfer).

Standard option otherwise.

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

Standard option.

11.5.7 Codewords applicable to Standard Data

11.5.7.1 Request Standard Data Communication RQD

Standard option.

11.5.7.2 Availability Check for Standard Data AHYD

Standard option.

11.5.7.3 Go to Transaction GTT

Standard option.

11.5.7.4 Standard Data Random Access Radio Unit General Information DRUGI

Standard option.

11.5.8 Codewords applicable to Standard Data Transactions

11.5.8.1 Standard Data General Purpose Acknowledgement DACKD

Standard option.

11.5.8.2 Standard Data Codeword DACK containing Submessages DAL, DALG, DALN or GO

Standard option.

11.5.8.3 Standard Data Acknowledgement for Expedited Data DACKZ

Standard option.

11.5.8.4 Standard data General Ahoy DAHY

Standard option.

Standard option.

11.5.8.10 Request to close a Transaction DRQX

Standard option.

11.5.8.11 Standard Data Selective Acknowledgement Header SACK

Standard option.

11.5.8.12 Standard Data Address codeword for a Dataitem SITH

Standard option.

11.6 Channel Discipline

Informative.

11.6.1 Channel Discipline for TSC

11.6.1.1 Control Channel Discipline for TSC

Informative.

11.6.1.2 Traffic Channel Discipline for TSC

11.6.1.2.1 Monitoring

Informative.

11.6.1.2.2 Signal Timing

Informative.

11.6.1.3 Data Channel Discipline for TSC

Informative.

11.6.1.3.1 Monitoring

Informative.

11.6.1.3.1 Signal Timing

Informative.

11.6.2 Channel Discipline for Radio Units

11.6.2.1 Control Channel Discipline for Radio Units

11.6.2.1.1 Control Channel Acquisition

Mandatory where specified. The radio unit shall also meet the requirements of section 9 of this specification.

11.6.2.1.2 Retaining a Control Channel

Mandatory as specified, where:

- an applicable system identity code is any system identity code where bits 1-12 differ from the verified value or where bits 13-15 (LAB) are a value which does not permit access to the control category assigned to the radio unit;

- appropriate codewords are CCSC's and, if the radio unit is equipped to receive them, MARK messages;

- a correct value of the system identity code is one in which bits 1-12 of the SYS field from a received appropriate codeword match bits 1-12 of the verified value value and bits 13-15 (LAB) are a value which permits access to the control category assigned to the radio unit.

The radio unit shall also meet the requirements of section 9 of this specification.

11.6.2.1.3 Signal Timing

Mandatory as specified.

The reception-to-reception retuning time limits stipulated in MPT 1327, [6.2.1.3], [6.2.2.1], [7.4.2], [9.2.2.5], [9.2.3.4] and [9.2.3.8] all refer to the time between the end of the relevant invoking codeword and the start of the last 16 bits of the preamble to the standard data message on the new channel. The only requirement is to be able to decode such a message.

Time limits for satisfactory reception of speech or non-standard data are not specified.

11.6.2.2 Traffic Channel Discipline for Radio Units

11.6.2.2.1 Monitoring

Mandatory as specified.

For definition of the re-tuning time limits, see 11.6.2.1.3.

11.6.2.2.2 Signal Timing

Mandatory as specified.

11.6.2.2.2.1 Radio Unit Response

Mandatory as specified.

11.6.2.2.2.2 Unsolicited Transmission that Requires a Response

Standard option.

11.6.2.3 Data Channel Discipline for Radio Units

Standard Option

11.6.2.3.1 Monitoring

Standard Option

11.6.2.3.2 Signal Timing

Standard Option

11.7 Random Access Protocol

Informative.

11.7.1 The Principle

Informative.

11.7.2 TSC Random Access Facilities

11.7.2.1 Marking Random Access Frames

Informative.

11.7.2.2 Subdividing the Radio Unit Population

Informative.

11.7.2.3 Inviting Specific Types of Random Access Message

Informative.

11.7.2.4 TSC Responses

Informative.

11.7.2.5 Withdrawing Slots from Frames

Informative.

11.7.3 Radio Unit Random Access Protocol

Mandatory as specified.

11.7.3.1 Checking Subsets of the Radio Unit Population

Mandatory as specified.

11.7.3.2 Checking the Aloha Function

Mandatory as specified. The recognition of ALHF is mandatory; the implementation of the fall back mode is a standard option (see section 13).

11.7.3.3 Frames Defined by Aloha Numbers

Mandatory as specified.

11.7.3.4 First Try Option

Standard Option as stated.

11.7.3.5 Choosing a Slot from a New Frame

Mandatory as specified.

11.7.3.6 Check for Withdrawn Slot

Mandatory as specified. It is mandatory for the radio unit not to make a random access when a codeword is not decodable (or no signal is received) (item d. of MPT 1327 section 7.3.6).

11.7.3.7 Noting the Response Delay

Mandatory as specified. The required value of parameter NW is defined in Appendix B of this specification.

11.7.3.8 Retry Decision and Time-outs

Informative. The function of ALHF is specified in sections 9 and 13.

11.8.2 Procedures for Registration by Random Access

11.8.2.1 TSC Procedures

Informative.

11.8.2.1.1 Responses to a Random Access RQR Message

Informative.

11.8.2.1.2 Acknowledgements Sent to Indicate Progress of Registration

Informative.

11.8.2.1.3 TSC Time-out

Informative.

11.8.2.2 Radio Unit Procedures for Registration by Random Access

11.8.2.2.1 Criteria for Registration

Mandatory where specified. The requirements placed on the radio unit as regards registration are given in section 10. The radio unit shall not attempt random access to a system unless that system is identified in its personality (see section 6). Where a system requires a radio unit to register, the radio unit shall be required to register successfully before attempting to make any calls.

11.8.2.2.2 Registration Request and Valid Responses

Mandatory where specified. The required values of timeout and default parameters listed are defined in section 6 and Appendix B of this specification. The radio unit shall set the INFO field to all zeros, unless permitted otherwise by the network.

11.8.2.2.3 Acknowledgement Received

Mandatory where specified. The action that the radio unit shall take when registration is denied is defined in section 10 of this specification.

11.8.2.2.4 Time-out after Waiting

Mandatory where specified. The action that the radio unit shall take when registration is denied is defined in section 10 of this specification.

11.8.3 Procedures for Registration on Demand

11.8.3.1 TSC Procedures for Demanding Registration

Informative.

11.8.3.2 Radio Unit Procedures for Registration on Demand

11.8.3.2.1 Individually Addressed ALHR Message

Items a1, a2: mandatory as specified. Item b: all radio units shall have the capability to register, and hence the radio unit shall respond with RQR in this case. Item c. is not applicable.

11.8.3.2.2 Response to RQR sent on Demand

Mandatory as specified. Additional mandatory requirements are placed on the radio unit in section 10 of this specification.

11.9 Basic Call Procedures

Informative.

It shall be mandatory for the radio unit to be able to make "simple" calls to the following destinations:

Radio units and line units with the same prefix.
Radio units and line units with a different prefix.

It is a standard option for the radio unit to make "simple" calls to destinations other than those listed above.

It is a standard option for a radio unit to make the following calls:

Calls to a group.
Calls to all units on a system.

11.9.1 Basic Call Procedures for TSC

Informative.

11.9.1.1 Basic TSC Procedures for Setting Up Calls

11.9.1.1.1 Responses to a Short Addressing RQS Message

Informative.

11.9.1.1.2 Responses to an Extended Addressing RQS Message

Informative.

11.9.1.1.3 Instructions to Send Extended Address Information

Informative.

11.9.1.1.4 Acknowledgements Sent to a Calling Unit to Indicate Progress of a Simple Call

Informative.

11.9.1.1.5 Availability Check on Called Radio Unit

Informative.

11.9.1.1.6 Availability Check for Calls to PABX Extensions and PSTN Destinations

Informative.

11.9.1.1.7 Availability Check on Requesting Radio Unit

Informative.

11.9.1.1.8 Call Cancellation

Informative.

11.9.1.1.9 Call Amalgamation

Informative.

11.9.1.1.10 Queue Management and Queue Time-out

Informative.

11.9.1.1.11 Resolving Call Conflicts

Informative.

11.9.1.1.12 Traffic Channel Allocation

Informative.

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

Informative.

11.9.1.2.1 Call Maintenance Options

Informative.

11.9.1.2.2 Availability Check on Traffic Channel

Informative.

11.9.1.2.3 Disabling User Transmission

Informative.

11.9.1.2.4 Allocating Replacement Traffic Channel

Informative.

11.9.1.2.5 Clearing Down Unwanted Radio Units During a Call

Informative.

11.9.1.2.6 Call Cleardown

Informative.

11.9.2 Basic Call Procedures for Radio Units

Mandatory where specified.

It is a mandatory for the radio unit to be fitted with a "ready for communication control" (RFCC).

11.9.2.1 Procedures for Radio Units Making Simple Calls

Mandatory where specified.

It is a standard option for a radio unit to make calls to a PABX or PSTN destination.

11.9.2.1.1 Request for a Simple Call

Mandatory as specified.

It shall be mandatory for the radio unit to be able to make simple calls to common prefix and interprefix destinations.

It is a standard option for a radio unit to make data calls.

11.9.2.1.2 Valid Responses to Short Addressing RQS

Mandatory as specified.

11.9.2.1.3 Valid Responses to Extended Addressing RQS

Mandatory as specified.

11.9.2.1.4 Acknowledgement Received

Mandatory as specified.

Requirements for confidence indications are given in section 8.1. The radio unit shall make an indication to the user following receipt of ACKB (QUAL='0').

The facility to cancel a call accepted for call back by use of an RQQ message (STATUS = '11111') is a standard option.

Diversion requests (RQT) and use of diversion information are a standard option. Automatic re-dial to the diversion IDENT is optional.

11.9.2.1.5 Availability Check and Channel Allocation for Own Call

Mandatory as specified.

11.9.2.1.6 Time-out after Waiting

Mandatory as specified. The requirements for confidence indications are given in section 8.1.

11.9.2.1.7 Call Cancellation

Mandatory. It shall be possible for the user to cancel the call. The requirements for confidence indications are given in section 8.1.

11.9.2.2 Basic Procedures for All Radio Units on a Control Channel

Informative.

11.9.2.2.1 Instruction to Send Address Information or Data Message

Mandatory for the following function:

Interprefix calls.

Standard option for the other transaction types listed.

Mandatory as specified.

11.9.2.3.1 Call Maintenance Messages

For values of NPON=1 and NPOFF=1 : mandatory as specified.

For values of NPON>1 or NPOFF>1 : standard option.

11.9.2.3.2 Availability Check on Traffic Channel

Section A) Mandatory as specified

Section B) Standard Option

11.9.2.3.3 Disabling User Transmission

See also 11.5.5.4.2.

If the radio unit on a traffic channel receives a MAINT (OPER = '111') message with the STI flag equal to zero then:

i. the SIL3 field = RSVD and has no meaning;

ii. the radio unit shall understand and take any mandatory action required.

If the radio unit on a traffic channel receives a MAINT (OPER ='111') message with the STI flag NOT equal to zero, then:

i. the user transmission shall only be inhibited if the SIL3 field matches the three least significant bits of the verified SIL code.

11.9.2.3.4 Replacement of Traffic Channel

Mandatory where specified.

For definition of the retuning time limits, see 11.6.2.1.3.

The radio unit shall meet the requirements of any prearrangement made as regards the sending of periodic messages during data calls .

11.9.2.3.5 Going "on-hook" on Traffic Channel

Mandatory as specified.

11.9.2.3.6 Time-outs on Traffic Channel

For values of NPON=1 and NPOFF=1: mandatory where specified.

For values of NPON>1 or NPOFF>1: standard option.
The requirements for confidence indications are given in section 8.1.

The definition of inactivity that shall be used in this section of MPT 1327 is that a radio unit is considered inactive on a traffic channel when it is not transmitting and the received audio is muted because the receiver quieting is insufficient.

It is an option for radio units to incorporate a maximum call duration timer. This timer shall be initialised immediately that the radio unit has tuned to a designated forward traffic channel following receipt of a GTC message in accordance with !!9.2.2.5!! (unless inhibited by the latest received value of TSCLIM, see below). The timer shall remain in operation for as long as the radio unit remains tuned to either the forward or return channel of the designated traffic channel or any other traffic channel to which the radio unit may be directed by subsequent GTC messages in accordance with !!9.2.3.4!! but shall be cancelled when the radio unit tunes to a control channel in accordance with !!9.2.3.5!!, !!9.2.3.6!!, !!9.2.3.7!! or !!9.2.3.8!!.

Upon expiry of the maximum call duration timer the radio unit shall:

i) Mute the audio.

ii) If the radio unit is transmitting it shall send one or more Pressel Off messages to indicate the end of the item in accordance with !!9.2.3.1!!.

iii) Send ND1 or ND2 Disconnect messages if its individual address is PFIX/IDENT1 or PFIX/IDENT2 from the GTC (as in section !!9.2.3.5!!).

iv) Cease transmission on the traffic channel, indicate the end of the call to the user in accordance with 8.1.3.8 and enter the control channel acquisition procedures (see section 9).

The radio unit may also use the call duration timer to indicate to the user that the above action is imminent, at some time prior to the action being carried out.

The call duration timer shall expire after a period as determined below:

- Upon acquiring a new control channel and until a BCAST (SYSDEF='00010') message has been received, the period shall be CLIM.

- If at least one decodable BCAST (SYSDEF='00010') message has been received by the radio unit since the start of the session or since acquiring a new control channel, the period shall be as indicated by the value of TSCLIM received in the last decodable BCAST (SYSDEF='00010') message (see 11.5.5.4.5c) unless that value of TSCLIM is '00000000' when the period shall be CLIM or is '11111111' when the maximum call duration timer shall be inhibited.

- If the radio unit has tuned to the traffic channel as a result of receiving a GTC message whilst waiting for signalling for an emergency call following the receipt of an AHY message with bit E set to '1' or following the transmission of RQE, the period shall be CLIME.

If the radio unit transmits an item that reaches the maximum permitted duration TT then it shall mute the audio and shall
as a default satisfy the procedures defined in !!9.2.3.6.A!!

As an alternative !!9.2.3.6.B!! may be activated during personalisation of the radio unit using the TT flag defined in Table 6.1 (Item nn)

11.9.2.3.7 "Selective" Clear-Down Message: MAINT with OPER='110'

See also 11.5.5.4.2.

The requirements for confidence indications are given in section 8.1.

If a radio unit on a traffic channel receives a MAINT (OPER ='110') with the STI flag equal to zero then:

i. the SIL3 field = RSVD and has no meaning;

ii. the radio unit shall understand and take any mandatory action required.

If the radio unit on a traffic channel receives a MAINT (OPER ='110') message with the STI flag NOT equal to zero, then:

i. the radio unit shall clear down only if the SIL3 field matches the three least significant bits of the verified SIL code.

11.9.2.3.8 CLEAR Message

If a radio unit on a traffic channel receives a clear-down message CLEAR with the STI flag equal to zero

and

i. channel number (CHAN) equal to the number of the traffic channel

and

ii. field REVS equal to '101010101010',

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

If a radio unit on a traffic channel receives a clear-down message CLEAR with the STI flag NOT equal to zero

and

i. channel number (CHAN) equal to the number of the traffic channel

and

ii. field REVS equal to '101010101010'

and

iii. the SIL3 field matches the three least significant bits of the verified SIL sub-field,

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

If the field CONT is set to '0000000000' then the radio unit shall either return to the last active control channel , or remain on the nominated fall-back channel if in fall-back mode.

