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.

11.9.2.2.2 Availability Check on Called Radio Unit

Mandatory where specified. It is optional whether the radio unit indicates the IDENT of the

caller to the user. It is optional whether the radio unit makes a distinct indication for an emergency call.

If, while waiting for an incoming traffic channel call, a radio unit receives a repeat AHY, and the user has already activated the RFCC, the unit shall not re-alert the user.

In the event of an incoming traffic channel call (IDENT2 = Ident(1-8100), INCI, IPFIXI, PSTNGI or PABXI) the unit shall respond with one of ACK(QUAL='0'), ACKI(QUAL='0'), ACKB(QUAL='0'), ACKB(QUAL='1'), ACKV(QUAL='1') or ACKX(QUAL='0') in accordance with MPT 1327. In addition, the radio unit shall only respond with ACKX(QUAL='0') if one of the following conditions is met:

i. Bit D of the received AHY message is '0' and the unit is not accepting speech calls.

ii. Bit D of the received AHY message is '1' and the unit is not accepting or not ready for data calls (see section 12).

The radio unit shall not accept a call for call back (using ACKB(QUAL='0')) unless it has facilities for making the return call.

It is mandatory for the radio unit to send RQQ off-hook/on-hook signalling.

As a standard option, the radio unit may respond to AHY, bit CHECK='1', with ACK (QUAL-'0'). This option shall only be "enabled" by network personalisation and the default state shall be "disabled".

11.9.2.2.3 Availability Check on Requesting Radio Unit

Mandatory as specified.

11.9.2.2.4 Cancelling Alert State of Called Unit

Mandatory where specified.

The requirements for confidence indications are given in section 8.1.

11.9.2.2.5 Traffic Channel Allocation

Mandatory as specified. User indication of calling IDENT is optional. For definition of the retuning time limits, see 11.6.2.1.3.

11.9.2.2.6 Storing Call Maintenance Parameters

Mandatory as specified.

It is an option for radio units to store the value of TSCLIM from the last decodable BCAST, SYSDEF='00010' message received in read/write memory (see 11.5.5.4.5 c).

11.9.2.3 Procedures for all Radio Units on an Allocated Traffic Channel

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

Mandatory as specified.

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 (refer to section 6).

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.

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 ='111') 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 DataInterrogation 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 not send call maintenance messages except disconnect messages.

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 channel number zero, 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 13.5. 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)
- CCITT Alphabet No 2 (Telex), Recommendation S1
- CCITT Alphabet No 5 (ASCII), Recommendations V3 and V4
- two formats which are reserved for future definition
- two formats which are 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 CCITT Alphabet No 2 (Telex) characters or 25 CCITT Alphabet No 5 (ASCII) characters. An MST is capable of carrying 176 BCD characters, 140 CCITT Alphabet No 2 (Telex) characters or 100 CCITT 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.

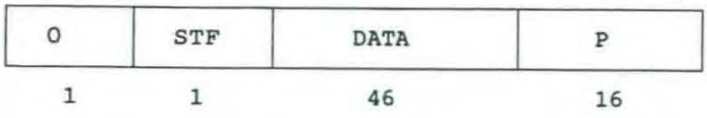
14.2.2 Data Codewords

14.2.2.1 General Structure

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:

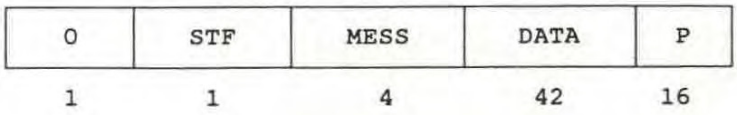
i) First and third data codewords following the HEAD codeword:

MPT1327 Short Data Message Format (STF = '0')



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')



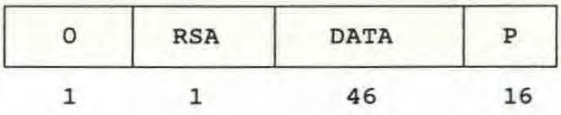
STF - Segment Transaction Flag. '1'- MPT1343 short data message format as defined in this specification).

