MASC/MPAK

Protocol Description

Contents

1 Introduction

This programmer's manual is written for anyone who intends to develop applications for use with radio modems. The manual describes the Mobitex Asynchronous Communication (MASC) protocol for data transfer between PCs and radio modems.

The manual also describes the different data packets (MPAKs) that are used in the Mobitex network, as well as the dialogues used in Mobitex network communication.

1.1 Radio Modem

A radio modem that operates on the Mobitex network acts as a link between a data terminal and the network. There are various different versions of radio modems.

The versions differ in appearance as they are each designed for use in a specific environment.

The hardware interfaces, and how you turn the modem on or off, also differ. These differences are described in the Interface Description, which is available for each particular radio modem type.

1.2 Mobitex

Mobitex (Figure 1) is a wireless, packet-switched, datacom network. The network consists mainly of exchanges, radio base stations, fixed terminals and mobile terminals. A fixed terminal is connected to the network by landline facilities. A mobile terminal is a piece of data equipment, often a portable PC or a data terminal, that is connected to a radio modem.

The radio modem transmits data from the data terminal to the nearest radio base station. The radio base station directs the data to the addressed terminal, either by itself or via exchanges, depending on whether the addressed terminal is close to it, or far away.

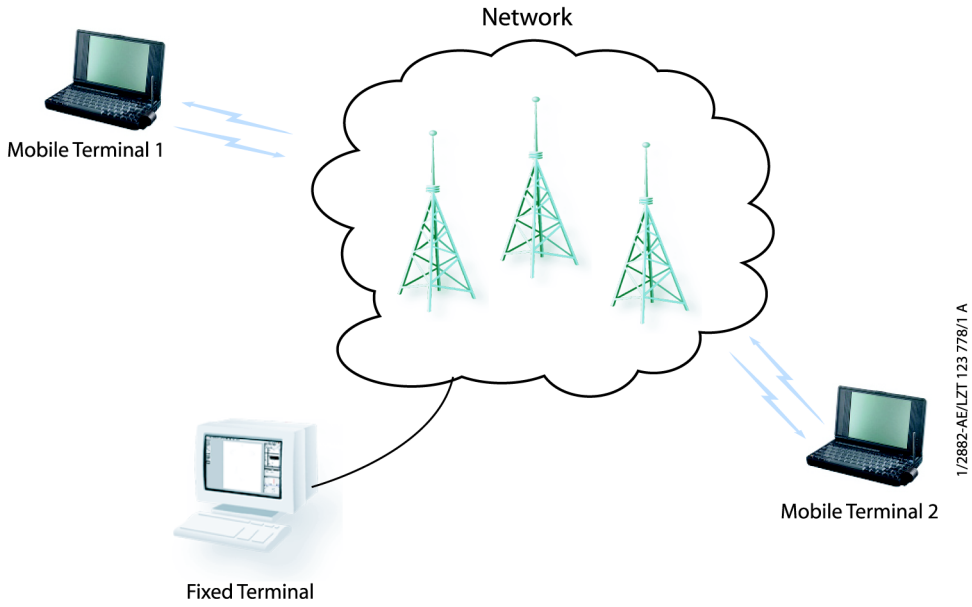


Figure 1 The Mobitex network

1.3 Data Terminal

The data terminal, that is used with a Mobitex mobile terminal, is referred to as the PC in this manual. It may be any personal computer, or any other device that is capable of communicating with a modem.

1.4 OSI Layers Described in this Manual

Figure 2 shows an OSI representation of the mobile and fixed terminals that work in the Mobitex network. The protocol shown for the fixed terminals are examples only.

The OSI layers 1, 2, and 3 constitutes the three layers that specify the radio modem's interfaces to a data terminal, and to the Mobitex network.

The topic of this manual is the interface between the radio modem and the data terminal.