The requirements for confidence indications are given in section 8.1.

11.10 Emergency Call Procedures

Standard option.

Other modes of customised emergency service are not precluded.

11.10.1 Standard Emergency Call Procedures for TSC

Entire subsection: informative.

11.10.2 Standard Emergency Call Procedures for Radio Units

Entire subsection: standard option.

Standard emergency call procedures on a traffic channel are defined in MPT 1327 section 9.2.3.

11.11 Include Call Procedures

Standard option.

11.11.1 TSC Procedures for Include Calls

Entire subsection: informative.

11.11.2 Procedures for Radio Units Requesting Include

Entire subsection: standard option.

11.11.3 Procedures for All Radio Units on an Allocated Traffic Channel

11.11.3.1 Instruction to Send Extended Address Information

Standard option.

11.12 Call Diversion Procedures

Standard option.

11.12.1 TSC Procedures for Call Diversion Requests

Entire subsection: informative.

11.12.2 Procedures for Radio Units Requesting Call Diversion

Entire subsection: standard option.

11.13 Status Message Procedures

Entire section: procedures involving RFCC signalling are mandatory.
It is mandatory that the radio unit is able to recognise and respond to the AHYQ message (refer to MPT 1327 section 13.2.3).
Otherwise: standard option.

11.14 Short Data Message Procedures

Entire section: standard option.

11.15 Data Interrogation Procedures

Informative.

11.15.1 Data Interrogation Procedures for TSC

11.15.1.1 Data Interrogation on a Control Channel

Informative.

11.15.1.2 Data Interrogation on a Traffic Channel

Informative.

11.15.2 Procedures for All Radio Units

It is a mandatory requirement that radio units shall recognise Mode 2 AHYC messages and respond with the serial number transmission as specified below.

11.15.2.1 Data Interrogation Message (AHYC, Mode 2) on a Control Channel

The radio unit shall be equipped to transmit its serial number on interrogation using the SAMIS message. The form of the serial number transmitted is defined in section 7.

11.15.2.2 Data Interrogation Message (AHYC, Mode 2) on an Allocated Traffic Channel

The radio unit shall be equipped to transmit its serial number on interrogation using the SAMIS message. The form of the serial number transmitted is defined in section 7.

11.16

This paragraph is not used.

11.17 Standard Data Procedures

Entire section: standard option.

12. NON STANDARD DATA INTERFACE PROVISION

The provision of a non standard data facility on a radio unit is a standard option.

Within the procedures RQS and RQE with DT=1, provision may be made for connection of external data equipment to radio units for transmission over transparent signalling paths. The quality of the paths will be determined by individual networks.

12.1 Muting

The equipment shall be constructed so that the data path shall never be disturbed by the squelch for speech reception. Receiver audio shall be muted during data reception.

12.2 Maladjustment

Those controls which if maladjusted might increase the interference potential of the transceiver shall not be easily accessible to the user.

12.3 Standard Signalling

Whilst in a data call and receiving signals from the TSC the Radio unit shall monitor the channel continuously for messages from the TSC and shall take appropriate action.

The radio unit shall send disconnect messages but may send other call maintenance messages only by pre-arrangement with the network operator.

12.4 Data Call Handling

The radio unit shall incorporate a Data Call Duration Timer TU, and an associated suppression flag as part of its network personalisation.

12.4.1 Call Establishment

Calls are established by the unit receiving a GTC (D=1). Timer TU shall be started upon first tuning to the traffic channel.

12.4.2 Call Clearance

The radio unit shall send disconnect messages as specified in MPT 1327 section 9.2.3.5,

either:

on expiry of the Data Call Duration Timer,

or:

at end of the data transaction when detected by the radio unit (whereupon TU is de-activated), whichever is earlier.

12.5 Facilities

Equipment that does not integrate the keyboard and display or other means of data entry or retrieval into the transceiver shall provide a suitable interface covering at least:

RX Audio - shall not be affected by the radio unit volume control setting

TX Audio - at levels that shall not affect the overall deviation requirements.

Keyline - form unspecified; the keyline shall be inhibited until at least TR has elapsed from the receipt of GTC (D=1) or on completion of a standard data transaction on the traffic channel which starts within TR and over-runs TR.

In addition the following facilities may be made available:

Data Channel Ready - This signal is generated by the RU shall become active after a period of at least TR has elapsed from the receipt of GTC (D=1) or on completion of a standard data transaction on the traffic channel which starts within TR and over-runs TR. This signal does not guarantee that an end to end communication path has been established.

Data Equipment Available - This signal is generated by the external data equipment and shall only be active when the data equipment is ready to receive or transmit data. This signal enables the RU to provide the appropriate control channel signalling for call set-up and rejection for RQS (DT=1), data calls. AHY (D=1) or GTC (D=1). If during a data call the Data Equipment Available signal is de-activated, this shall initiate a call clear down.

NOTE

It is recommended that manufacturers of external data equipment should list those Radio Units for which the equipment combination complies with MPT 1323.

13. FALL-BACK MODE

13.1 Introduction

The fall-back mode enables a reduced service to be offered to radio units when there has been a partial equipment failure in the network, for example if the network loses the ability to trunk channels. Implementation of the fall-back mode is a standard option for radio units, and also for systems.

The general method of fall-back operation is as follows. Each radio unit will relapse to a pre-programmed channel (all members of a fleet would be programmed with the same channel number). The network may operate each of these channels independently, as a set of single channel systems; each channel will alternate between being a control channel (using the Aloha protocol to control random access) and a traffic channel.

This section defines the additional requirements for radio units which implement the fall-back option. Radio units which implement the fall-back option shall also conform to the requirements of all other sections of this specification, except where stated otherwise in this section. The requirements for radio units which do not implement the fall-back option are covered in sections 9 and 11 of this specification.

13.2 Storage Requirements

The radio unit shall be programmable with the following parameters appropriate to the selected network. The parameters shall be stored in read-only memory.

a) The number of the channel on which the radio unit will receive the fall-back service.

   If programmed with a zero (null) value for the channel number, the radio unit shall be inhibited from operating the fall-back mode. In this case the radio unit shall conform to the requirements for a radio unit which is not equipped for fall-back operation.

b) The system identity code conveyed on the channel on which the radio unit will receive the fall-back service. Only the NDD field (section 9.3.4.2.2) needs to be programmable explicitly; the other fields in the fall-back system identity code may be assumed to match the system identity code personalisation data for the normal operation mode.

The specification is written for a radio unit which is equipped to operate on only one fall-back channel. Operation on more than one fall-back channel, for example different channels in separate parts of a network, is not prohibited, but is not explicitly supported by this specification.

13.3 Entering Fall-Back Mode

The radio unit shall enter the fall-back mode if, while active on a control channel and in the normal operation mode, it receives an applicable ALHF message (see section 7.3.1 of MPT 1327) containing a correct CHAN4. The radio unit shall abandon any call set-up or transaction in progress. The radio unit shall then attempt to find and confirm an alternative control channel which is in the normal operation mode, commencing with the preferential

hunt sequence. An additional requirement for confirming that a control channel is in the normal operation mode is the receipt of a normal operation mode Aloha message (i.e. ALH, ALHS, ALHD, ALHE, ALHR or ALHX).

If the radio unit fails to find and confirm a normal operation mode control channel (all prescribed hunt stages shall be completed), it shall tune to its pre-programmed fall-back channel, and attempt to confirm the fall-back channel. The condition for becoming active and confirming the fall-back channel is the receipt of a CCSC containing the radio unit's pre-programmed fall-back system identity code (the confirmation conditions specified in section 9.3.4 are not applicable).

Until the radio unit has confirmed the fall-back channel, it shall not transmit on that channel or obey any messages received. After the radio unit has confirmed the fall-back channel it shall conform to the fall-back procedures defined in section 13.4.

Upon entering the fall-back mode the radio unit shall maintain existing registration records and continue to operate the registration timers.

13.4 Procedures in Fall-Back Mode

The requirements in this section augment, and in some cases modify, the requirements of other sections of this specification which apply to normal operation mode.

13.4.1 Call Procedures

a) ALHF invites the following types of call request: RQS, RQX, RQT, RQE, RQQ and RQC.

b) The radio unit shall not attempt to register by random access, and shall not make use of control channel messages to implicitly register; the radio unit is free to initiate and receive calls even if the unit does not hold a registration record for the verified AREA code of the fall-back system identity code.

c) The radio unit shall not initiate calls to a PABX or PSTN.

d) The timeout TC shall have a value TX (see, for example, TC in section 8.1.3.5, and in !!7.3.8!!).

13.4.2 Channel Discipline

a) The radio unit shall not apply the error checking criterion specified in section 9.4.1 item a) for leaving the fall-back control channel.

b) When the radio unit hunts according to the criteria specified in sections 9.4.1 and 9.4.2, if it fails to find and confirm a normal operation mode control channel (all prescribed hunt stages shall be completed), it shall re-tune to its fall-back channel and attempt to confirm the fall-back channel.

c) The unit shall suspend activity if a system identity code different from its fall-back system identity code is received on its fall-back channel, as specified in section 6.2.1.2 of MPT 1327. See also section 9.4.1 item b).

d) The time out TS shall have a value TF while the radio unit is operating on the fall-back channel during the fall-back mode.

e) As normal, the radio unit shall mute the received audio while not assigned for traffic.

f) If a GTC message which allocates the fall-back channel for traffic is received on the fall-back channel, then if the radio unit is not required to obey the GTC message it shall remain tuned to the fall-back channel.

g) The condition for becoming active and confirming the fall-back channel is the receipt of a CCSC containing the radio unit's pre-programmed fall-back system identify code (the confirmation conditions specified in section 9.3.4 are not applicable).

13.5 Leaving Fall-Back Mode

Under any of the following conditions the radio unit shall exit from fall-back mode, abandon any call set-up or transaction in progress, and enter the control channel acquisition procedures:

(a) An applicable MOVE message is received (the radio unit shall ignore any MOVE message that is not applicable to it).

(b) A CLEAR message (with correct CHAN field) is received in which CONT is not set to zero or to the radio unit's fall-back channel. The radio unit shall perform a single channel hunt (if CONT=O, or is set to the radio unit's fall-back channel, the radio unit shall remain in the fall-back mode on the fall-back channel).

(c) A normal operation mode Aloha message (ie ALH, ALHS, ALHD, ALHE, ALHR or ALHX) is received while active on any channel. The radio unit shall perform the final checks according to the requirements of section 9.3.4.4 before leaving the fall-back mode, ie normal operation of the channel shall be confirmed before leaving the fall-back mode.

(d) A user-initiated change of selected network. See also section 13.6.

When the network terminates the fall-back service, the radio unit may receive on the fall-back channel either a MOVE command (if another channel becomes the normal operation mode control channel), or a CLEAR message (as specified above), or a normal operation mode Aloha message.

However, in case the radio unit does not receive the signalling which terminates the fall-back mode on the fall-back channel, and to provide an opportunity to exit from the fall-back mode if the fall-back channel quality degrades, the hunting requirement specified in section 9.4.1 c) provides an alternative route for returning to normal operation mode.

While in the fall-back mode on the fall-back channel, the radio unit may come within range of a normal operation mode control channel on which it could obtain a better service. Therefore, it is recommended that, when not in traffic or waiting for signalling, the radio unit hunts occasionally for a normal operation mode control channel, regardless of the quality of the channel and whether or not the radio unit is active.

While in the fall-back mode and examining channels other than the fall-back channel, the radio unit shall operate the normal rules for control channel acquisition (section 9), but receipt of a normal operation mode Aloha message is an additional requirement for confirming the control channel. As defined above, receipt of a normal operation mode Aloha message shall terminate the fall-back mode, whereas the radio unit shall resume hunting if it receives ALHF (note that the radio unit shall not dwell indefinitely on a control channel while active and waiting for an Aloha message to confirm the channel). Upon leaving the fall-back mode the radio unit shall attempt to register if required to by sections 10.2.3 and 10.2.7 (or 10.3.3 and 10.3.7 if the radio unit supports multiple registration).

13.6 User Initiated Change of Network

If the user initiates a change of network while the radio unit is in the fall-back mode, then if the network which was operating the fall-back service is re-selected (when fall-back service may or may not have terminated in the network) the radio unit shall re-enter the network in the fall-back mode as if it had received an applicable ALHF message, as defined in section 13.3. If the radio unit fails to find and confirm a normal operation mode control channel (all prescribed hunt stages shall be completed), it shall tune to its pre-programmed fall-back channel, and attempt to confirm the fall-back channel.

14 SHORT DATA ON THE CONTROL CHANNEL USING RQC

14.1 Introduction

This section describes the air interface requirements necessary to support signalling between radio units and TSCs during the transfer of short data messages on the control channel. The implementation of the procedures defined in this section is a standard option.

The transfer of short data messages conforms with the basic procedure defined in MPT1327 section 14. This allows transmission of HEAD messages containing free format data on the control channel. Implementation of the short data standard option defined in this document requires some of these bits to carry control information. The protocol allows the use of only MPT1327 procedures, or the procedures as described in this section.

A calling radio unit requests to transmit a short data message by sending an RQC random access request message addressed to the called unit or service. For extended addressing PSTN and PABX calls (and optionally for interprefix calls), the TSC will solicit the full called party address information using the MPT1327 extended addressing procedures at an appropriate point in call set-up. The TSC may check the availability of a called radio unit using the General Availability Check Message AHY, before requesting the caller to send a HEAD message by means of the Short Data Invitation Message AHYC (refer to sections !!5.5.3.2.1!! and !!5.5.3.2.8!!). The calling party sends a Short Data Message Header HEAD and up to four appended data codewords to the TSC. The TSC then forwards the data by re-transmitting the HEAD message to the called party which is required to respond with an acknowledgement in accordance with the procedures outlined in section 14 of MPT1327. The TSC sends an acknowledgement to the calling party to advise the receipt of the HEAD message (or otherwise) by the called party. Where the called party is a group and not an individual address, no acknowledgement by radio units in that group to a HEAD message is permitted (see section !!14.3.1.2!!) and, in this case, the TSC sends an acknowledgement to the calling party to advise whether the HEAD message has been received by the TSC and transmitted to the group.

Note: The term "HEAD message", where used in this section, shall be taken to mean "HEAD address codeword and appended data codewords" collectively.

The procedures defined in !!14!! support the transmission of a single segment of free-format data. (A "segment" is that amount of free-format data which can be accommodated in a single HEAD message; see section 3.1). This specification extends the scope of the above referenced procedures to allow up to four segments to be associated with a single request (RQC). For convenience a short data transaction for which the T-message (see section 3.1) is confined to a single segment is referred to as a Single Segment Transaction (SST) in this specification. A short data transaction for which the T-message comprises more than one segment is referred to as a Multiple Segment Transaction (MST).

14.1.1 General Description

A radio unit requests to transmit short data HEAD messages in accordance with the procedures of !!14!! by sending an RQC message on a control channel. The TSC then solicits the transmission of a HEAD message using the address codeword AHYC. In the case of a Multiple Segment Transaction, each HEAD message of the transaction is individually solicited by the TSC using an AHYC message. The TSC need not support Multiple Segment Transactions, in which case this will be indicated in the AHYC message. In these circumstances a radio unit wishing to send a T-message comprising more than one segment is required instead to generate an RQC for each segment treating each as an SST.

In the case of an MST, the TSC is responsible for requesting each segment from the radio unit and forwarding it to the called party. The TSC either will assemble the complete T-message before forwarding it or will forward each segment by means of a HEAD message as soon as it has been received correctly.