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:



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:

MESS

GFI	I
3	1

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' CCITT Alphabet No 2 (Telex).
- '011' CCITT Alphabet No 5(ASCII).
- '100', '101' Reserved.
- '110', '111' Spare.

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:

MESS

NSEG	CSEG	RSVD
2	1	1

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

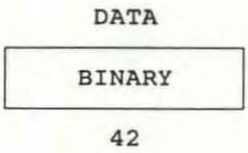
The format of the DATA field shall be determined by the value of the GFI field and shall be as specified below.

Note: 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.

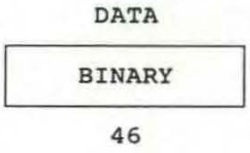
i) Binary

(GFI = '000')

First and third codeword:



Second and fourth codeword:

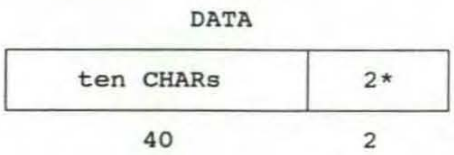


BINARY - Free format binary data.

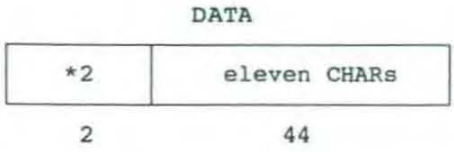
ii) BCD (as in Appendix 5 of MPT1327)

(GFI = '001')

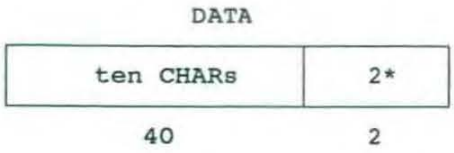
First codeword:



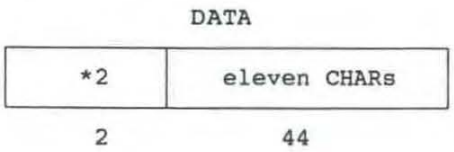
Second codeword:



Third codeword:



Fourth codeword:



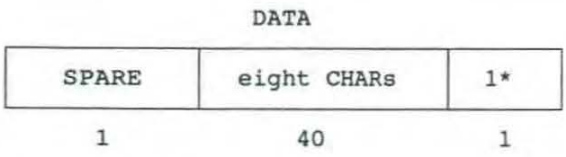
CHAR - Binary value, as prescribed in MPT1327 Appendix 5, of unspecified BCD character.

Note: The maximum number of BCD characters which can be included in a segment is 44.

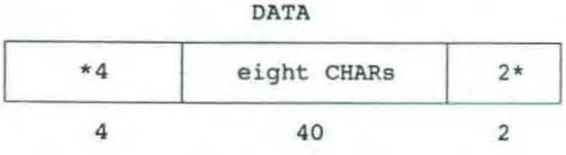
iii) CCITT Alphabet No 2 (Telex Type Characters)

(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 CCITT Recommendation S1 (Alphabet No 2), of an unspecified character.

Note: The maximum number of CCITT Alphabet No 2 characters which can be included in a segment is 35.

iv) CCITT Alphabet No 5 (7 bit ASCII)

(GFI = '011')

First codeword:

DATA

SPARE	five CHARs	6*
1	35	6

Second codeword:

DATA

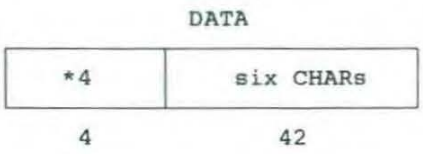
*1	six CHARs	3*
1	42	3

Third codeword:

DATA

*4	five CHARs	3*
4	35	3

Fourth codeword:



SPARE - Available for customisation.

CHAR - Binary value, as prescribed in CCITT Recommendation s V3, V4 (Alphabet No 5), of an unspecified character.

Note: The maximum number of CCITT 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' and '101' are reserved for future definition. Formats for GFI values of '110' and '111' are spare for customisation.

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.

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 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

14.4.2.1.1 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 set at value TA and start its individual incoming short data timer and shall wait for further signalling; see also sections 14.4.2.1.2 to 14.4.2.1.5.