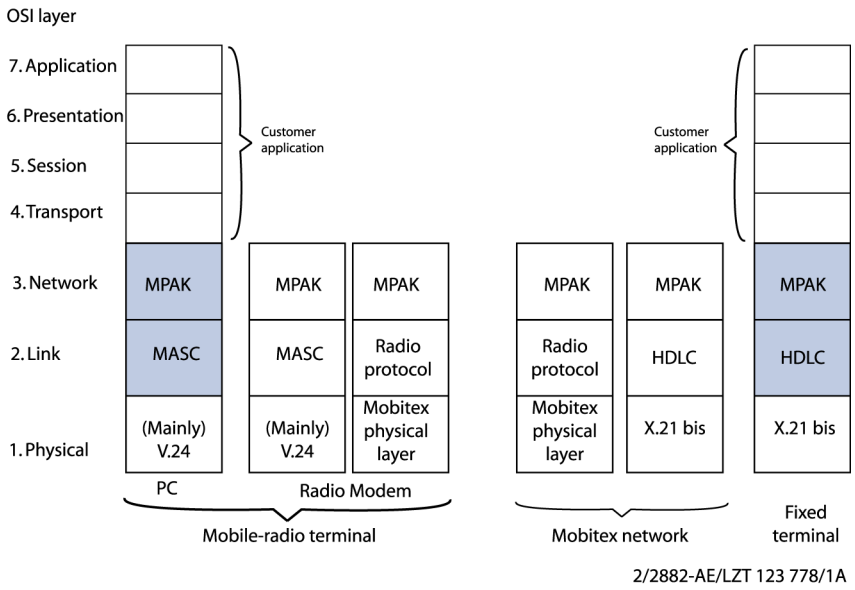


Figure 2 Communication overview according to the OSI model. The shaded areas represent the parts described in this manual.

1.4.1 V.24/V.28 Physical Interface

The physical interface connects the radio modem to the PC. The interface is mainly V.24/V.28, depending on the radio modem used.

1.4.2 MASC Frames

The information sent between a PC and a radio modem takes the form of frames, defined in accordance with the MASC interface.

1.4.3 MPAKs

A Mobitex Packet, or MPAK, is the primary data communication unit used in Mobitex networks. Text, status or data information to be transferred between different Mobitex terminals are included in MPAKs, together with other information necessary for switching the packets, for example, addressee and sender.

Certain MPAKs contain information used for communication between the Mobitex system and the terminals (mobile and fixed).

2 Physical Interface

Radio modems that use the MASC protocol for modem control come in several different physical designs. All of them share the same physical interface, namely the standard RS232/V.24. Some models may lack the usual RS232 connector, but they will have a similar function built into the interface. Please refer to the Interface Description for the radio modem that you intend to use, for details pertaining to the physical interface.

2.1 Data Transmission Rate and Format

The interface utilizes asynchronous, serial data transmission at rates of 1200, 2400, 4800 or 9600 bits per second (bps). It will support the following data format:

- one start bit, seven data bits, even parity, one stop bit.

In the radio modem, the transmission speed can be set by sending an F X-frame, see *3.4.28 F X, Change MASC Communication Parameters*.

2.2 Interface Signals

The communication port of the radio modem includes a limited number of CCITT V.24 signals.The following table shows the V.24 signals and their usage:

Signal	Usage
RxD	Radio modem data output to the PC
TxD	Radio modem data input from the PC
DTR	a. An active signal from the PC to this line forces a turned-off radio modem into the power-on state. b. RS232/V.24 DTR functionality
DSR	The radio modem activates this signal to denote that it is turned on.
RTS	The PC's software must activate this signal when it is ready to send data.
CTS	This signal is activated by the radio modem's software when it is ready to receive data from the PC.
RI	The radio modem activates this signal when it has data to be transferred to the PC, if the RTS signal from the PC is inactive. The signal can be used to activate a PC in stand-by mode.

In some models of the radio modem, the interface may also include other signals, whose function is described in the Interface Description for the individual type of radio modem.

2.3 Power Management

For specific power on/off procedures outside of those described below, please refer to the Interface Description that applies to the individual type of the radio modem.

2.3.1 Power On

Power is turned on by raising the DTR-signal in the physical interface. This is usually the case when any communication software is started.

2.3.2 Power Off

Power is turned off by sending an F O-frame to the radio modem from the PC. Please refer to *3.4.20 F O, Prepare to Close Down the Radio Modem* for further information.