SSTs and MSTs may be addressed to individual units, to groups or to a TSC gateway.

A simple message repeat error correction protocol is incorporated into this specification. If an error is detected by the TSC in a return channel data codeword (calling radio unit to TSC) a repeat may be demanded until a satisfactory error-free segment can be assembled. If an error is detected by an individually called radio unit in a forward channel data codeword (TSC to called party), repeat transmissions may be requested. The TSC may make repeat transmissions, subject to timing rules and network limits, when no acknowledgement of receipt is obtained from the called party.

14.1.2 Facilities

T-messages may be sent in one of the 8 formats listed below. Changing between these formats within a transaction is not permitted.

- binary
- BCD (in accordance with MPT1327, Appendix 5)
- ITU-T Alphabet No 2 (Telex), Recommendation S1
- ITU-T Alphabet No 5 (ASCII), Recommendations V3 and V4
- two formats which are reserved for future definition
- A mechanism to transport control information to a radio unit. (See Appendix AN6)
- one format which is spare for customisation

A short data HEAD address codeword and appended data codewords may occupy up to three control channel timeslots. The data formats specified in this section allow an SST to convey 44 BCD characters, 35 ITU-T Alphabet No 2 (Telex) characters or 25 ITU-T Alphabet No 5 (ASCII) characters. An MST is capable of carrying 176 BCD characters, 140 ITU-T Alphabet No 2 (Telex) characters or 100 ITU-T Alphabet No 5 (ASCII) characters.

14.2 Message Formats

The procedures for short data message transmission described in this section utilise MPT1327 address codewords and data codewords. The formats of the address codewords are as prescribed in MPT1327 with, in the case of the AHYC codeword, some additional meanings ascribed to the values of one field within the codeword. The format of data codewords is not specified in MPT1327, but a data codeword structure is specified for the procedures in this section to allow control parameters to be incorporated and defined data character formats to be utilised.

These particular applications of address and data codewords are described below.

14.2.1 Short Data Invitation Message, AHYC

The format of this message is as specified in !!5.5.3.2.8!! with the following addition (note that IDENT1 shall be set to SDMI for inviting short data HEAD messages):

DESC: '000' TSC supports SSTs only. Instruction to calling party to send a HEAD message.

'1xx' TSC supports MSTs. Instruction to calling party to send a HEAD message containing the appropriate segment of the MST -

xx = value assigned to the short data segment.

xx = '00' - First segment of MST or only segment of SST.

xx = '01' - Second segment.

xx = '10' - Third segment.

xx = '11' - Fourth segment.

14.2.2 Data Codewords

14.2.2.1

Up to four data codewords may be appended to a HEAD address codeword. Each data codeword shall conform to one of the following two general structures, depending on its position relative to the HEAD codeword:

i) First and third data codewords following the HEAD codeword:

MPT1327 Short Data Message Format (STF = '0')

0	STF	DATA	P
1	1	46	16

STF - Segment Transaction Flag.

'0' - MPT1327 short data message format (46 bits of free format data in each of up to 4 data codewords).

DATA - Free format binary digits.

P - Parity check bits.

MPT1343 Short Data Message Format (STF = '1')

0	STF	MESS	DATA	P
1	1	4	42	16

STF - Segment Transaction Flag. '1'- MPT1343 short data message format as defined in this specification).

MESS - Message Control Field (refer to 14.2.2.2).

DATA - Free format binary digits or binary-encoded free format text (refer to 14.2.2.3).

P - Parity check bits.

ii) Second and fourth data codewords following the HEAD codeword:

0	RSA	DATA	P
1	1	46	16

RSA - Return Slot Access Flag. When transmitted by the TSC on a control channel:

'0' - Radio units shall not attempt random access in the following slot on the return control channel.

'1' - Radio units may attempt 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'.

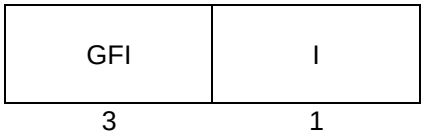
DATA - Free format binary digits or binary-encoded free format text (refer to 14.2.2.3).

P - Parity check bits.

14.2.2.2 Structure of MESS Field

The format of the MESS field shall conform to one of the following two structures, as determined by the position of the data codeword containing the MESS field relative to the HEAD codeword:

i) First data codeword following the HEAD codeword:



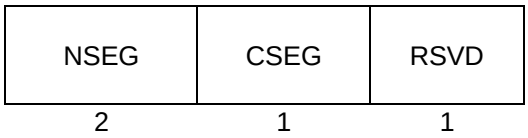
GFI - General Format Information, states the format in which the T-message is presented in the DATA fields of this and subsequent data codewords (see also 14.2.2.3).

- '000' Binary.
- '001' BCD (Appendix 5, MPT1327).
- '010' ITU-T Alphabet No 2 (Telex).
- '011' ITU-T Alphabet No 5(ASCII).
- '100' Reserved.
- '101' Spare
- '110' Command Message (see Appendix AN6)
- '111' Spare. (Note that MAP27 uses this format

I - Initial Segment flag.

- '1' First segment. (For an SST, I shall always be set to '1').
- '0' Subsequent segment.

ii) Third data codeword following the HEAD codeword:



NSEG - Indicates the number of segments to follow in an MST.

- '00' Last segment.
- '01' One segment to follow.
- '10' Two segments to follow.
- '11' Three segments to follow.

(For an SST, NSEG shall always be set to '00' where this codeword is used.)

CSEG - Indicates whether the message containing the next segment of an MST requires 2 or 3 control channel timeslots.

- '0' Two slots required.
- '1' Three slots required.

(Where NSEG = '00', CSEG shall be set to '0'. Where NSEG = '10' or '11', CSEG shall be set to '1'.)

RSVD - Reserved for future definition.

14.2.2.3 Structure of DATA Field

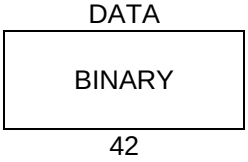
The format of the DATA field shall be determined by the value of the GFI field and shall be as specified below.

Note: For Telex type characters the start and stop units or elements are omitted (as is also the case for the start and stop bits when transmitting ASCII characters). For the purposes of describing the order in which ITA2 code units or elements are sent within the DATA field Code Element No. 1 may be considered to be the most significant and Code Element No. 5 the least significant. The elements are always sent in the order 1, 2, 3, 4, 5. Thus in the formats given below, “n*” represents the most significant bits of an encoded character whose remaining bits form the start of the DATA field of the next codeword. “*m” represents the m least significant bits of an encoded character whose preceding bits concluded the DATA field of the previous codeword.

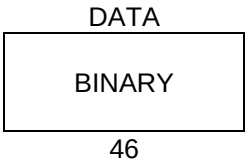
i) Binary

(GFI = '000')

First and third codeword:



Second and fourth codeword:

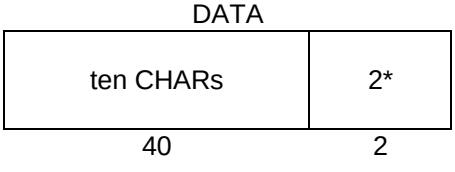


BINARY - Free format binary data.

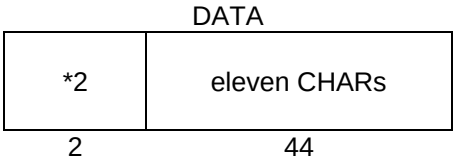
ii) BCD (as in Appendix 5 of MPT1327)

(GFI = '001')

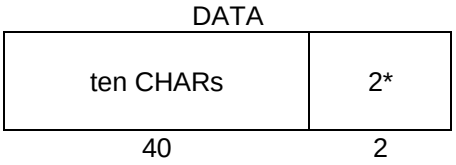
First codeword:



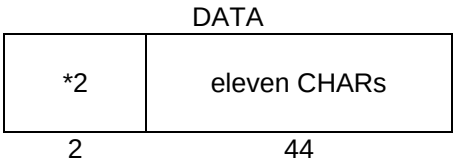
Second codeword:



Third codeword:



Fourth codeword:



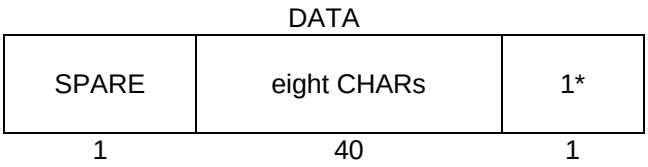
CHAR - Binary value, as prescribed in MPT1327 Appendix 5, of unspecified BCD character.

Note: The maximum number of BCD characters which can be included in a segment is 44.

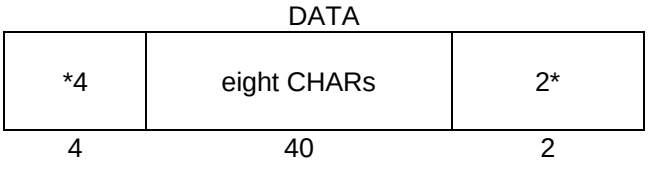
iii) ITU-T Alphabet No 2 (Telex Type Characters)

(GFI = '010')

First codeword:



Second codeword:



Third codeword:

DATA		
*3	seven CHARs	4*
3	35	4

Fourth codeword:

DATA	
*1	nine CHARs
1	45

SPARE - Available for customisation.

CHAR - Binary value, as prescribed in ITU-T Recommendation S1 (Alphabet No 2), of an unspecified character.

Note: The maximum number of ITU-T Alphabet No 2 characters which can be included in a segment is 35.

iv) ITU-T Alphabet No 5 (7 bit ASCII)

(GFI = '011')

First codeword:

DATA		
SPARE	five CHARs	6*
1	35	6

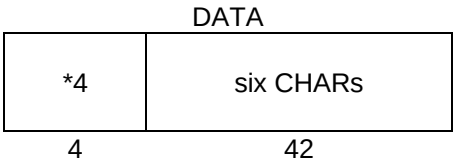
Second codeword:

DATA		
*1	six CHARs	3*
1	42	3

Third codeword:

DATA		
*4	five CHARs	3*
4	35	3

Fourth codeword:



SPARE - Available for customisation.

CHAR - Binary value, as prescribed in ITU-T Recommendation s V3, V4 (Alphabet No 5), of an unspecified character.

Note: The maximum number of ITU-T Alphabet No 5 (7 bit ASCII) characters which can be included in a segment is 25.

v) Other formats

Formats for GFI values of '100' is reserved for future definition and GFI='101 is spare. GFI = '110' indicates a control message directed to the recipient radio unit (see Appendix AN6), GFI = '111' is spare for customisation. (Note that MAP27 uses the GFI='111' format)

14.3 The Use of Control Fields for STF = '1'

A calling radio unit divides its T-message into a maximum of four segments, where all segments except the last utilise exactly four data codewords. The last segment may utilise up to four data codewords as required to accommodate the T-message. The segments of a Multiple Segment Transaction are logically linked by the 'NSEG', 'CSEG' and 'I' fields.

A HEAD message containing the first segment shall have the I bit set to '1', and those containing subsequent segments shall have I set to '0'.

The NSEG field represents a decrementing counter which shall indicate the number of segments to follow to complete the transaction such that the value of NSEG is '00' for the last segment of an MST. If the last segment uses less than three data codewords, then the NSEG field will not be transmitted and the recipient shall behave as though its value had been '00'.

The CSEG field informs the TSC of the number of slots required for data codewords containing the next segment. The value shall always be '1' when transmitted with leading segments (NSEG = '10' or '11') and may be either '1' or '0' when transmitted with the penultimate segment (NSEG = '01'). With the final segment CSEG defaults to '0' and the TSC will ignore the value.

HEAD messages transmitted by the TSC to a called radio unit or group shall contain the same values of I, NSEG and CSEG as those of messages containing the corresponding segments received by the TSC from a calling radio unit. The called radio unit may perform a check to ensure that the values of these fields are logically consistent.

An example, illustrating the use of the Control fields, is given in 14.5.

The called radio unit uses the values of STF and NSEG in the HEAD messages to determine which value to use in the individual incoming short data timer. See section 14.4.2.1.

14.4 Procedures for Radio Units

Radio units which implement the option to transmit and receive short data messages (either SSTs or MSTs) shall comply with the requirements of !!14!!. In addition radio units shall meet the requirements of this specification which are given below.

14.4.1 Radio Unit Actions when Sending Short Data Messages

14.4.1.1 Composition of HEAD Messages

A radio unit complying with the procedures of this section shall set STF = '1' in all appropriate data codewords transmitted.

For an SST, the calling radio unit shall transmit its T-message by sending one segment. For an MST, all segments except possibly the last shall utilise exactly four data codewords.

A HEAD message containing a segment shall only be transmitted following an invitation from the TSC. For every message transmitted to, or received from, the TSC the radio unit shall operate the appropriate timer (see !!14.2.6!!). After sending the last segment the radio unit shall wait for the appropriate acknowledgement (see !!14.2.4!!).

The control information for the first segment (of an SST or MST) shall be composed as follows:

i) The GFI bits in the MESS field in the data codeword directly following the HEAD address codeword shall be set as appropriate to indicate the format of the T-message.

ii) The I bit of the MESS field in the DATA codeword directly following the HEAD address codeword shall be set to '1'.

In the case of a HEAD address codeword with three or more appended data codewords, the control fields in the third data codeword shall be set as follows:

i) NSEG shall be set to indicate the number of segments to follow (NSEG shall be set to '00' for an SST).

ii) CSEG shall be set to indicate the number of timeslots required for the next MST segment (CSEG shall be set to '0' when NSEG has the value '00').

The control information for subsequent segments of an MST shall be composed as prescribed above except that the I bit of the MESS field shall be set to '0'.

14.4.1.2 Message Transmission Procedures

When a radio unit is ready to send a short data message it shall send RQC (with the value of SLOTS set either to '10' for an SST requiring a HEAD message with one or two data codewords, or to '11' for either an SST requiring a HEAD message with more than two data codewords or an MST). It shall then await responses as specified in !!14.2.1!! to !!14.2.3!!.

Upon receipt of a Mode 1 AHYC (DESC = '000'), with IDENT1 set to SDMI and PFIX/IDENT2 matching its individual address, a radio unit shall send a HEAD message with NSEG = '00', CSEG = '0' and I = '1' as a response. The same HEAD message shall be retransmitted by the radio unit if a further identical AHYC is received. Note that a radio unit wishing to transmit a T-message with more than one segment which receives AHYC (DESC = '000') shall respond with a HEAD message containing the first segment. After the completion of this transaction, it may then attempt to initiate transmission of the remainder of the T-message by sending one or more subsequent RQC random access request messages.

Upon receipt of a Mode 1 AHYC (DESC = '100'), with IDENT1 set to SDMI and PFIX/IDENT2 matching its individual address, a radio unit shall send a HEAD message containing either the complete T-message of an SST, or the first segment of the T-message of an MST, as a response. The same HEAD message shall be retransmitted by the radio unit if a further identical AHYC is received.

Upon receipt of a Mode 1 AHYC, with IDENT1 set to SDMI and PFIX/IDENT2 matching its individual address, and where DESC has incremented by one binary count from that in the previous AHYC message addressed to it, a radio unit shall send a HEAD message containing the next segment of the MST (note: DESC values of '101', '110' and '111' correspond to 2nd, 3rd and 4th MST segments respectively). The same HEAD message shall be retransmitted by the radio unit if a further identical AHYC is received. If a Mode 1 AHYC message is received whose value of DESC is not consistent with the correct segment order for the T message then the radio unit shall transmit ACKX (QUAL = '0').