14.4.2.1.2 Receiving Individually Addressed HEAD Message

If a radio unit on a control channel receives a HEAD message with PFIX/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 14.4.2.1.3) 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/IDENT 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 14.4.2.1.3), 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 14.4.2.1.3) 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.

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), it shall set at value TGI and start its individual incoming short data timer and shall wait for further signalling; see also section 14.4.2.1.3.

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 wit 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 14.4.2.1.3.

14.4.2.1.3 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 14.4.2.1.2).

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.

14.4.2.1.4 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 or TA), discard any segments decoded in connection with that transaction, discard the recorded values of the control fields and assume that future HEAD and AHY (IDENT2 = SDMI)

messages are for another transaction.

This use of AHYX is in addition to the MPT1327 prescribed functions.

14.4.2.1.5 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!!.

14.4.2.1.6 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

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.

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

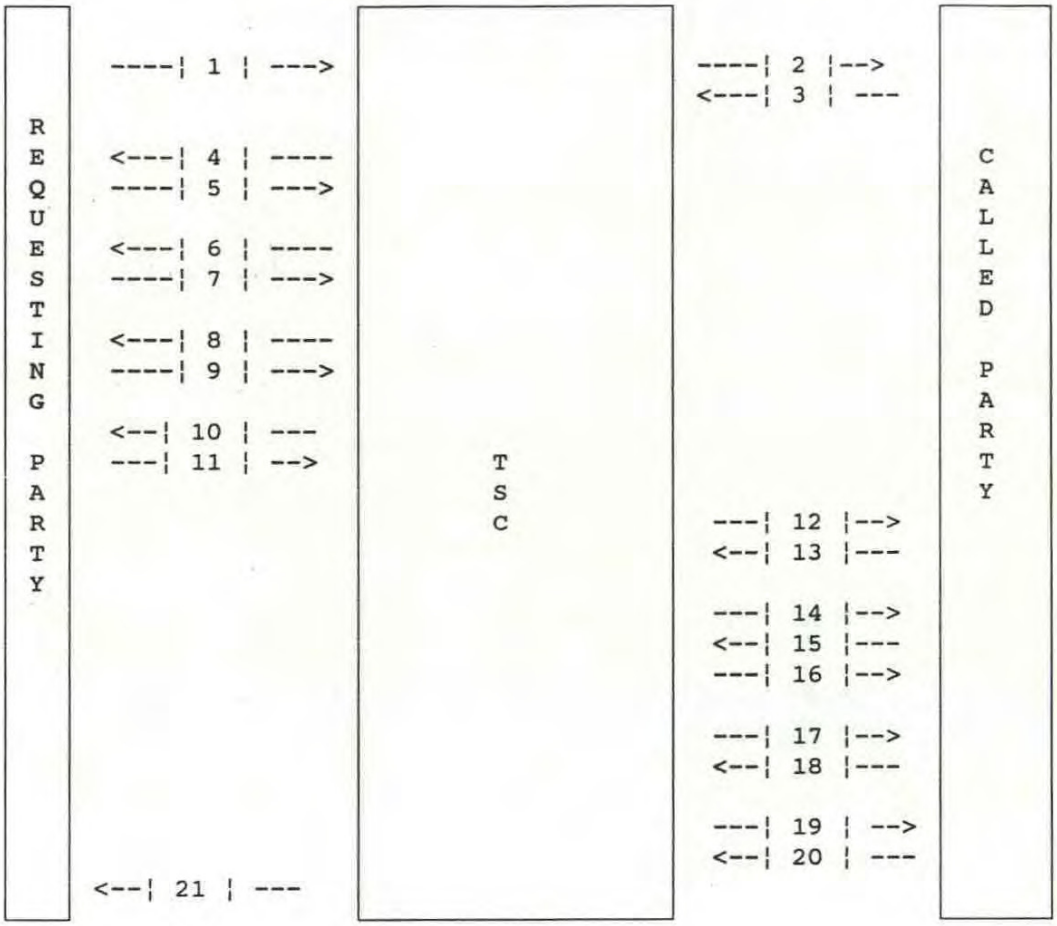
A radio unit waiting for further signalling for an incoming short data transaction shall maintain any relevant timers, including its group incoming short data timer, as prescribed in section 9.4.2, when leaving the control channel on which it is currently active.