3 MASC Protocol Description

The purpose of this chapter is to specify the MASC commands for the radio modem and to explain the actions to expect when using them.

3.1 The Link Layer

The link layer determines how data is transmitted between the radio modem and a PC. In the radio modem, the link layer is implemented as per the MASC interface.

The MASC protocol handles complete data packets, which are called MPAKs. Information is transferred between the radio modem and the PC in a frame format.

A frame is formed as a message packet with unique characters marking the beginning and end of the frame. Sending may be initiated either from the radio modem or from the PC. An information frame must be acknowledged before the next information frame is sent.

The MASC interface uses asynchronous, serial data transmission. Configurable bit rates are 1200, 2400, 4800 and 9600 bps. The initial value for a radio modem is configured at delivery and is provided by the equipment supplier. The value may be changed by an F X-frame, described later in this chapter.

The characteristics of the MASC protocol are:

- The MASC interface uses one start bit, seven data bits, even parity and one stop bit.
- All characters are coded into the seven least significant bits and bit no. eight is used for parity.
- Error control is done by longitudinal and character parity check and frame length control.
- Transparent data can be sent in the hexadecimal-coded data field.
- The protocol permits full duplex communication.

3.1.1 Protocol

The MASC interface is designed for connecting a PC to a radio modem. The PC must be capable of handling complete data packets (MPAKs). Information is transferred between the PC and the radio modem in the form of frames, as described in this chapter. Special commands of the MASC protocol are used for the control of the complete radio modem.

3.2 Frame Structure

There are two types of frames: *information* and *control frames*. Information frames are used to transfer commands and other information. Control frames are used to control the information frame flow.

3.2.1 Text Conventions

The following conventions are used in the figures describing the contents of frames:

- Lower case letters are used to show characters or character combinations, text or data, further described below the figure.
- UPPER CASE LETTERS are used where a specific letter or letter combination is to be used.
- SP always denotes the space character (hexadecimal 20).
- CR always denotes the carriage return character (hexadecimal 0D)

All characters as well as single digits or punctuation marks are inserted in the frames as ASCII-coded characters. See descriptions in connection with each frame.

3.2.2 Handling of Frames Unknown to the Application

If frames unknown to the application are sent from the radio modem to the PC, they must be acknowledged as other, known, frames. After acknowledgement, the unknown frames may be ignored by the application.

3.2.3 Control Frames

The MASC protocol consists of the following control frames:

ACK	Acknowledgement for an accurately received information frame.
NACK	Negative acknowledgement, an inaccurately received information frame.
RACK	Request for transmission of the previous ACK.
SENS	Link layer control.
SACK	SENS acknowledgement.

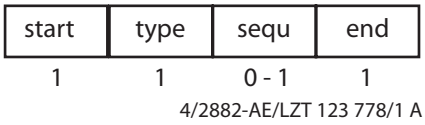


Figure 3 The control frames are divided into fields in accordance with the figure (the field length in number of bytes is stated below each field).

3.2.4 Information Frames

The information frames are divided into the following fields:

Figure 4 Fields in an information frame.

Note: The text field of a frame contains information concerning the use of the frame such as commands and parameters. Text and data to be transferred between different Mobitex terminals are always contained within the data field.

3.2.5 Description of Fields

Field	Description
start	The start of a frame is denoted by the ASCII circumflex character (^, hexadecimal 5E). All characters received before the start character should be ignored.
length	The size of the frame (number of bytes) should be written in this field with the ASCII codes of four hexadecimal digits. The least significant digit should always be written in byte 4. The size of the frame contains all bytes including the starting and ending characters. Characters permitted in the length field are: 0-9, A-F.