14.4.2 Procedures for All Radio Units on a Control Channel

The procedures in this section shall be obeyed by all radio units that are equipped to accept short data messages (either SSTs or MSTs). The ability to accept short data messages is a standard option.

If flag STF in a received HEAD message is set to '0' (see 14.2.2) then the radio unit behaviour shall be in accordance with !!14.3!! but any additional procedures shall be system dependent.

If flag STF in a received HEAD message is set to '1' then the procedures below shall apply.

14.4.2.1 Receiving Individually Addressed Short Data

Alternative Procedures for Radio Units receiving individually addressed MSTs and SSTs are specified. The first, in Section 14.4.2.1.1, conforms to the requirements specified in this document as revised and printed in September 1991. The second, in Section 14.4.2.1.2, is a revised procedure which offers a receiving radio unit the opportunity to accept MSTs and SSTs at an increased rate, limited by the data signalling capacity of the

control channel more than the expiry of timers in the radio unit. All radio units are required, when implementing this second option, to at least implement the first procedure to ensure compatibility with existing networks. The second procedure may be implemented and used when allowed by network personalisation.

Radio Units that are able to function using either procedure shall implement a Network Personalisation MST Flag which when set to '0' shall cause the unit to carry out the procedure specified in Section 14.4.2.1.1 and when set to '1' shall cause the unit to carry out the procedure specified in Section 14.4.2.1.2.

14.4.2.1.1 Original Procedure

14.4.2.1.1.1 Called Unit Response to AHY Message

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

- POINT set to '0',
- PFIX/IDENT1 as its individual address, and
- IDENT2 set to SDMI,

then it shall respond by sending a suitable acknowledgement; see !!9.2.2.2B!!.

If the radio unit's response is ACK (QUAL = 0) then the unit shall start timer TA and shall wait for further signalling; see also sections 14.4.2.1.1.2, 14.4.2.1.1.3 14.4.2.1.3 and 14.4.2.1.4.

14.4.2.1.1.2 Receiving Individually Addressed HEAD Message

If a radio unit on a control channel receives a HEAD message with PFIX1/IDENT1 in the HEAD address codeword matching its individual address then it shall behave as described below.

a. The radio unit shall accept, reject or solicit a repeat of that message by responding with a suitable acknowledgement (respectively ACK (QUAL = 0), ACKX or ACKV (QUAL = 1), or ACKB (QUAL = 1)). See !!14.3.1.1!! and also points b. to f. below.

b. If the radio unit is in a state of waiting for further HEAD messages (see section 14.4.2.1.1.3) then it shall reject the received segment by responding with ACKX (QUAL = 1) if PFIX2/IDENT2 in the HEAD address codeword does not match PFIX2/IDENT2 from previously received HEAD messages for that transaction to which it responded with ACK (QUAL = 0) or ACKB (QUAL = 1).

c. The radio unit shall note the value of the I flag in the MESS field of the first data codeword.

   If the radio unit:

   - is not in a state of waiting for further HEAD messages (see section 14.4.2.1.1.3), or
   - is awaiting retransmission of a HEAD message with I set to '1' which it solicited using ACKB (QUAL = 1), or

- is in a state of waiting for further HEAD messages, having received a HEAD message with I set to '1' and NSEG set to '00',

then it shall reject the received HEAD message if the I flag is set to '0' by responding ACKX (QUAL = 1).

If the radio unit has sent ACK (QUAL = 0) or ACKB (QUAL = 1) in response to a previously received HEAD message for that transaction containing I set to '0', then it shall reject the received HEAD message if the I flag is set to '1' by responding ACKX (QUAL = 1).

d. The radio unit shall note the value of LEN in the HEAD address codeword. For LEN = '00' or '01' the radio unit shall not expect to receive NSEG in the appended data codewords but shall behave as though its value had been '00' (see !!15.6.2!!).

e. The radio unit shall record the value of the NSEG control field in the third data codeword if the HEAD message contains three or four data codewords.

If the radio unit is in a state of waiting for further HEAD messages (see section 14.4.2.1.1.3) then:

- the HEAD message shall be deemed to be a repeat transmission of the last received HEAD message if both have identical values of NSEG;
- the segment contained in the HEAD message shall be deemed to be the first transmission thereof to be received by the radio unit if the value of NSEG has been decremented by one binary count from that of the last received HEAD message.
- If a head message is received whose value of NSEG is not consistent with the correct segment order for the T message then the radio unit shall transmit ACKX(QUAL=1).

The radio unit shall reject any received HEAD message by sending ACKX (QUAL = 1) where the value of NSEG:

- has been incremented since the last received HEAD message, or
- has been decremented by more than one binary count since the last received HEAD message, or
- has been decremented and the previous segment has not been decoded successfully.

If the radio unit is not in a state of waiting for further HEAD messages then any value of NSEG is valid.

f. If the HEAD message contains one or more corrupted data codewords, the radio unit may extract uncorrupted data codewords from this and subsequent retransmissions thereof, until it is able to assemble a complete and uncorrupted segment. If a retransmission of the HEAD message is required, then the radio unit shall respond with ACKB (QUAL = 1).

When the segment has been assembled, the radio unit shall respond with either ACK (QUAL = 0) or ACKX (QUAL = 1) as appropriate.

g. If the radio unit responds to the HEAD message with ACK (QUAL = 0) or ACKB (QUAL = 1), then the unit shall start timer TM (if NSEG● 0) or TGI (if NSEG=0) and shall wait for further signalling; see also section 14.4.2.1.1.3.

For other responses, the radio unit shall leave its individual incoming short data timer in its existing state (either running, or not set, as appropriate).

The radio unit shall offer the complete T-message to the user when a HEAD message with NSEG = '00' has first been successfully decoded (or its associated segment has been assembled as in point f. above). The T-message shall be formatted in accordance with the GFI bits in the MESS field. The radio unit shall then continue to wait as defined in section 14.4.2.1.1.3.

14.4.2.1.1.3 Individual Time-out TGI/TA

Radio units shall operate an individual incoming short data timer which shall be set to either of two different values as described below.

The timer shall be set to a value TA and started or restarted when the radio unit responds with ACK (QUAL = 0) to an AHY message with IDENT2=SDMI. The timer shall be set to a value TGI and started or restarted when the radio unit responds with ACK (QUAL = 0) or ACKB (QUAL = 1) to a HEAD message.

A radio unit is in a state of waiting for further signalling for an incoming individually addressed short data transaction if its individual incoming short data timer is running. A radio unit is in a state of waiting for further HEAD messages if this timer is running and the radio unit has received and responded to an earlier HEAD message with ACK (QUAL = 0) or ACKB (QUAL = 1) during that transaction.

A radio unit waiting for further signalling for an incoming individually addressed short data transaction (SST or MST) shall assume that no further signalling will be received for that transaction if its individual incoming short data timer expires.

Thereupon, if the T-message has not been fully decoded, the short data transaction shall be deemed to have failed and the radio unit may generate an appropriate indication to the user. The radio unit may offer an incomplete T-message to the user only if a suitable warning of incompleteness is included with the data presented to the user.

Note: if the T-message has been fully decoded, then it already should have been offered to the user at that time (see 14.4.2.1.1.2).

After expiry of the individual incoming short data timer, the radio unit shall discard the recorded values of the control fields and shall assume that future HEAD and AHY (IDENT2 = SDMI) messages are for another transaction.

The value of TGI is network dependent and shall be programmable as part of a radio unit's personality with a range of 1 to 15 seconds in 1 second steps. The recommended value for TGI is 5 seconds. For the permissible value for TA, refer to section 6.

14.4.2.1.2 Revised Protocol

The procedures specified in this section differs from the procedures defined in 14.4.2.1 in that:

a) The TSC retains in its subscriber database, or by other means, a flag to indicate that the individually addressed radio unit complies with this revised protocol i.e. operates timer TM (see below) and is able to clear timer TGI on receipt of either AHY, IDENT2=SDMI or AHY, D=0 etc.

b) Once the Radio Unit has responded to an AHY, IDENT2 = SDMI with ACK, QUAL = '0' and has then received an applicable HEAD message, any new AHY, IDENT2 = SDMI indicates the commencement of a new MST. If the new AHY is received before the completion of the current MST in progress the unit may respond to the new AHY with an appropriate response rejecting it or may abandon the call in progress and discard the message so far received. The chosen course is forced by network personalisation flags.

c) Once the Radio Unit has responded to an AHY, IDENT2 = SDMI with ACK, QUAL = '0' and has then received an applicable HEAD message, a new AHY, IDENT2 = Individual Address indicates the commencement of a speech call. If the AHY is received before the completion of the current MST in progress the unit may respond to the AHY, IDENT2 = Individual Address with an appropriate response rejecting it or may abandon the call in progress and discard the message so far received. The choice of action may be made dependent on the state of the 'E' flag in the new AHY message. The chosen course is forced by network personalisation flags.

d: For individually addressed MSTs, once all segments of an MST have been received and the radio unit has sent a final acknowledgement, the receipt of an AHY, with any value of IDENT2, from the TSC indicates that the acknowledgement has been received by the TSC, which is commencing a new transaction with the unit. The Radio Unit therefore terminates all timers associated with the previous message and responds to the TSC with an acknowledgement to indicate that it is accepting the ahoy as the commencement of a new transaction.

e) A new timer, TM, has been introduced to avoid the use of TA.

f) The radio unit may accept a new MST for each address which it contains whilst in the process of assembling a message in progress. i.e. the unit's individual address and each of its group addresses. The radio unit may limit the number of group addresses for which it accepts MSTs simultaneously to any number. Note that the unit risks the chance of missing a segment if the TSC sends an applicable group HEAD message in the slot immediately after an applicable individual HEAD message because the radio unit will be acknowledging the individually addressed message.

14.4.2.1.2.1 Called Unit Response to AHY Message

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

d. The radio unit shall note the value of LEN in the HEAD address codeword. For LEN = '00' or '01' the radio unit shall not expect to receive NSEG in the appended data codewords but shall behave as though its value had been '00' (see !!15.6.2!!).

e. The radio unit shall record the value of the NSEG control field in the third data codeword if the HEAD message contains three or four data codewords.

If the radio unit is in a state of waiting for further HEAD messages (see section 14.4.2.1.2.3) then:

- the HEAD message shall be deemed to be a repeat transmission of the last received HEAD message if both have identical values of NSEG;
- the segment contained in the HEAD message shall be deemed to be the first transmission thereof to be received by the radio unit if the value of NSEG has been decremented by one binary count from that of the last received HEAD message.
- If a head message is received whose value of NSEG is not consistent with the correct segment order for the T message then the radio unit shall transmit ACKX(QUAL=1).

The radio unit shall reject any received HEAD message by sending ACKX (QUAL = 1) where the value of NSEG:

- has been incremented since the last received HEAD message, or
- has been decremented by more than one binary count since the last received HEAD message, or
- has been decremented and the previous segment has not been decoded successfully.

If the radio unit is not in a state of waiting for further HEAD messages then any value of NSEG is valid.

f. If the HEAD message contains one or more corrupted data codewords, the radio unit may extract uncorrupted data codewords from this and subsequent retransmissions thereof, until it is able to assemble a complete and uncorrupted segment. If a retransmission of the HEAD message is required, then the radio unit shall respond with ACKB (QUAL = 1).

When the segment has been assembled, the radio unit shall respond with either ACK (QUAL = 0) or ACKX (QUAL = 1) as appropriate.

g. If the radio unit responds to the HEAD message with ACK (QUAL = 0) or ACKB (QUAL = 1), then the unit shall start timer TM and shall wait for further signalling unless, when responding ACK (QUAL = 0), the NSEG field is set to '00' or there is no third data codeword in the segment then the unit shall start timer TGI; see also section 14.4.2.1.2.3.

For other responses, the radio unit shall leave its individual incoming short data timer in its existing state (either running, or not set, as appropriate).

The radio unit shall offer the complete T-message to the user when a HEAD message with NSEG = '00' has first been successfully decoded (or its associated segment has been assembled as in point f. above). The T-message shall be formatted in accordance with the GFI bits in the MESS field. The radio unit shall then continue to wait as defined in section 14.4.2.1.2.3.

h. Once a radio unit has received a HEAD message with the NSEG field set to any value other than '00' it may reject any AHY message containing IDENT2 = SDMI with ACKX (QUAL = 1) and continue to wait for the next HEAD message or abandon the transaction in progress, abandon the message so far received and commence a new transaction dependent on the state of the 'E' flag on the AHY message. (See 14.4.2.1.2, b)).

14.4.2.1.2.3 Individual Time-out TGI/TM

If the Network Personalisation Flag is set to '1' (See 14.4.2.1.) radio units shall operate an individual incoming short data timer which shall be set to either of two different values as described below.

The timer shall be set to a value TM and started or restarted when the radio unit responds with ACK (QUAL = 0) to an AHY message with IDENT2=SDMI. The timer shall also be set to a value TM and started or restarted when the radio unit responds with ACK (QUAL = 0) to a HEAD message which contains a value other than '00' in the NSEG field or ACKB (QUAL = 1) to any HEAD message. The timer shall be set to a value TGI and started or restarted when the radio unit responds with ACK (QUAL = 0) to a HEAD message which contains a value of '00' in the NSEG field or where the segment does not contain a third data codeword. (i.e. if the message is an SST or for the last segment of an MST.)

A radio unit is in a state of waiting for further signalling for an incoming individually addressed short data transaction if its individual incoming short data timer is running. A radio unit is in a state of waiting for further HEAD messages if this timer is running and the radio unit has received and responded to an earlier HEAD message with ACK (QUAL = 0) or ACKB (QUAL = 1) during that transaction.

A radio unit waiting for further signalling for an incoming individually addressed short data transaction (SST or MST) shall assume that no further signalling will be received for that transaction if its individual incoming short data timer expires.

Thereupon, if the T-message has not been fully decoded, the short data transaction shall be deemed to have failed and the radio unit may generate an appropriate indication to the user. The radio unit may offer an incomplete T-message to the user only if a suitable warning of incompleteness is included with the data presented to the user.

Note: if the T-message has been fully decoded, then it already should have been offered to the user at that time (see 14.4.2.1.2.2).

After expiry of the individual incoming short data timer, the radio unit shall discard the recorded values of the control fields and shall assume that future HEAD and AHY (IDENT2 = SDMI) messages are for another transaction.

The value of TM is network dependent and shall be programmable as part of a radio unit's personality with a range of 1 to 60 seconds in 1 second steps. The recommended value for TM is 15 seconds. See Section 6.

The value of TGI is network dependent and shall be programmable as part of a radio unit's personality with a range of 1 to 60 seconds in 1 second steps. The recommended value for TGI is 5 seconds. See Section 6.

If a final or single segment is sent which contains only two data codewords following the HEAD codeword then NSEG is not transmitted. In this case the radio unit shall behave as if NSEG is set to '00'.

When a radio unit has responded with ACK (QUAL=0) to a HEAD message containing NSEG='00' and it receives AHY, with IDENT1 set to the unit's individual address it shall cease to wait for further signalling for the short data message it has just received. If IDENT2=SDMI the radio unit shall start the individual incoming short data timer with a value of TM for a new message. (During the time TGI after the final HEAD message an AHY message sent by the TSC indicates that it has received the ACK as well as announcing a new message).

14.4.2.1.3 Receiving AHYX Message

If, whilst waiting for further signalling for an incoming individually addressed short data transaction, a radio unit receives an AHYX message with:

- PFIX/IDENT1 as its individual address, and
- IDENT2 set to SDMI

then it shall respond with ACK (QUAL = 1) as defined in !!9.2.2.4!! and shall cease to wait for further signalling. It shall terminate the individual incoming short data timer (TGI, TM and TA), discard any segments decoded in connection with that transaction, discard the recorded values of the control fields and assume that future AHY (IDENT2 = SDMI) and HEAD messages are for another transaction.