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).

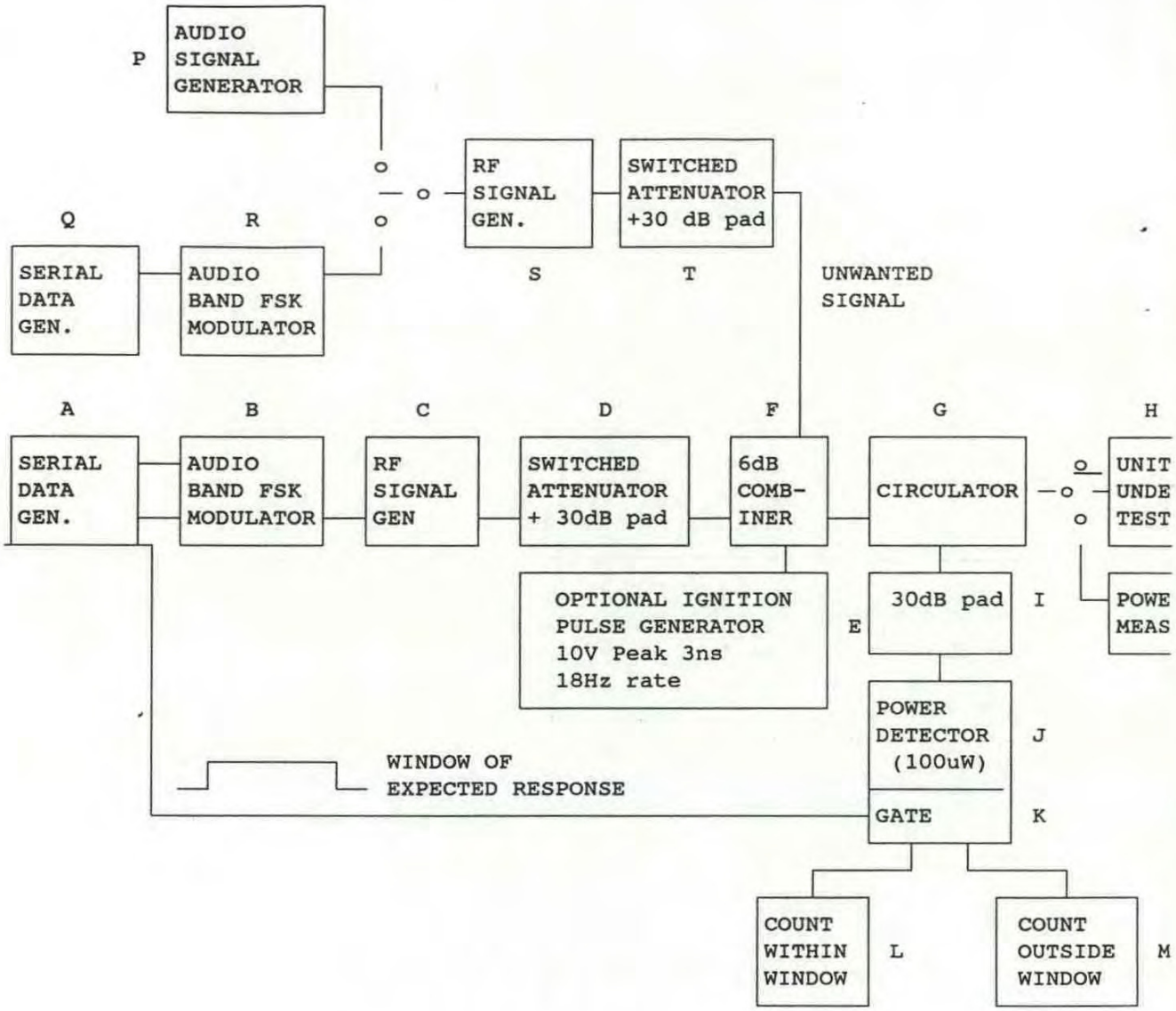
A.2 Method of Measurement

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 $\pm$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 (114dB relative to 1uV emf or -99dBm)