Field	Description
text	The text field contains the frame-significant command and its parameters. The text field consists of at least one character and a maximum of 256 characters coded as per international ASCII standard, ISO 646. Numeric information, for example command parameters, are always to be given as the ASCII codes of the corresponding hexadecimal digits 0-F. Characters permitted in the text field are: all between space (SP, hexadecimal 20) and brace (}, hexadecimal 7D), except for the std (:, hexadecimal 3A) and start (^, hexadecimal 5E) characters.
std	Start data. The text and data fields are separated by the colon character (:, hexadecimal 3A). std must be stated even if the data field is empty.
data	The data field consists of data. The data field is coded in hexadecimal code so that transparent data can be sent. Each byte of data to be sent is divided into half-bytes of four bits each. Each of these four-bit groups is then represented in the data field by the ASCII code of the corresponding hexadecimal digit 0-F. Thus, each input byte is represented by two characters (bytes) in the data field. See *Figure 5*. The data field consists of a maximum of 1,120 characters. Permitted characters of the data field are: 0-9, A-F.
check	A longitudinal checksum is calculated, by performing a Boolean exclusive OR operation on all characters starting with the start-character and ending with the last character before the check field. The check field consists of two ASCII-coded hexadecimal digits with the least significant digit in byte no. two. Characters permitted for the check field are: 0-9, A-F.
end	The frame is terminated with the carriage return character (CR, hexadecimal 0D). A frame which is not ended with the end-character is ignored.
type	The type of control frame is stated with one character. The characters used are: * (hexadecimal 2A), ? (hexadecimal 3F), ! (hexadecimal 21), # (hexadecimal 23) or & (hexadecimal 26).
sequ	The sequence number for ACK frames. The sequence number is one of the characters 0 (hexadecimal 30), 1 (hexadecimal 31) or - (minus sign, hexadecimal 2D).

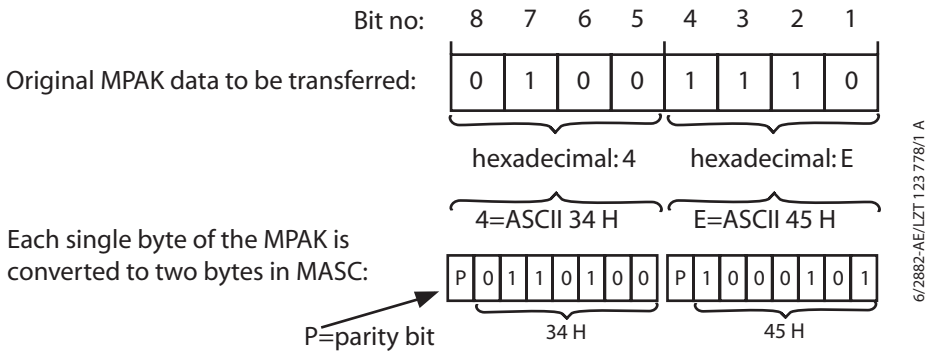


Figure 5 Example of a byte of data to be transferred by the Mobitex network (contents of an MPAK)

3.3 Description of the Control Frames

For use of the control frames, please refer to the examples in *chapter 6 Mobitex Dialogues*.

3.3.1 ACK, Acknowledgement

ACK is sent to acknowledge an accurately received information frame. An accurate information frame must comply with the following:

- Starts with character (^).
- Contains one colon (:).
- The fields *check* and *length* have the accurate values.
- Only permitted characters exist in the *text* and *data* fields.
- No character with parity error exists.
- The maximum number of characters has not been exceeded in any individual field or in the complete frame.
- Ends with the end character (CR).

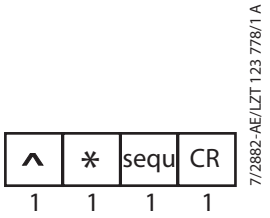


Figure 6 Structure of the ACK frame.

For each frame sent, the field sequ (sequence number) should alternate between the ASCII character 0 and the ASCII character 1, except when the latest ACK on a RACK request is repeated. In that case, the last value used is sent again.

The first time an ACK is sent, sequ should be the character 0. If a RACK is received before any ACK has been sent, the field sequ should contain the - (minus sign) character. sequ with the value of - (minus) is only used when the RACK is received prior to ACK being sent for the first time.

3.3.2 NACK, Negative Acknowledgement

NACK is sent if the conditions for sending ACK are not fulfilled and the information frame:

- Starts with character (^).
- Contains one and only one colon (:).
- Has a total length of 10 characters or more.
- Ends with the end character (CR).