This use of AHYX is in addition to the MPT1327 prescribed functions.

14.4.2.1.4 Ignoring Group Call GTC Messages

A radio unit waiting for further signalling for an incoming individually addressed short data transaction shall ignore any received GTC message unless the unit is individually addressed by that GTC message (either by PFIX/IDENT1 or by PFIX/IDENT2) or IDENT1 is set to ALLI.

This requirement is in addition to the procedure in !!9.2.2.5!!.

14.4.2.1.5 Maintaining Timers

A radio unit waiting for further signalling for an incoming short data transaction shall maintain any relevant timers, including its individual incoming short data timer, as prescribed in section 9.4.2, when leaving the control channel on which it is currently active.

14.4.2.2 Receiving Short Data Addressed to a Group

The procedures for receiving group call short data messages remains unchanged in this revision of the specification.

14.4.2.2.1 Receiving HEAD Message Addressed to a Group

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

- PFIX/IDENT1 matching one of its group addresses for that system, or
- IDENT1 set to the system-wide all-call ident ALLI

then it may follow the procedures outlined in this section but shall transmit no response. For the purposes of this section, the term "group-addressed HEAD message" shall mean any HEAD message so addressed.

If a radio unit receives a group-addressed HEAD message containing the I flag set to '1' and NSEG is set to '00' or not included, then this message constitutes an SST. If a radio unit receives a group-addressed HEAD message containing NSEG set to a value other than '00' or I is set to '0' then this message constitutes part of an MST.

If a radio unit receives a group-addressed HEAD message whilst in the state of waiting for further signalling for a short data transaction addressed to that group, it shall ignore that message if the calling address PFIX2/IDENT2 does not match PFIX2/IDENT2 from any previously accepted HEAD message for that transaction.

If a received group-addressed HEAD message contains one or more corrupted data codewords, the radio unit may extract uncorrupted data codewords from this and subsequent retransmissions thereof, until it is able to assemble a complete and uncorrupted segment. The radio unit shall use the fields PFIX1/IDENT1, PFIX2/IDENT2, LEN, I and NSEG to identify repeat transmissions and to determine whether all segments of a T-message have been decoded as follows:

a. If a received HEAD message contains the I flag set to '0' and the radio unit is not in the state of waiting for further signalling for a short data transaction addressed to this group, then the unit shall deem that insufficient segments will be received for that transaction to assemble a complete T-message.

b. The radio unit shall note the value of LEN in the HEAD address codeword of a received group-addressed HEAD message. For LEN = '00' or '01' the radio unit shall not expect to receive NSEG in the appended data codewords but shall behave as though its value had been '00' (see !!5.6.2!!).

c. The radio unit shall record the value of the NSEG control field in the third data codeword of a received group-addressed HEAD message if it contains three or four data codewords.

If the radio unit is in a state of waiting for further signalling for a short data transaction for that group (see section 14.4.2.2.2) then:

- the HEAD message shall be deemed to be a repeat transmission of the last received HEAD message for that group if both have identical values of NSEG.
- the segment contained in the HEAD message shall be deemed to be the first transmission thereof to be received by the radio unit if the value of NSEG has been decremented from that of the last received HEAD message for that group.
- If a head message is received whose value of NSEG is not consistent with the correct segment order for the T message then the radio unit shall transmit ACKX(QUAL=1).

The radio unit shall deem that insufficient segments will be received to assemble a complete T-message where the value of NSEG:

- has been decremented by more than one binary count since the last received HEAD message, or
- has been decremented and the previous segment has not been decoded successfully.

After accepting a group-addressed HEAD message the radio unit shall then wait for further HEAD messages for that transaction (see 14.4.2.2.2).

When a HEAD message with NSEG set to '00' has first been successfully decoded (or its associated segment has been assembled) then, if the T-message is complete, the unit shall offer the T-message to the user. Otherwise, if the T-message is incomplete, the radio unit may offer the received data to the user only if a suitable warning of incompleteness is included with the data presented to the user. The T-message or segments thereof shall be formatted in accordance with the GFI bits in the MESS field. The radio unit shall then continue to wait, as defined in section 14.4.2.2.2.

14.4.2.2.2 Group Time-out TGG

A called radio unit waiting for further signalling for a short data transaction addressed to a group shall assume that no further signalling will be received for that transaction (SST or MST) if a time TGG has elapsed since the last HEAD message it received for that transaction. The radio unit shall discard the recorded values of the control fields and shall assume that any future HEAD messages are for another transaction.

Thereupon, if the T-message has not been fully decoded, the short data transaction shall be deemed to have failed. The radio unit may offer an incomplete T-message to the user only if a suitable warning of incompleteness is included with the data presented to the user.

The value of TGG is network dependent and shall be programmable as part of a radio unit's personality with a range of 1 to 30 seconds in 1 second steps. The recommended value for TGG is 10 seconds.

14.4.2.2.3 Maintaining Timers

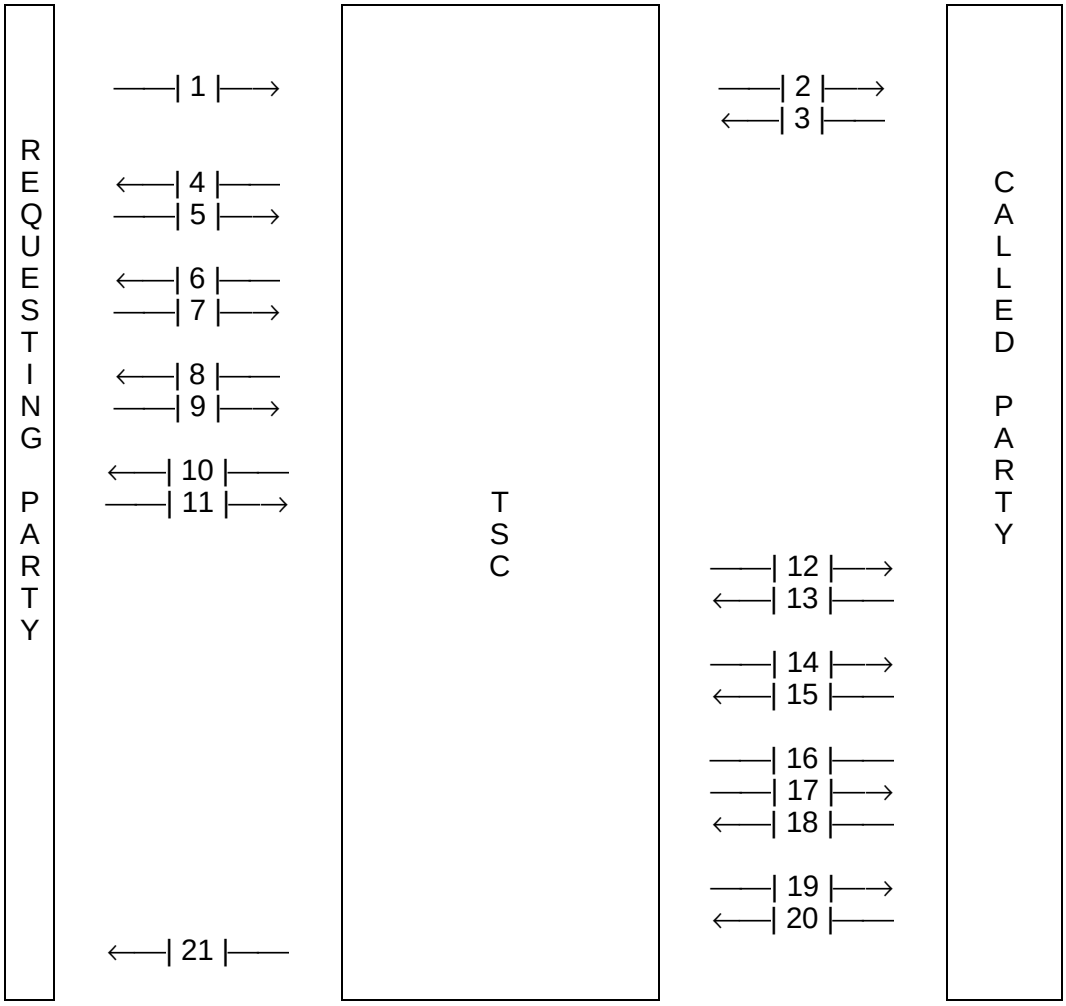
A radio unit waiting for further signalling for an incoming short data transaction shall maintain any relevant timers, including its group incoming short data timer, as prescribed in section 9.4.2, when leaving the control channel on which it is currently active.

14.5 An Example of The Procedure for Extended Data Messages

In order to illustrate the use of the procedure in section 14, a typical message interchange is shown in Figure 14.1. The example shows a successful Multiple Segment Transaction linking three segments. An SST would be similar to the transmission of the first segment of the MST, but with the appropriate field values changed in the HEAD message. This example is illustrative only and does not form part of the specification.

In the example, an availability check is carried out on the called radio unit and some segment repeats are shown.

Figure 14.1 - Example of Successful MST Transaction



Descriptions of message interchanges

|1|: An RQC message requests a short data transaction (Assuming extended addressing is not required). The value of SLOTS in the RQC is '11', indicating that three slots are required for the HEAD message containing the first segment of the MST.

|2|: An AHY (POINT=0) message checks the availability of the called radio unit (optional).

|3|: An ACK (QUAL=0) message indicates general acknowledgement of the AHY.

|4|: Any AHYC message is sent to the requesting radio unit with DESC set to '100'. The first bit of DESC indicates that MSTs are supported. The second and third bits indicate that the first segment is required. SLOTS is set to '11' to indicate that three slots have been reserved for the HEAD message containing the first segment of the T-message.

|5|: A HEAD message containing the first segment of the MST is sent. The GFI field indicates the format of the T-message data. NSEG = '10' indicates that two more segments are yet to be sent. CSEG = '1' indicates that three slots are required for the HEAD message containing the next segment.

|6|: An AHYC message with DESC '101' solicits a HEAD message containing the second segment of the MST. SLOTS is set to '11' to indicate that three slots have been reserved for the HEAD message.

|7|: A HEAD message containing the second segment of the ST is sent. NSEG = '01' indicates that one more data segment is to be sent. CSEG = '0' indicates that two slots are required for the HEAD message containing the next segment.

|8|: An AHYC message with DESC = '101' solicits a repeat of the second segment of the MST. SLOTS is set as in |6|.

|9|: A HEAD message containing the second segment is retransmitted as in |7|.

|10|: An AHYC message with DESC = '110' solicits a HEAD message containing the third segment of the MST. SLOTS is set to '10' to indicate that two slots have been reserved for the HEAD message.

|11|: A HEAD message containing the third segment of the MST is sent. Since the message only contains two data codewords, NSEG (which is transmitted in the third codeword when present) is not sent. The TSC behaves as though its value had been '00'.

|12|: The TSC sends a HEAD message containing the first segment of the MST to called party. LEN is set to '11' to indicate that four data codewords are appended to the HEAD codeword and NSEG in the third appended data codeword is set to '10' to indicate that two segments of the MST are to follow.

|13|: An ACKB (QUAL=1) message indicates that the called party required the first segment to be transmitted.

|14|: The TSC sends a HEAD message containing a repeat of the first segment as in |12|.

|15|: An ACK (QUAL=0) message indicates successful receipt of the HEAD message by the called radio unit.

|16|: The TSC sends a HEAD message containing the second segment of the MST. LEN is set to '11' to indicate that four data codewords are appended to the HEAD codeword and NSEG in the third appended data codeword is set to '01' to indicate that one segment of the MST is to follow.

|17|: No acknowledgement is received by the TSC in the subsequent slot so a HEAD message containing a repeat of the second segment is transmitted as in |16|.

|18|: An ACK (QUAL=0) message indicates successful receipt of the HEAD message by the called radio unit.

|19|: The TSC sends a HEAD message containing the final segment of the MST. LEN is set to '01' to indicate that two data codewords are appended to the HEAD codeword. Since the message only contains two data codewords NSEG (which is transmitted in the third codeword when present) is not sent. The radio unit behaves as though its value had been '00'.

|20|: An ACK (QUAL=0) message indicates successful receipt of the HEAD message by the called radio unit.

|21|: An ACK (QUAL=0) message is sent by the TSC to the calling party to indicate that the transaction has been successfully completed. This acknowledgement may be repeated for reliability.

APPENDIX A: ERROR RATE PERFORMANCE

A.1 Definition

The receiver FSK demodulator error rate performance is measured in terms of the success rate of Ahoy codewords (see MPT 1327 section 5.5.3.2 for the definition of Ahoy codewords).

A.2 Method of Measurement

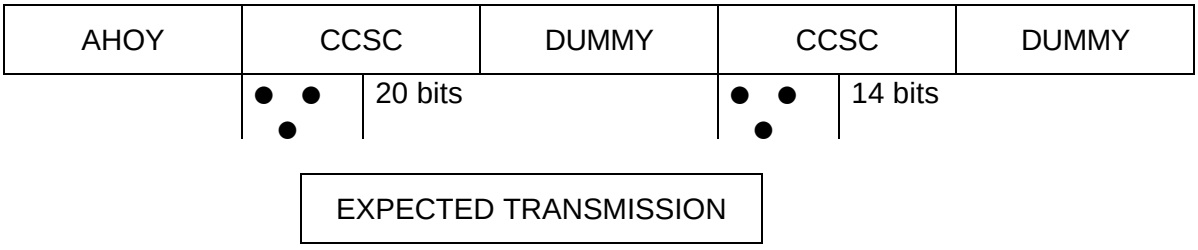
The unit under test shall be programmed to respond to the PFIX/IDENT given in Figure A-2. It shall also be programmed to scan a channel which satisfies the value of CHAN4 specified in Figure A-2 (i.e. the least significant 4 bits of the CHAN field shall match CHAN4).

A block diagram of the test set up is shown in Figure A-1. Serial data generator 'A' produces a test data stream of the form shown in Figure A-2. This data stream is fed to audio band FFSK modulator 'B', which modulates the data stream according to MPT 1323 section 6.1.1. The modulated audio signal is fed to RF signal generator 'C'. RF signal generator 'C' is set up to produce a signal of carrier frequency equal to the nominal frequency of the receiver, and modulated to a peak frequency deviation of ±1.5kHz. The resulting RF signal is fed through attenuator 'D' to resistive combiner 'F' where it is combined with simulated ignition pulses from generator 'E'. Ignition pulse simulator 'E' produces a stream of pulses of 10 volt peak and duration <3ns at a 18Hz rate. The combined signal is fed through circulator 'G' to the input terminals of the unit under test 'H'. The transmissions from unit under test 'H' pass through the circulator 'G' to RF load 'I' which feeds power detector 'J'. Power detector 'J' is designed to ignore the pulses from ignition simulator 'E'. If power above the threshold is detected by 'J', either counter 'L' or counter 'M' is incremented, depending upon whether serial data generator 'A' indicates that a transmission is expected. Power measurement device 'N' is used to calibrate the power level received by unit under test 'H' by switching out attenuator 'D'. For co-channel interference tests, the unwanted audio signal is generated either in audio signal generator 'P' or by serial data generator 'Q' and audio band FSK modulator 'R' for the case of interfering data. The interfering audio is modulated by RF signal generator 'S' and attenuated to the required level of interference switched attenuator 'T'. The resulting unwanted RF signal is then fed to resistive combiner 'F' where it is combined with the wanted signal.