A-1 DATA PERFORMANCE TEST SET UP

The data stream generated by serial data generator 'A' shall be as follows:

Number of bits:

16	64	64	64	64	64	64	64	64	64	64
PREAMBLE	SYNC	MARK	CCSC	MARK	CCSC	AHOY	CCSC	DUMMY	CCSC	DUMMY

<——— This section repeated 100 times in total ———>

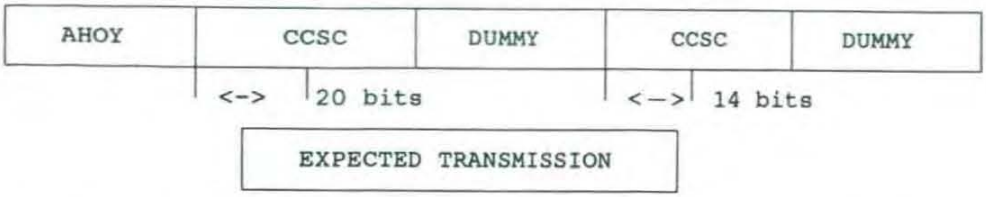
```
PREAMBLE = 1010101010101010
SYNC     = 1100010011010111
CCSC     = 00000000000000000001000101010001101010101010101011000100110101111
MARK     = 10101100000000000000010001100000010010101111001011000100110101111
AHOY     = 11011011111000110101110001000000000000000000000000100110100001110 1
DUMMY    = 10000000000000000000010001000000000000000000000000011000110010100 1

PFIX     = 1011011
IDENT    = 1110001101011
CHAN4    = 0101
```

Sections of the AHOY message

A-2 TRANSMITTED DATA STREAM

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 AHBOY codewords is selected to differ by 1 bit from 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:

10011011111000110101110001000000000000000000000000011101110000101 10
11111011111000110:011100010000000000000000000000000100100000001101
11001011111000110101110001000000000000000000000000111100110001010 1
11010011111000110101110001000000000000000000000000101011101001100 1
11011111111000110101110001000000000000000000000000100000000101111 1
11011001111000110101110001000000000000000000000000011111110010100 0
11011010111000110101110001000000000000000000000000111010001000011 0
11011011011000110101110001000000000000000000000000100101101000101
11011011101000110101110001000000000000000000000000111100101011000 1
11011011110000110101110001000000000000000000000000101011100100101 1
11011011111001101011100010000000000000000000000000110100000100010
11011011111010110101110001000000000000000000000000010110001011 1
11011011111001110101110001000000000000000000000000011101010001100
11011011111000010101110001000000000000000000000000110010100101010 0
11011011111000100101110001000000000000000000000000101100100011100 0
11011011111000111101110001000000000000000000000000100011100000111 0
11011011111000110001110001000000000000000000000000011110000000000 1
11011011111000110111111000100000000000000000000000011101011000100 11
11011011111000110100110001000000000000000000000000010010101000111 0
11011011111000110101010001000000000000000000000000011010010000 01

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	MPT 1327 Default	MPT 1343 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 networ such as TA, TC, TD, TJ, TN, TS, 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 BSCAST (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.