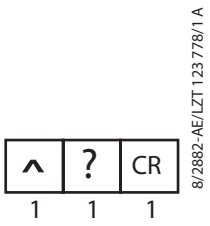


Figure 7 Structure of the NACK frame.

Should the criteria for sending ACK or NACK not be fulfilled, no reply will be given. The frame will then be repeated by the time-out function in the sending unit.

Note: If the receiving unit cannot handle the incoming data flow, NACK may be used to limit the flow.

3.3.3 RACK, Request for Repeat of the Last Sent ACK

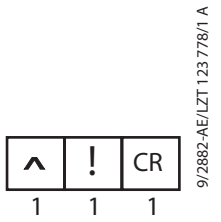


Figure 8 Structure of the RACK frame.

If no ACK is received within 10 seconds after an information frame has been sent, a RACK is to be sent. The unit receiving the RACK must reply by repeating the last sent ACK. The repeated ACK must contain the last sequence number (sequ) used.

3.3.4 SENS, Link Layer Control

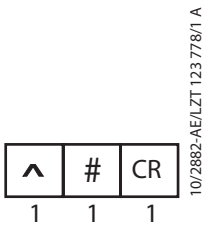


Figure 9 Structure of the SENS frame.

SENS is used to check the communication link when there is no traffic. The sender decides when SENS will be sent. The time between two SENS frames should be at least 10 seconds.

When a SENS is sent, a reply (SACK) will be received within 10 seconds. If no reply is received within 10 seconds, a new SENS will be sent. When two SENS have been sent and no reply is received or no information frame has been accurately transmitted, the communication link is considered to be broken. A restart must be done by sending an INIT frame. The restart will be initiated by the unit that sent the SENS.

If SACK is received and no SENS has been sent, the SACK will be ignored.

3.3.5 SACK, SENS Acknowledgement

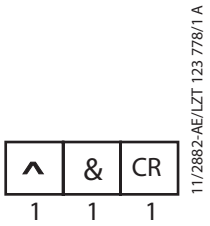


Figure 10 Structure of the SENS frame.

SACK will be sent when a SENS frame has been received.

3.4 Description of the Information Frames

Information frames are used to transfer commands and data between the PC and the radio modem. A description of each frame is given in the following pages.

Examples of use of the frames are given in *chapter 6 Mobitex Dialogues*.

The following table shows the frame types used in the radio modem.

Name	Description
B	Parameters for the MASC 1 protocol
D	Route received MPAKs from Mobitex network to an output
E	Error command or function
M	Send/receive MPAK by radio
N	Return of MPAK not sent
R	Return of incorrect MPAK
S	The PC sends an MPAK to a specified output port of the radio modem
F	F-Commands, System Control
F A	Power save mode function
F B	Change to Mobitex operation mode
F F	Contact with the Mobitex network
F G	No contact with the Mobitex network
F H	MPAK sent by radio to the network
F I	Cancel previous transmission of MPAK

Name	Description
F J	Print out current MANs from terminal
F K	Error message
F L	Activate external call indication
F M	Transmitter on/off
F N	Change to MANUAL RADIO mode
F O	Prepare to close down the radio modem
F P	Terminal MAN request/answer
F Q	MASC device identity
F R	Change network identification
F S	Change of traffic area
F T	Change TEMP_DEFAULT_LIST
F U	Power control of separate radio transceiver module
F W	Configuration of CCITT-V.24 RLSD (DCD) signal
F X	Change MASC communication parameters
F Y	Battery saving mode control
F Z	Product information request/answer
F 01	Request/List network contact status
F 02	Request/List subscription information
F 03	Change network request/reply
F 04	Mobitex Time Packet Filter
QA01	Request/List AREA LIST information (8 kbps only)
QA02	Request/List roaming parameters (8 kbps only)
QA03	Request/reply radio modem locking to specific up and down channel numbers
F !	Change operation mode
P	P-Command, Request/List Parameters
PA01	Request/List radio parameters
PA02	Request/List identity parameters
PA03	Request/List channel parameters
PA04	Request/List power control parameters
PA05	Request/List roaming parameters
PA06	Request/List test parameters
PA07	Request/List battery saving protocol parameters

Name	Description
PA09	Request/Reply INVALID_LIST parameters
PA10	Setting the MODE/SKIPNUM parameters
K	Receive/Transmit Frequency Number
KA	Set/Receive transmit frequency band and numbers

In the following pages, the frames are described in the same order as they are listed above.