Circulator 'G' shall have a continuous power handling capability of 100 Watts, and shall have a 1dB bandwidth of at least 40MHz centred on 200MHz, i.e. it shall have less than 1dB amplitude response variation over the frequency range 180MHz to 220MHz.

Test power levels at the input terminals of unit under test 'N':
Level A: +2dB relative to 1uV pd (+8dB relative to 1uV emf or -105dBm)
Level B: -5dB relative to 1uV pd (+1dB relative to 1uV emf or -112dBm)
Level C: +8dB relative to 1uV pd (+14dB relative to 1uV emf or -99dBm)

The window of expected response is defined in MPT 1327, section 6 (pages 6-7). The boundaries of the window are 20 bits and 14 bits after the start of CCSC as shown below:



Following the transmission of the data stream of Figure A-2, count 'L' and count 'M' shall be recorded. Between each test listed below in A.3, the counters are reset.

A.3 Limits

A.3.1 Test 1

Test conditions:

i. Transmit power level A.
ii. Ignition simulator switched OFF.
iii. Co-channel interference switched OFF.

Count 'L' shall be not less than 99.
Count 'M' shall be zero.

A.3.2 Test 2

Test 2 is optional.

Test conditions:

i. Transmit power level A.
ii. Ignition simulator switched ON.
iii. Co-channel interference switched OFF.

Count 'M' shall be zero. Count 'L' shall be not less than 89.

A.3.3 Test 3

Test conditions:

i. Transmit power level B.
ii. Ignition simulator switched OFF.
iii. Co-channel interference switched OFF.

Count 'L' shall be not less than 89.
Count 'M' shall be zero.

A.3.4 Test 4

Test conditions:

i. Wanted signal transmit power level C.
ii. Ignition simulator switched OFF.
iii. Co-channel interference switched ON.

Audio signal generator 'P' shall be used to inject a frequency of 400Hz. RF signal generator 'S' shall modulate the signal to 60% of the maximum peak frequency deviation designated in section 5.3.2 of MPT 1323. The level of unwanted signal, as set by attenuator 'T', shall be 10dB below the level of the wanted signal supplied through attenuator 'D'.

Count 'L' shall not be less than 89.
Count 'M' shall be zero.

The test shall be repeated with the carrier generated by RF signal generator 'S' offset by ±1200 Hz from the nominal frequency.

Count 'L' shall not be less than 89.
Count 'M' shall be zero.

A.3.5 Test 5

Test conditions:

i. Wanted signal transmit power level C.
ii. Ignition simulator OFF.
iii. Co-channel interference switched ON.

Serial data generator 'Q' shall be used to generate a 511 bit test pattern, in accordance with CCITT recommendation V52, at a rate of 1200 bits/second. This pattern is then fed to audio band FSK modulator 'R' to provide an FFSK signal in compliance with section 6.1 of MPT 1323. RF signal generator 'S' shall modulate the signal to 60% of the maximum peak frequency deviation designated in section 5.3.2 of MPT 1323. The level of the unwanted signal, as set by attenuator 'T', shall be 10dB below the level of the wanted signal supplied through attenuator 'D'.

Count 'L' shall not be less than 89.
Count 'M' shall be zero.

The test shall be repeated with the carrier generated by RF signal generator 'S' offset by ±1200 Hz from the nominal frequency.

Count 'L' shall not be less than 89.
Count 'M' shall be zero.

A.3.6 Test 6

Test conditions:

i. Transmit power Level A.
ii. Ignition simulator OFF
iii. Co-channel interference switched OFF.
iv. The prefix/ident section of the AHOY codewords is selected to differ by 1 the prefix/ident of the unit. The parity is then set to give a valid codeword. The location of the bit difference is changed for successive AHOY codewords so that each of the 20 bit differs are sent 5 times in the stream of 100 AHOY messages.

The list of modified AHOY codewords is as follows:

10011011111000110101110001000000000000000000000001110111000010110
11111011111000110101110001000000000000000000000001001000000001101
11001011111000110101110001000000000000000000000001111001100010101
11010011111000110101110001000000000000000000000001010111010011001
11011111111000110101110001000000000000000000000001000000001011111
11011001111000110101110001000000000000000000000001111111100101000
11011010111000110101110001000000000000000000000001110100010000110
11011011011000110101110001000000000000000000000001001011010001 01
11011011101000110101110001000000000000000000000001111001010110001
11011011110000110101110001000000000000000000000001010111001001011
11011011111100110101110001000000000000000000000001101000001000 10
11011011111010110101110001000000000000000000000001011000100101 11
11011011111001110101110001000000000000000000000001111010100011 00
11011011111000010101110001000000000000000000000001100101001010100
11011011111000100101110001000000000000000000000001011001000111000
11011011111000111101110001000000000000000000000001000111000001110
11011011111000110001110001000000000000000000000001111000000000001
11011011111000110111110001000000000000000000000001110101100010011
11011011111000110100110001000000000000000000000001001010100011 10
11011011111000110101010001000000000000000000000001101001000001

Count 'L' shall be zero.
Count 'M' shall be zero.

APPENDIX B: TIMING AND DEFAULT PARAMETERS

B.1 Default Parameters

Timing Parameter	MPT1327 default	MPT1343 Value	Function
ND1	2	3	Number of disconnect messages sent by individually addressed radio unit
ND2	4	5	Number of disconnect messages sent by calling radio unit
NE	16	16	Maximum number of random access transmissions of RQE
NI	4	4	Maximum number of include request access attempts
NR	8	8	Maximum numberof random access transmissions of RQS, RQD, RQX, RQT, RQR or RQQ
NW	4	5	Response delay (in slots)

The requirement for the storage of parameters that may vary from network to network such as LA, LZ, NC1, NC2, NT, NV1, NV2, NX1, NX2, NZ1 and NZ2 are specified in section 6.

B.2 Timing Parameters

Timing Parameter	MPT1327 default	MPT1343 Value	Function
TB	2 s	2 s	Time barred from calling same ident after ACK/ACKX/ACKV or any ident after ACKT/ACKB
TF		180 s	Value of TS in fall-back mode
TI	2 s	2 s	Include timer
TP	5 s	5 s	Maximum interval between periodic messages (within speech items) to be assumed at switch-on or equivalent
TX		180 s	Value of TC in fall-back mode
TR		500 ms	Call set-up Data Keyline delay

The requirements for the storage of timing parameters which may vary from network to network such as TA, TC, TD, TJ, TN, TS, TGG, TGI, TT and TW are specified in section 6.

ANNEX AN1 CLARIFICATION OF RADIO UNIT OPERATION ON TIME SHARED CONTROL CHANNELS

In this specification the term "time-shared control channel" refers to a control channel where multiple base station transmitters (whether co-sited or multi-sited) share one radio frequency for control purposes by dividing the use of the frequency in time. Each period of transmission from a base station transmitter is referred to as a burst.

For clarity, multi-site time-shared control channels are assumed in this Annex.

AN1.1 Purpose of ANNEX

The purpose of this annex is to clarify and explain the activity of radio units when operating on time-shared control channels whilst complying with section 9 of this specification. It does not, in itself, constitute a part of the requirements of this specification and does not change the requirements of this specification in any way.

The matters discussed as relevant are:

- the general principles of the detection of synchronisation loss and subsequent re-synchronisation,
- error checking on a control channel,
- control channel acquisition

  and
- the use of SYS codes on time-shared control channels.

AN1.2 Identification of, and operational changes on, time-shared control channels

This specification recognises that particular problems apply in making valid error measurements on time-shared control channels. These problems occur during sampling prior to confirmation and during continuous monitoring after confirmation. They are associated with discontinuous reception of the forward control channel which the radio unit is likely to encounter.

One mechanism which can be employed by network operators to compensate for these problems is to select the values of NV, NC, NX and NZ accordingly. Thus a network operator employing time-shared control channels may specify quite different values of these parameters from one employing continuous control channels, and the allowable ranges of these parameters have been set accordingly. The use of this mechanism would however be problematic for a network operator employing a mix of continuous and time-shared control channels, since he may wish to specify different parameter values for each type of channel. This problem is foreseen by this specification, and two sets of the

parameter values (one for time-shared control channels and one for continuous control channels) may be set in the radio unit. The radio unit uses the values appropriate to a continuous control channel unless it has reason to believe that the control channel being monitored is time-shared.

To facilitate this, each channel in the normal hunt list is marked by a time-shared flag (named TSI) which also appears in MOVE messages, CLEAR messages and any BCAST message which may identify a control channel for possible later use by the radio unit. BCAST (SYSDEF = '00000'), BCAST (SYSDEF = '00100') and BCAST (SYSDEF = '00101'). The flag causes the radio unit to change the following operating parameters when set to the "time-shared" state:

NV - Number of consecutive received CCSCs to select a value of SYS for verification,

NC1 - size of error check sample prior to confirmation,

NX1 - error codeword limit prior to confirmation,

NC2 - size of error check sample after confirmation,

NX2 - error codeword limit after confirmation.

NZ1, NZ2, NC1, NX1, NC2 and NX2 are employed in the error analysis procedures used for control channel acquisition and control channel quality monitoring purposes. Their use is discussed in detail in section AN1.4.

NV is used in control channel acquisition and is further discussed in section AN1.5.

Another operational difference is that a time period TS is mandated for use when searching for a valid SYS code during control channel identification on time-shared control channels (see 9.3.4.1). No specific time value is mandated for continuous control channels. This operational difference is detailed in section AN1.5.

AN1.3 Synchronisation loss and subsequent re-synchronisation

Each reference to a control channel in this section (AN1.3) of this Annex applies to one which has already been verified and references to codewords apply to codewords after any error correction has been performed. The rules defined in 9.3 and 9.4 override any of the descriptions in this section ie if a criterion for rejecting or relinquishing the channel is met any attempt at re-synchronisation is abandoned.

AN1.3.1 Discontinuous control channels

!!6.2.1.2!! states that a radio unit shall be capable of satisfactory operation on a control channel which has interruptions of duration less than TS seconds (where slot timing might not be maintained across interruptions) and where CCSCs are displaced by data codewords in up to two consecutive time slots. Section 11.6.2.1.2 states that !!6.2.1.2!! is mandatory as specified. The title of this section in MPT 1327 is "Retaining a control

channel" and therefore an MPT 1343 radio unit shall not relinquish such a channel unless the criteria specified in 9.4 are met.

Some clarification is required here to indicate how a radio unit can cope with such interruptions in a control channel and continue with the error checking defined in 9.3.4.3. This explanation is more general and covers interruptions in reception of control channel signalling across which synchronisation is not guaranteed. It is pertinent to both continuous and discontinuous control channels and therefore also to time-shared control channels.

In order to cope with the above situation a radio unit must have some means of determining that synchronisation has been lost and some means of re-synchronising on that channel.

It is considered that the guidelines for achieving synchronisation in 9.3.4 are adequate. The procedures for synchronisation are employed when identifying a candidate control channel whilst hunting. The procedures for re-synchronising are employed whenever synchronisation has been lost on a control channel.

AN1.3.2 Criteria for determining synchronisation loss and subsequent re-synchronisation

A radio unit may lose bit synchronisation, codeword synchronisation or slot synchronisation. There is no concept of frame synchronisation: a radio unit considers itself either to be in a frame or not to be in a frame. It is important to note that, when performing a random access attempt, a radio unit must maintain information regarding its slot position within a frame. This information must be maintained even if the radio unit transmits data (see !!7.3.5!! para. 2) or loses synchronisation (no allowances are made for loss of synchronisation in the random access rules).

A radio unit operating to MPT 1327 must have the capability of determining that synchronisation with the received control channel data has been lost or is no longer guaranteed and must also have the capability of re-synchronising without losing the slot numbering information of the currently monitored frame, if any.

If slot synchronisation is monitored by the radio unit and some mechanism detects loss of slot synchronisation then a bit or codeword re-synchronisation procedure may commence. This process would also cope with loss of bit and loss of codeword synchronisation as either of these would cause loss of slot synchronisation and would be detected and corrected in the same way. If bit synchronisation cannot be guaranteed the re-synchronisation procedure should commence at the bit synchronisation stage otherwise the re-synchronisation procedure can commence at the codeword synchronisation stage. In each of these cases slot re-synchronisation would be achieved provided that control channel data is receivable. It should be noted that detection of synchronisation loss and subsequent re-synchronisation should be optimised when on time-shared control channels as a radio unit should detect the end of a control channel data burst as soon as possible. Such a mechanism may cause re-synchronisation to take place frequently and an alternative mechanism may be employed on non time-shared control channels to reduce this effect.

The criteria for determining that synchronisation has been lost are not specified in MPT 1327 or section 9. One such mechanism for determining loss of slot synchronisation could be as follows.

Check the first codeword in the slot, if the codeword is not decodable and the CRC does not contain the SYNC pattern then assume that synchronisation has been lost but continue to attempt to decode codewords on the basis of the last SYNC received until a new SYNC is received; the exception to this is where the radio unit, from interpretation of messages on the forward control channel (eg the receipt of a HEAD codeword), expects the codeword not to be a CCSC as the result of displacement of the CCSC by a data codeword and thus does not regard failure of the CRC to match the SYNC pattern as a loss of synchronisation. (It should be noted that this strategy carries the risk that, if the radio unit is unable to predict the displacement of a CCSC by a data codeword and that codeword is received corrupted, it may seek to re-synchronise unnecessarily and could find SYNC mimicked within a subsequent codeword. However such false synchronisation should be rare and should soon be detected and rectified by the radio unit). Also, in addition to the above criteria, the radio unit may assume loss of synchronisation if the first codeword in the slot is decodable and the most significant bit is '1'.

Even when a radio unit assumes that synchronisation has been lost it shall continue to consider each consecutive group of 64 bit positions to be a codeword. It shall continue to perform any error analysis which may be in progress whilst at the same time scan for synchronisation. Achieving re-synchronisation does not reset any error count in progress. Any incompletely received codeword at the time when re-synchronisation is achieved may be, for the purposes of any error analysis, either considered as an errored codeword or ignored.

AN1.4 Error checking on a control channel

AN1.4.1 Error checking philosophy

This specification employs the measurement of codeword error rates as the means of assessing the received control channel quality. This is convenient since the radio unit is required by the protocol to attempt to decode every received codeword when it is tuned to the forward control channel and the first step in this process is to validate the error checking sequence in bits 49 to 64. Thus the radio unit is equipped for codeword error checking by virtue of meeting the basic requirements of MPT 1327. The codeword error rate is determined by successive counts of blocks of codewords; the number of codewords which fail the validation of the error checking sequence in any block being the measure of the codeword error rate.

Since the error checking sequence employed by MPT 1327 provides some capability for error correction, MPT 1343 allows the radio unit to count any corrected codeword as unerrored.

An essential feature of the error monitoring procedures specified by this specification is that monitoring, once started, is a continuous process until stopped or suspended for some other reason (eg the radio unit leaves the control channel). Thus even when the radio unit is unable to detect recognisable signals on the received control channel (eg it fails to receive the codeword synchronisation sequence) it is required to continue the assessment

until such time as the radio unit determines that it should relinquish the channel, according to the rules of this specification. It does this by retaining the bit, codeword and slot timing which it last received from the forward control channel prior to loss of signal. On the basis of this retained timing every first and second half of each slot is examined for a codeword. Failure to decode a codeword, for any reason, is recorded as a codeword error.

AN1.4.2 Summary of error checking procedures on a control channel

The radio unit employs three parameters to control the manner in which error monitoring is carried out. These are NC, NX and NZ:

- NC is the number of contiguous positions in which codewords are expected (ie the first and second halves of slots) which shall be monitored in each codeword sample.