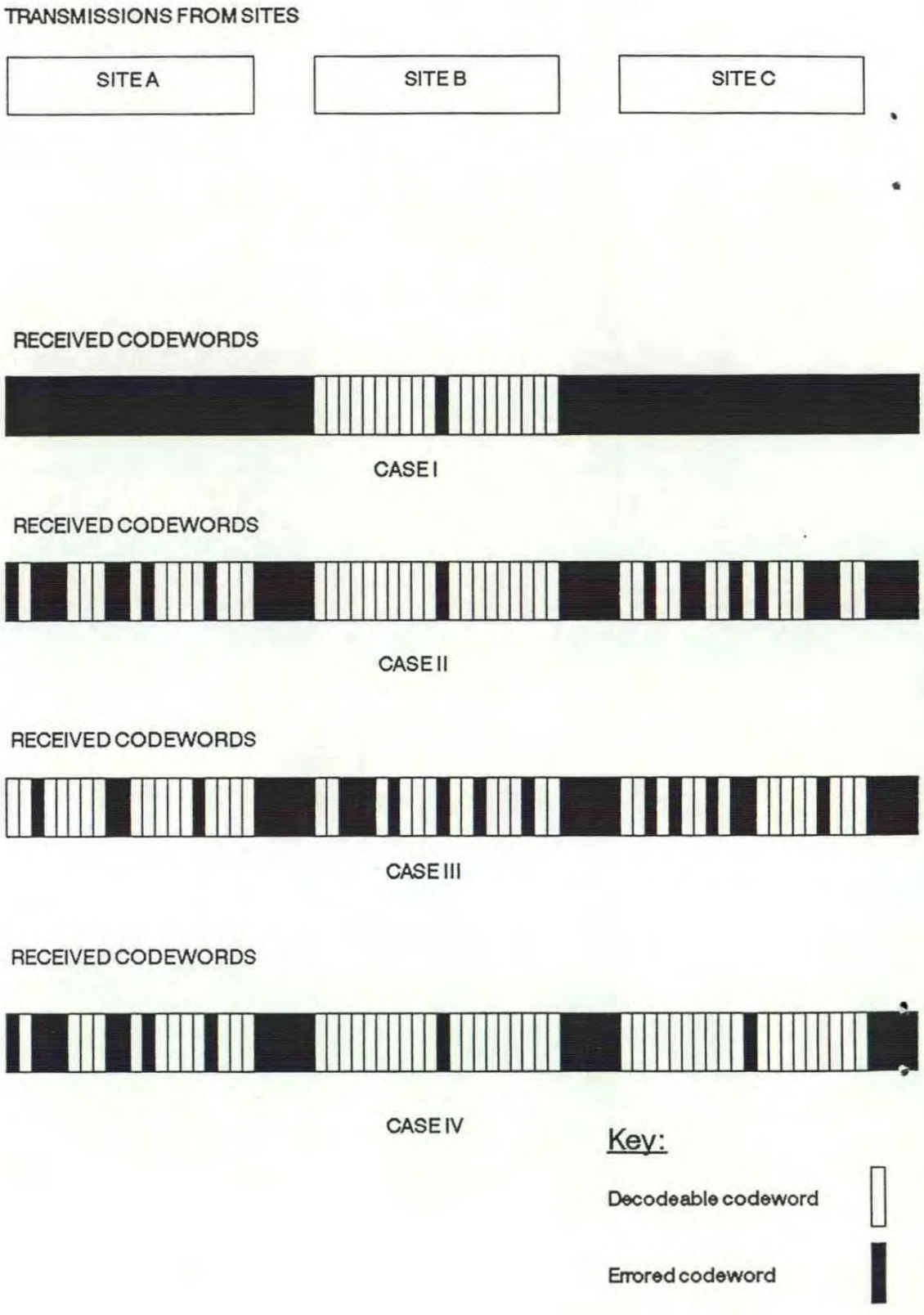


Figure AN1-1 Time-shared Control Channel Example

ANNEX AN2 RECOMMENDATION FOR RADIO UNIT BEHAVIOUR ONCE THE COMPREHENSIVE HUNT SEQUENCE HAS BEEN ENTERED

Section 9.3.3.5 of this Specification allows a radio unit in the process of undertaking a "comprehensive hunt sequence" to carry out a "preferential hunt sequence" or "normal hunt sequence" as its own option, returning to the "comprehensive hunt sequence" if the optional sequence is unsuccessfully completed. Experience with operational systems has led to the following recommendation regarding the exercise of this option.

"The exercise of the option to undertake other hunting sequences whilst in the 'comprehensive hunt sequence' is recommended since it can be expected that the time taken to acquire a control channel during a 'comprehensive hunt sequence' may be much longer than in other hunting sequences. Failure to exercise this option may result in excessive delays in acquiring one of the control channels applicable to the 'normal hunt sequence' (ie a 'normal' control channel for the selected network) following the temporary loss of the current control channel. It should be noted, however, that the exercise of the option will have the effect of further extending the time taken to complete a 'comprehensive hunt sequence' and that the intervals at which a normal or preferential hunt sequence is performed should be chosen with care."