Note: In the following description, only the text and data fields of the frames are described.

The contents of the remaining fields are described in the Frame structure of this chapter.

3.4.1 B-command, Parameters for the MASC 1 Protocol

The B-command is used to set communication parameters for the MASC 1 protocol.

Direction: Radio modem to PC

PC to Radio modem

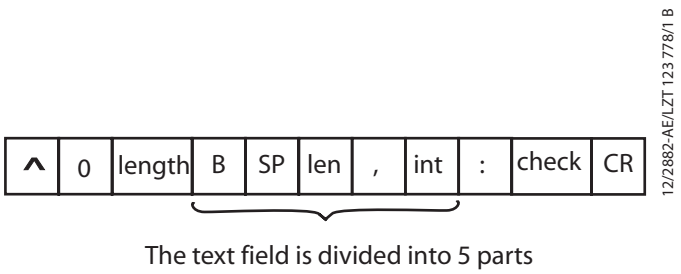


Figure 11 Structure of the B-command text field. The data field is empty.

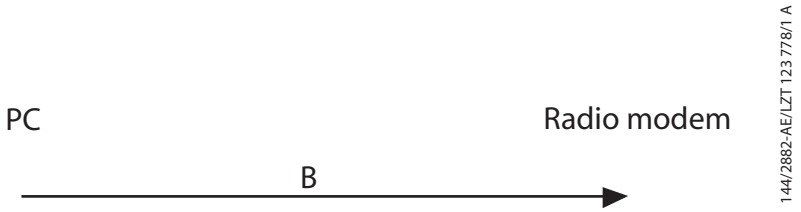


Figure 12 Direction of the B-command.

len — is a 3-digit ASCII-coded hexadecimal number which sets the maximum length of an information frame. Always set this field to the maximum possible frame size, i.e., hexadecimal 47E (1150 decimal).

, — len and int are separated by a , (comma).

int — is a 4-digit ASCII-coded hexadecimal number which sets the shortest time between two consecutive information frames. The value is given in 10 ms increments. If the value is not specified, the current timing value has to be used. The default value is 0 (zero, hexadecimal 30).

The default values are used until a B-command has been received. A B-command should be the first frame sent after start-up.

After receiving a B-command, the protocol should send a start_of_line signal to a higher protocol, to make clear that the connection is established and that the start sequence can follow.

Start_of_line signal is an internal signal between the link layer and higher layer.

3.4.2 D-command, Route Received MPAKs from Mobitex Network to an Output

Direction: PC to Radio modem

This command is only required in radio modems with more than one communication port.

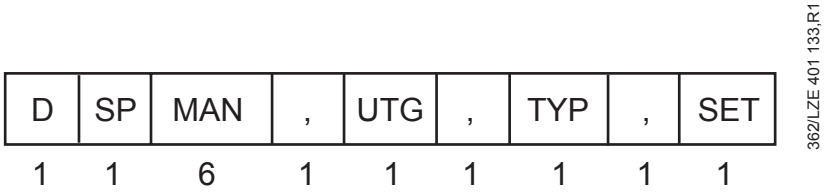


Figure 13 Structure of the D-command text field. The data field is empty.

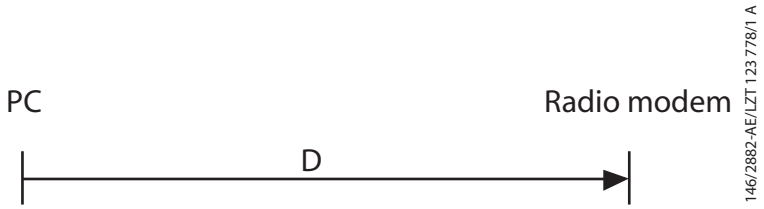


Figure 14 Direction of the D-command

MAN	is a 6 digit ASCII coded hexadecimal number stating the MAN for which MPAKs are to be routed to output UTG. The MAN must be one of the possible MANs of the terminal (terminal MAN, group MAN or personal MAN).
UTG	is a single digit ASCII coded hexadecimal number stating the output to which received MPAKs are to be routed.
TYP	is a single digit ASCII coded hexadecimal number stating the type of MPAK which is to be routed to UTG.
SET	sets/resets these parameters.