- NX is the number of errored codewords which must be exceeded in the count of NC codewords before the sample of NC codewords is considered as yielding a codeword sample error event.

The combination of NC and NX, accordingly, set the error threshold at which the control channel performance is considered inadequate. In order to allow different error criteria to be applied to the assessment of a control channel for sampling during hunting and to the continuous monitoring after confirmation to determine when the radio unit should relinquish the channel,two values of NC and NX are specified. Parameters NC1 and NX1 are employed for sampling during hunting and NC2 and NX2 are employed for the continuous monitoring after confirmation. The values of these would normally be selected by the network operator to provide a more stringent error performance requirement for sampling during hunting than for the continuous monitoring after confirmation.

A further parameter NZ is specified to allow further samples to be taken to improve the averaging of the error sample. As with NC and NX to values are specified, NZ1 and NZ2, but as well as having possible different values, NZ1 and NZ2 are employed differently in the error monitoring process:

NZ1 is employed by the radio unit for error checking when sampling during hunting. It is the number of contiguous samples of NC1 codewords without a codeword sample error event which must be recorded before the control channel being sampled may be confirmed.

NZ2 is employed by the radio unit for error checking when sampling during continuous monitoring of the control channel after confirmation. Following the first sample error event it is the number of further contiguous samples of NC2 codewords each with a codeword sample error event, which must be recorded before the radio unit may relinquish the control channel on the grounds of unacceptable codeword error rate.

AN1.4.3 Examples of error checking on time-shared control channels

This section considers the possible application of the error monitoring procedures provided by this specification. Figure AN1.1 illustrates a simple time-shared control channel provided by three sites with an equal duration burst from each site (equivalent to twenty

codewords). There is a blank period between any two bursts of duration equivalent to five codewords to accommodate tolerances and equipment switching delays.

Four samples of the forward control channel, as received by the same radio unit at different instances of time, are shown in the figure and are labelled Case I, Case II, Case III and Case IV. Each of these samples starts at the instant immediately before the next transmission. The sample duration is therefore 75 codewords (20 + 5 + 20 + 5 + 20 + 5).

In the figure, codewords received by the radio unit unerrored are indicated by white and those received errored are indicated by black. Since the blanks between transmissions will be interpreted by the radio unit as errored codewords these blanks are coloured black in the figure.

In Case I the radio unit is receiving a good signal (one errored codeword) from site B but no signal at all from sites A and C.

In Case II the radio unit is receiving a good signal from site B (one errored codeword) and inadequate signals from A and C (eight errored codewords each).

In Case III the radio unit is receiving an approximately equal quality of signal from all three sites (A has four errored codewords, B seven and C six). It is assumed for this example that this level of errored codewords is too high for reliable communication with any site.

It should be noted that, whilst II and III represent totally different situations, the total number of errored codewords received in the sample taken by the radio unit is equal (31 in each case).

In Case IV the radio unit is receiving a good signal from two of the sites (B and C) and an inadequate signal from site A.

The case of a radio unit error monitoring after confirmation shall be considered, with NC2 set to 75 to correspond to the sample length. The network operator is required to select an appropriate value of NX2. In calculating this value it seems appropriate to consider Case I, since this is likely to be a common occurrence. If it is assumed that three errored codewords in any burst from a single site represents the maximum tolerable error level, then in order to detect this level in the burst from site B the value of NX2 should be set to 58 (ie assuming all errored codewords outside the burst from site B plus three within the burst = 55 + 3).

If it is assumed that sites A, B and C all radiate the same value of SYS code then a radio unit set with NC2 = 75 and NX2 = 58 will not register a codeword error event in Case I. It will also not register such an event in Case II, since the number of errored codewords will be 31. The same will be true of Case III. This is clearly an undesirable result since the radio unit should register a codeword error event in Case III because reliable communication is not likely. It is clear that whatever the chosen value for NX2, the radio unit will not be able to differentiate between cases II and III.

This problem may be solved if the three sites radiate different values of SYS code. Assuming that the radio unit holds the value radiated by site B as the valid value of SYS, then it will count as errors all codewords received from sites A and C, irrespective of the

actual received condition. In Case III this will result in a total error count of 62 codewords resulting in a codeword error event. In Case II the error count will be 56 which will not result in a codeword error event. Thus the required differentiation between cases II and III will be achieved.

However, this solution does have a disadvantage which is illustrated by Case IV. Here the radio unit has an equal choice of two sites (B and C). If all sites radiate the same value of SYS code then the radio unit may access either site thus doubling the total time available to it for system access. If, however, the three sites radiate different SYS codes the radio unit will not be able to access both sites B and C (since the value of SYS received from only one of those sites will be the one used in verification - refer to 9.4.1(b)) and will thus not be able to take advantage of the increased access time offered.

AN1.5 Control channel acquisition

The operational differences between a radio unit acquiring a time-shared control channel (ie one which the radio unit expects to be time-shared) and a radio unit acquiring a continuous control channel are as follows:

the use of NV;

the time period mandated in searching for a valid SYS code prior to verification;

error analysis.

The third issue was explained in section AN1.4 and the earlier two are explained here (refer to section 9.3.4.2.1).

When a radio unit is searching for a valid control channel codeword synchronisation sequence on a time-shared control channel prior to verification it should search for a period long enough to allow the radio unit to receive at least one complete burst from each site irrespective of the point at which synchronisation is originally obtained. The value TS is used by the radio unit to measure this time period and it therefore must be selected by the network operator to enable this to happen. No such time period is mandated for operation on a continuous control channel prior to verification.

A mechanism is mandated which enables the radio unit to select a good site on which to attempt verification. For a time-shared control channel which employs differing SYS codes this mechanism involves the radio unit receiving a predetermined number of identical SYS codes derived from consecutive (but not necessarily from contiguous slots) unerrored CCSCs prior to verification.

Using the examples in Figure AN1.1 where each site radiates a different SYS code and using an example value of NV (time-shared value) of 9 the following behaviour can be observed.

In Case I the radio unit will not begin verification until 9 CCSCs containing the same SYS code have been received. The radio unit may have to receive more than one burst from site B to receive 9 CCSCs; this depends upon when the radio unit acquires synchronisation on the channel.

In Case II the radio unit will again select the system on site B for verification as it will not receive 9 consecutive CCSCs containing the same SYS code from either site A or site C.

In Case III the radio unit will not receive 9 consecutive CCSCs containing the same SYS code and will reject the channel after TS seconds.

In Case IV the radio unit will select the system on either site B or site C for verification depending upon when it acquires synchronisation.

It can therefore be seen that on such a system, a value of NV should be selected by the network operator which is low enough to allow channel acquisition and is high enough to make the radio unit select a good site.

On channels where only one SYS code is used it is expected that the selected value of NV will be low to allow faster channel acquisition.

AN1.6 Use of SYS codes on time-shared control channels

Note that not all situations are considered here.

AN1.6.1 Comparison of the received and verified SYS codes

The value of SYS code used for each site operating the time-shared control channel is network dependent. The radio unit shall decode the received SYS code in accordance with Section 9.3.4 and shall compare the received SYS code with that verified during control channel acquisition authorisation in accordance with section 9.4.1(b). If bits 1-12 of the SYS code recovered from decodable control channel system codewords received differs from the value of the bits verified during acquisition authorisation the radio unit shall continue error checking and suspend any random access attempts in accordance with section 9.3.4.3 and 9.4.1(b) respectively. Irrespective of bits 1-12, if there is any discrepancy in the LAB field (bits 13-15) the radio unit should act in accordance with 9.4.1(g). It is expected that network operators will use the same value of the LAB field on all sites on a time-shared control channel.

One effect on the radio unit of different sites using different SYS codes should be noted: it will only act upon signalling from one of the sites on an acquired control channel. This is because when a radio unit acquires such a channel it commences or continues a session on only one of the systems (ie one of the sites) and it will not therefore act upon any of the codewords from the other sites (see 11.6.2.1.2) except that it will treat them as errored codewords during error analysis (see section 9.3.4.3).

AN1.6.2 Requirements to register

Use of a different SYS code at sites on the time-shared control channel may result in the radio unit registering as it roams (as the unit relinquishes and acquires the control channel from the different sites). The radio unit shall attempt to register on the confirmed channel (by random access) when it does not hold a successful registration record for the AREA

field within the verified SYS code (section 9.3.4.2.2), provided that this AREA field is not already entered in the unit's list of denied registration records (section 10.3).

The radio unit shall not attempt to register at sites radiating a zero value AREA field (section 10.2.3i. and 10.3.3i.) or when the radio unit is personalised with a zero length AREA field (section 10.3.(i)). If the sites sharing the time-shared control channel are radiating SYS codes differing only in the value of the FREE bits (see section 9.3.4.2.2) the radio unit shall not be required to register as it roams from site to site.

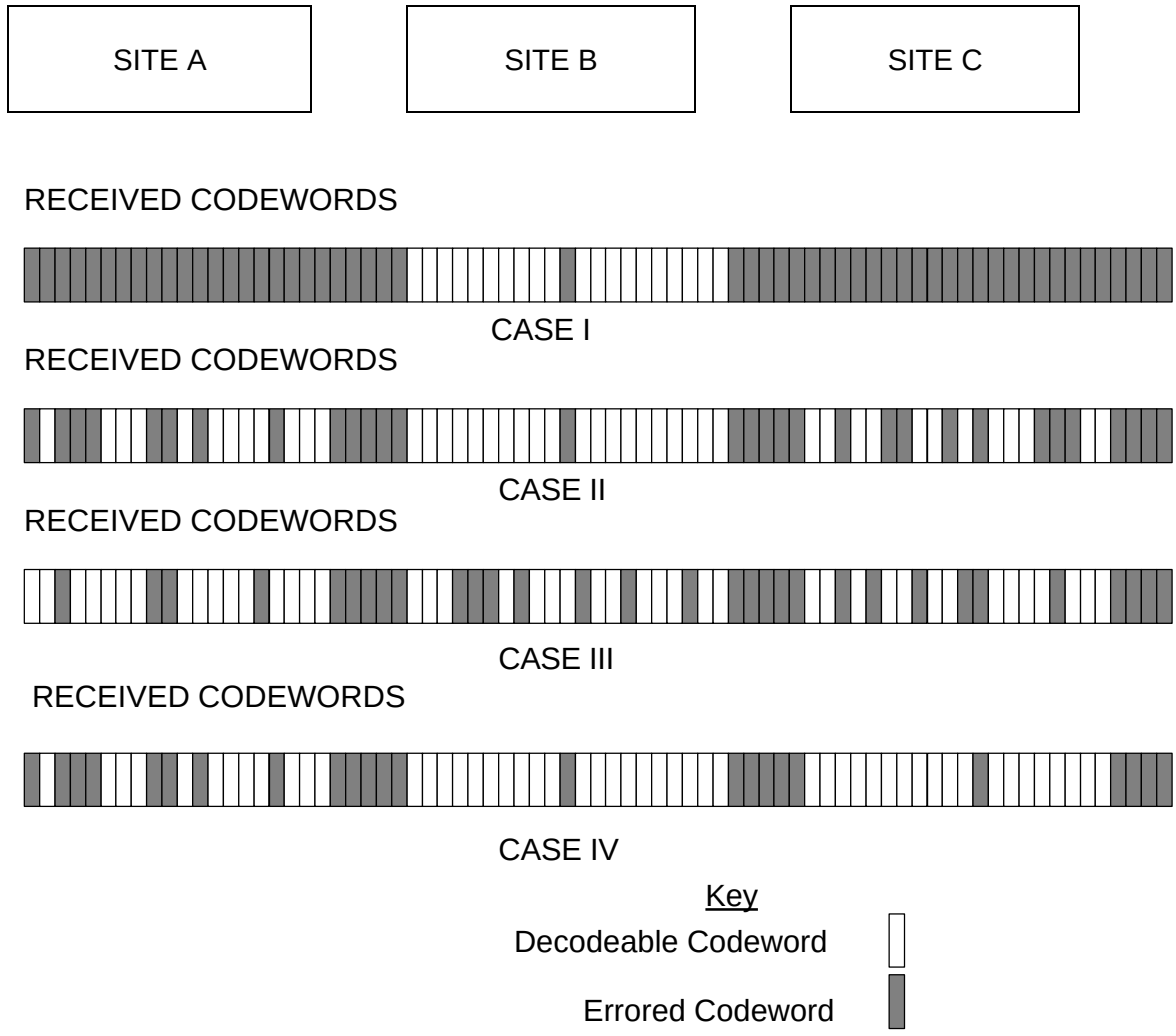


Figure AN1-1 Time-shared Control Channel Example

The rapid progression in RF technology has led to the receivers in new radios being capable of providing good SINAD figures at very low received carrier levels. This leads to better error rates at low received signal levels. The error rate is further enhanced if forward error correction is used.

Radio units exhibiting such characteristics can acquire or remain confirmed on a control channel even when a large geographical distance exists between the radio and the base station. This can lead to reciprocity problems, noisy calls and potentially to co-channel interference with other sites re-using the same frequency. In areas where coverage may overlap, a better quality of service may be available to the radio from a closer site. To obtain service on the new site the radio must first relinquish the control channel on which it is currently confirmed. If the received error rate is very low rate then the error checking algorithms of NC1, NX1, NZ1 and NC2, NX2, NZ2 become ineffective and the radio cannot be forced to leave the control channel until the received signal level is extremely low.

Solutions

Use of Background Search Sequence

Personalising a radio with a background search sequence enabled is one method which can be employed. This is only effective however, when a better control channel is likely to be available. It must also be noted that :-

If a radio unit leaves the control channel in an attempt to locate an alternative one, there is a period when it is unable to receive calls. The Network believes that the radio unit is active on a particular site from its registration record and does not know when the radio unit will initiate a background hunt. A period between background hunts must be chosen very carefully. This will be related to the coverage area and the speed at which the radio unit is moving through the coverage area.

Use of Programmable RF Threshold Level

An alternative method is to allow radio units to acquire and relinquish a control channel by the use of a programmable RF threshold level. When a radio unit is located near the edge of the coverage area, the received signal strength is subject to fluctuations due to the multi-path reception. If an RF threshold is used to determine if a channel will be relinquished, one sample will not be sufficient. Several samples must be taken over a period of time and an average or statistical measurement taken. The period is dependant on characteristics of the multi-path.

User Services vs. Network Optimisation

The solutions proposed in this annex should be applied, where necessary, to ensure adequate operation of the radio unit on the network.

Beyond this, manufacturers are reminded that user service and network optimisation often conflict, with the overall aim being to offer the best service for the user while maintaining the infrastructure performance.

The Network operator will wish to maximise the network loading by encouraging radio units to make single-site rather then multi-site calls (only one traffic pair and no lines used for the call) which may be achieved by background searching in the radio unit. Note that in this case the radio unit would be encouraged to relinquish a strong site for a weaker (but still adequate) site transmitting the PREFERRED NDD.

ANNEX AN4 NOTES RELATING TO THE USE OF THE INFO FIELD IN REQUEST TO REGISTER RQR MESSAGE

AN 4.1 Introduction

The INFO field in the RQR message provides additional information to be conveyed from the radio unit during registration. This information may be -

a) Additional information that the radio unit wishes to convey to the TSC regarding the radio unit type or personalisation.

b) Additional information gleaned from the TSC. Registration attempts from the radio unit may be heard by TSC sites other than the site intended, resulting in a misdirected registration. The use of part of the SYS provides additional security against misdirected registrations.