UTG and TYP to be used as follows:

UTG =	0	default output
	1	printer
	3	alert
	4	terminal device: 1 (MASC protocol)
	5	terminal device: 2
	6	terminal device: 3
	7	terminal device: 4
	8	terminal device: 5
	9	terminal device: 6
TYP =	0	no types (reset all)
	1	text
	2	data
	3	status
	5	alert
	6	all types except alert
	7	extpak
	8	hpdata
	9	dteserv
SET =	0	set these parameters
	1	reset these parameters

After receiving the D-command, the radio modem will route incoming MPAKs (from the Mobitex network) of the specified type which are intended for the specified MAN to the function block which handles the communication (formatting etc.) for the specified output. Thus it is possible to route MPAKs to several outputs, that is, to both printer and terminal.

When receiving a D-command with UTG = “default output”, the radio modem resets all earlier D-commands for the specified MAN and specified TYP. If, for example, the TYP is *all types*, all earlier D-commands concerning this specified MAN are reset and all types are sent to default output connection. If TYP is *no types*, then all types is reset for this MAN and UTG.

It is possible to set or reset an earlier D-command, using the parameter set or reset.

The radio modem is responsible for removing the personal subscriptions from both the flexlist (network layer) and the routing table. This is done when the PC sends a logout.

When the power is switched on, the radio modem sets up default outputs, that is, text, data and status to terminals.

All MPAK:DTESERV are routed to output, where terminal MAN is located (may be more than one).

3.4.3 E-command, Error Command or Function

Direction: Radio modem to PC

PC to Radio modem

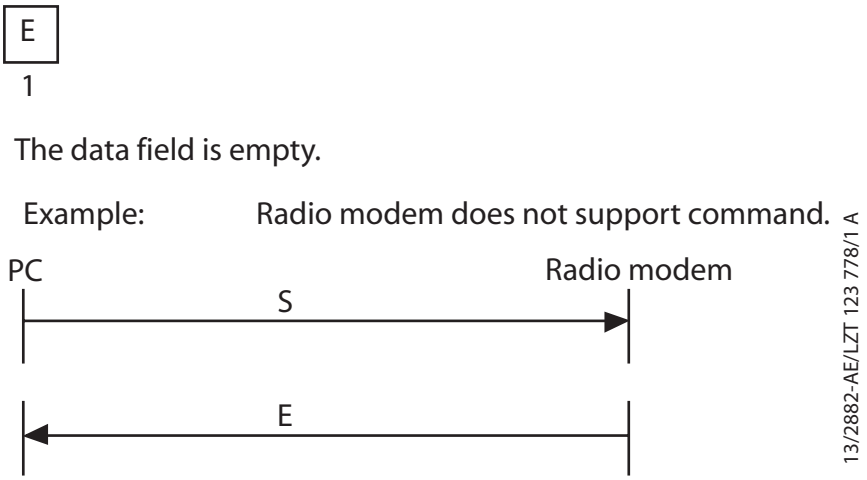


Figure 15 Structure of the text field and direction of the E-command.

The data field may be used to send information about the error.

This data field is a free format field with the limitations of the data field in the physical frame. The E-command data field can be used by an application.

The E-command indicates that the previously received command or function cannot be executed. (Command or function is not implemented by the receiving unit or included parameters are not accepted).

Note: Refer to *chapter 3.4.52 Network Status and Error Messages*, for other error messages.