AN 4.2 Misdirected Registrations

For Networks with sites employing the same Control Channel, under certain circumstances and RQR may be received by more than one TSC. Similarly the RQR may be received by the TSC of another Network. The result may be erroneous registration records being stored within a Network. Some security against this phenomena may be achieved by transmitting part of the System Identity Code currently being propagated by the TSC within the INFO field of the RQR message.

Note that 11.5.5.3.1.6 MPT1343 states
The "Info" field shall be set to all zeros, unless permitted otherwise by the network

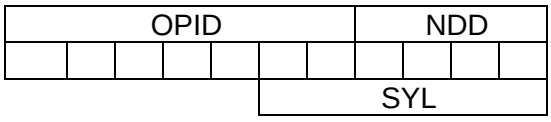
INFO-FIELD in RQR

SYL	ESNF	RSVD	SIF	SPARE
6	1	2	1	5

SIF - If non zero then SYL holds a subset of the OPID and/or the NDD sub field of the system identity code (SYS) currently being propagated by the system originating the message.

SYL - With bit 1 of the SYS field set to '1' (indicating that the Network is a National Network), SYL contains the six least significant bits of the NDD sub field of the system identity code appropriate to the system originating the message.

With bit 1 of the SYS field set to '0' (indicating that the Network is a Regional Network), SYL contains the two least significant bits of the OPID field concatenated to the four bits of the NDD sub field of the system identity code appropriate to the system originating the message.



For SIF='0' then SYL='000000'

ESNF - Electronic Security Number Flag. See Section 10.2.3

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

A TSC which incorporates the SYL feature shall examine the SIF flag within the INFO field of any registration request.

If the SIF flag is non zero then:

The TSC shall only acknowledge the registration request if the SYL field matches the least significant six bits of the NDD field of the System Identity Code being propagated by the system originating the message.

If the SIF flag is zero then:

The TSC shall acknowledge the registration request. If the TSC is not equipped to make use of the INFO field in the RQR message, then it may reject the RQR by transmitting an ACKX (Q=0) in response to the registration attempt.

ANNEX AN5 NOTES REGARDING THE IMPLEMENTATION OF REGISTRATION ON DEMAND IN RADIO UNITS. ISSUES OF NETWORK COMPATIBILITY.

INFORMATIVE

The information given in this annex is important for any radio unit manufacturer planning to implement a radio unit for use on any MPT1343 compliant work. It is particularly important if the radio unit design is planned to be used on more than one network.

The radio unit manufacturer should be aware that somewhat different behaviour may be expected of the radio unit by different networks when a demanded registration takes place. This is dependent upon which issue of MPT1343 the particular network concerned is conforming to.

The earlier version of MPT1343 (1988) contained the following text in its specification of the expected radio unit behaviour when a demand for registration was received.

> "If, while confirmed on a control channel and not attempting to register by random access, a radio unit receives an applicable individually addressed ALHR, it shall attempt to register, complying with the procedures defined in MPT 1327 section 8.23.2.
>
> Provided that the prime registration record is not already a NULL containing the same AREA code as the currently verified AREA code, then upon making a registration attempt (as a result of a demand) the radio unit shall:
>
> a) Change the prime registration record into a timed record with a newly-started timer, deleting, if necessary, the registration record closest to expiry (see section 10.6), and
>
> b) Create a NULL record as the prime registration record.
>
> The radio unit action after transmitting RQR upon demand, whilst not attempting to register by random access, shall be as defined in sections 10.4.2.1 and 10.4.2.3."

Note that a network which has been implemented to make use of this earlier version of the MPT 1343 specification (1988 version) will require the radio unit to handle its prime and timed registration records differently to one which has been implemented to the 1991 version.

Radio unit manufacturers wishing to ensure that their radio equipment is compatible with a particular network are advised to check this particular issue with the network operator. For radio equipment which is likely to be required to operate on more than one network, the equipment manufacturer may wish to make appropriate design decisions which will enable this matter to be configured for the different network types.

ANNEX AN6 DYNAMIC REGROUP OPERATION

AN6.1. Introduction

A radio unit has one unique individual identity and may have one or more group identities implanted during personalisation. Dynamic Regrouping allows additional group identities to be added or withdrawn by the reception of an appropriate short data message.

Each radio unit has optionally a array of storage locations into which dynamic regroup identities may be stored. The short data message contains fields for both the identity and the array index pointer such that each location may be individually referenced.

It is strongly recommended that checks are included in the design of the radio unit to prevent the possibility of a user transmitting an individual identity using this mechanism, perhaps by a range check during radio unit personalisation. A check may also be incorporated by the recipient to ensure that the originator of the message is valid.

AN6.2. Format of the Short Data Message

The format of the short data message is prescribed in section 14. The mechanism makes use of a Single Segment Transaction (SST) to transport the appropriate data across the Network. An SST contains a three bit General Format Information Field(GFI) which informs the recipient of the format of the data bits within the message. GFI='110' is used to signify that the SST contains command data for the recipient radio unit. CFUNC values '000001' to '000100' and '100010' to '100100 are used for the dynamic regroup functions.

AN6.3 Structure of the DATA field (GFI='110')

First Data Codeword

0	STF	GFI	I	SIZE	CFUNC	CPARAMETER 1	P
1	1	3	1	8	6	28	16

Second Codeword

0	RSA	CPARAMETER2	P
1	1	46	16

Third Codeword

0	STF	NSEG	CSEG	RSVD	CPARAMETER3	P
1	1	2	1	1	42	16

Fourth Codeword

0	RSA	CPARAMETER4	P
1	1	46	16

Fields defined in Section 14 of MPT1343

STF - '1' MPT1343 format message
GFI - '110' Format of the message as defined in this Annex
I - '1' Initial segment flag always set to '1' for an SST
RSA - '0' if the codeword is the last codeword in this message otherwise set to '1'
NSEG - '00' for an SST
CSEG - '0' for an SST
P - MPT 1327 Parity bits
RSVD - Reserved. Default Value Zero

Data Fields defined in this section

SIZE - Indicates the number of meaningful data bits in the message within the CFUNC and CPARAMETERi fields.
CFUNC - Indicates the function of the command message.

'000000' Reserved for Future Definition
'000001' Dynamic Regroup using BCD format
'000010' Dynamic regroup using Binary Format (1st block of 8 idents)
'000011' Interrogate Radio Unit for Binary Regroup data (1st block of 8 idents)
'000100' Radio Unit response for CFUNC='000011' (1st block of 8 idents)
'000101' to '011111' spare for customisation
'100000' to '100001' reserved for future definition
'100010' Dynamic Regroup using Binary Format (2nd block of 8 idents)
'100011' Interrogate Radio Unit for Binary Regroup Data (2nd block of 8 idents)
'100100' Radio Unit Response for CFUNC='100011' (2nd block of 8 idents)
'100101' to '111111' reserved for future definition
'

CPARAMETERi - See definition below

Note: In the formats given below, "n*" represents the most significant bits of an encoded character whose remaining bits form the start of the DATA field of the next codeword. "*m" represents the m least significant bits of an encoded character whose preceding bits concluded the DATA field of the previous codeword.

AN6.3.1 BCD group downloading

(CFUNC= '000001')

The CPARAMETERi fields are composed of two or four data codewords to download up to seven group idents. If only three dynamic group idents are downloaded, only two data codewords are required. In this case GP4 and ID4 in the second data codeword are set to '0000' and '000000' respectively. The prefix of the group identities downloaded shall be equal to the prefix of the recipient radio unit. Each group ident is preceded by a storage pointer index (0 to 15). CPARAMETERi fields formats are -

First Data Codeword

0	STF	GFI	I	SIZE	CFUNC	RESET	NC	GP1	ID1	GP2	P
1	1	3	1	8	6	1	3	4	16	4	16

Second Codeword

0	RSA	ID2	GP3	ID3	GP4	ID4*	P
1	1	16	4	16	4	6	16

Third Codeword

0	STF	NSEG	CSEG	RSVD	*ID4	GP5	ID5	GP6	ID6*	P
1	1	2	1	1	10	4	16	4	8	16

Fourth Codeword

0	RSA	*ID6	GP7	ID7	RSVD	P
1	1	8	4	16	18	16

RESET - '0' Do not clear existing regroups stored in the recipient radio unit
'1' Clear all existing regroup addresses in the recipient radio unit before adding new regroups contained in this message.

NC - Number of group idents in the message (0 up to 7)

GPi - Dynamic group ident storage index (0 up to 15)

IDi - Dynamic group ident (in BCD code) to update (in the range 0001 to 8100)

RSVD - Reserved ='000000000000000000'

SIZE - Indicates the number of meaningful data bits in the message. (CFUNC,RESET,NC,GPi,IDi fields)

'00001010' no group ident (use for reset)
'00011110' 1 group ident to update
'00110010' 2 group idents to update
'01000110' 3 group idents to update
'01011010' 4 group idents to update

'01101110' 5 group idents to update
'10000010' 6 group idents to update
'10010110' 7 group idents to update

Note :

i) that all of the existing dynamic regroup idents may be cleared by transmitting two data codewords with

- SIZE='00001010'
  CFUNC='00000001'
  RESET='1'

or

ii) that any existing single regroup identity may be deleted by transmitting a null value of ident (BCD "0000")

AN6.3.2 Dynamic Regroup using Binary Format

(CFUNC = '000010' for the first block of 8 identities or CFUNC = '100010' for the second block of 8 identities)

The Data field is composed of two or four codewords, in order to download up to six (from 8 possible index storage locations) complete group identities (PFIX+IDENT). If only three group identities are transmitted, only two data codewords are required. Each group ident is referred by an index number (0 to 7) within the appropriate block. CPARAMETERi fields' formats are as following :-

First Data Codeword

0	STF	GFI	I	SIZE	CFUNC	RESET	NC	RSVD	GP1	PFIX1	IDENT1	P
1	1	3	1	8	6	1	3	1	3	7	13	16

Second Codeword

0	RSA	GP2	PFIX2	IDENT2	GP3	PFIX3	IDENT3	P
1	1	3	7	13	3	7	13	16

Third Codeword

0	STF	NSEG	CSEG	RSVD	GP4	PFIX4	IDENT4	GP5	PFIX5	IDENT5*	P
1	1	2	1	1	3	7	13	3	7	9	16

Fourth Codeword

0	RSA	*IDENT5	GP6	PFIX6	IDENT6	RSVD	P
1	1	4	3	7	13	19	16

RESET - '0' Do not clear existing regroups stored in the recipient radio unit

'1' Clear <u>all</u> (1st block and 2nd block) existing regroup addresses in the recipient radio unit before adding new regroups contained in this message.

NC - Number of group addresses contained in the message (0-6)

GPn - Index into the radio unit table of dynamic groups to by updated by the following PFIX/IDENT

PFIXn - MPT1327 7 bit PFIX of a dynamic group

IDENTn - MPT1327 13 bit IDENT of a dynamic group in the range 1-8100, (or set to 0 to delete the specified dynamic group ident)

RSVD - Reserved. Default value zero

SIZE - Indicates the number of meaningful data bits in the message and may be computed by SIZE=11+(NC*23)

'00001011'	no group ident (use for reset)
'00100010'	1 group ident to update
'00111001'	2 group idents to update
'01010000'	3 group idents to update
'01100111'	4 group idents to update
'01111110'	5 group idents to update
'10010101'	6 group idents to update

Note :

i) that all of the existing dynamic regroup addresses may be cleared by transmitting two data codewords with

SIZE='00001011'
CFUNC='00000001'
RESET='1'

or

ii) that any existing single regroup identity may be deleted by transmitting a null value of ident ('0000000000000') to an index location

AN6.3.3 Interrogate Radio Unit for Dynamic Regroup using Binary Format

(CFUNC = '000011') to interrogate the first block of 8 identities or CFUNC = '100011' to interrogate the second block of 8 identities)

If CFUNC in the first data codeword = '000011' (pointing to the first block of 8 identities) or '100011' (pointing to the 2nd block of identities), the recipient of the SST is instructed to transmit to the sender, the particular block of dynamic regroup identities stored in its memory. The recipient transmits its stored regroup identities by the use of a new Single Segment Transaction after the existing SST has been acknowledged. The format for the recipient to transmit in response to this interrogate dynamic regroups is prescribed in AN6.3.4.

Two data codewords are transmitted as follows

First Data Codeword

0	STF	GFI	I	SIZE	CFUNC	RESET	NC	RSVD	GP1	PFIX1	IDENT1	P
1	1	3	1	8	6	1	3	1	3	7	13	16

Second Codeword

0	RSA	GP2	PFIX2	IDENT2	GP3	PFIX3	IDENT3	P
1	1	3	7	13	3	7	13	16

RESET - Not Applicable. Set to '0'

NC - Number of group addresses to interrogate from the recipient (0 up to 6)

GPn - Index pointing to the first PFIX/IDENT for the interrogation

PFIXn - Not Applicable, set to '0000000'

IDENTn - Not Applicable, set to '0000000000000'

RSVD - Reserved. Default value zero

SIZE - Indicates the number of meaningful data bits in the message
'00001011' - no group ident

RSVD - Reserved

AN6.3.4 Respond Dynamic Regroup using Binary Format from Recipient

(CFUNC = '000100') to respond with the first block of 8 identities or CFUNC = '100100' to respond with the second block of 8 identities)

The Data field is composed of two or four codewords, in order to transmit up to six (from 8 possible index storage locations) complete group identities (PFIX+IDENT) to the sender, as a result of an interrogate defined in section AN6.3.3. If only three group identities are transmitted, only two data codewords are required. Each group identity within the particular block is referred by an index number (0 to 7). 'CPARAMETERi fields' formats are as following :-

First Data Codeword

0	STF	GFI	I	SIZE	CFUNC	RESET	NC	RSVD	GP1	PFIX1	IDENT1	P
1	1	3	1	8	6	1	3	1	3	7	13	16

Second Codeword

0	RSA	GP2	PFIX2	IDENT2	GP3	PFIX3	IDENT3	P
1	1	3	7	13	3	7	13	16

Third Codeword

0	STF	NSEG	CSEG	RSVD	GP4	PFIX4	IDENT4	GP5	PFIX5	IDENT5*	P
1	1	2	1	1	3	7	13	3	7	9	16

Fourth Codeword

0	RSA	*IDENT5	GP6	PFIX6	IDENT6	RSVD	P
1	1	4	3	7	13	19	16

RESET - Not Applicable. Set to '0'

NC - Number of group addresses to interrogate from the recipient (0 up to 6)

GPn - Index into the radio unit table of dynamic groups to by updated by the following PFIX/IDENT

PFIXn - MPT1327 7 bit PFIX of a dynamic group

IDENTn - MPT1327 13 bit IDENT of a dynamic group in the range 1-8100

RSVD - Reserved. Default Value Zero

SIZE - Indicates the number of meaningful data bits in the message and may be computed by SIZE=11+(NC*23)

'00001011' no group ident (use for reset)
'00100010' 1 group ident in message
'00111001' 2 group idents in message
'01010000' 3 group idents in message
'01100111' 4 group idents in message

'01111110'	5 group idents in message
'10010101'	6 group idents in message

AN6.3.5 Responses for short addressing Command Messages. (GFI='110)

AN6.3.5.1 Receiving Individually Addressed HEAD message with GFI='110'

If a radio unit receives Command Message (GFI='110') then it shall respond with a suitable acknowledgement -

ACK(QUAL=0)	-	Unit has accepted the Command information
ACKX(QUAL=0)	-	Unit is not equipped to accept the Command message
ACKX(QUAL=1)	-	Unit cannot accept the Command message at this time
ACKV(QUAL=1)	-	Unit does not wish to accept the command 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.

AN6.3.5.2 Responses 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.