3.4.4 M-command, Send/Receive MPAK via Radio

Direction: Radio modem to PC

PC to Radio modem

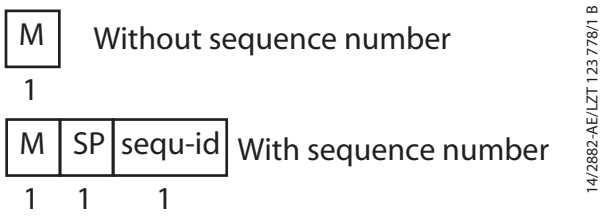


Figure 16 Structure of the M-command text field.

SP indicates that a sequence number identity is added. If there is no SP then there is no sequ-id.

sequ-id is a 1-digit ASCII-coded decimal number between 0 and 9. This sequence number is the identity of the MPAK.

Figure 17 Structure of the M-command data field.

Note: A description of the different MPAKs can be found in *chapter 5 MPAK Protocol Description - Packet Formats*.

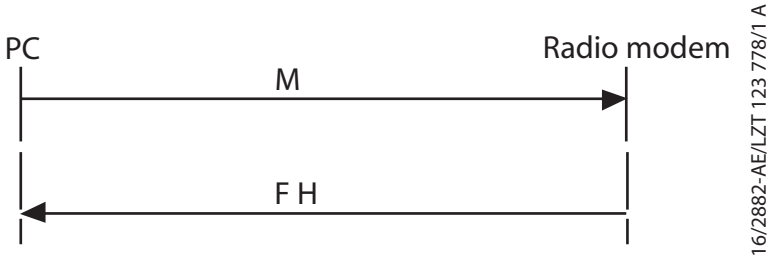


Figure 18 Direction of M-command without sequence number.

MPAK received via the radio path, are sent over the interface to the PC with the M-command (MAN is included in MPAK). The sequence number is not used in this M-command.

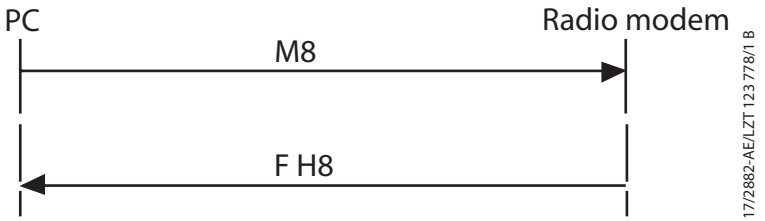


Figure 19 Direction of M-command with sequence number.

The radio modem receiving the M-command sends MPAK via the radio path to the network. If the M-command contains a sequence number, the command F H indicating “sent to Mobitex network” is sent to the PC, together with the sequence number. Returned MPAK should also indicate sequence number.

The received MPAK (to be sent via the radio path) should be a permitted MPAK containing valid information in the MPAK head and MPAK length (sender, trafstate, class, packet type, size of MPAK).

3.4.5 N-command, Return of MPAK Not Sent

Direction: Radio modem to PC

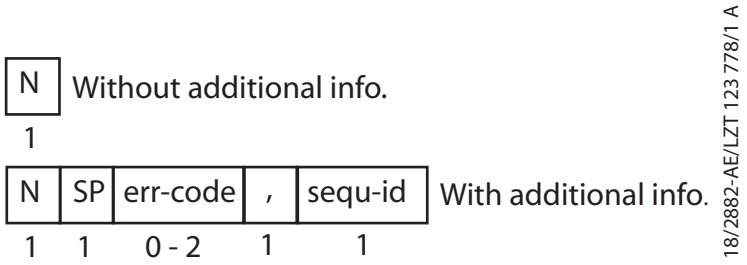


Figure 20 Structure of the N-command text field.

SP	indicates that an error code and/or a sequence number is added. If there is no SP then there is no error code or sequence number.
err-code	is a 2-digit ASCII coded hexadecimal number between 00 and FF. Error codes are described in *3.4.52 Network Status and Error Messages*.
sequ-id	is a 1-digit ASCII coded decimal number between 0-9. This sequence number is an identity of the MPAK.

Figure 21 Structure of the data field for the N-command.

In manual mode MPAKs should be returned by the N-command.

Note: A description of the different MPAKs can be found in *chapter 5 MPAK Protocol Description - Packet Formats*.

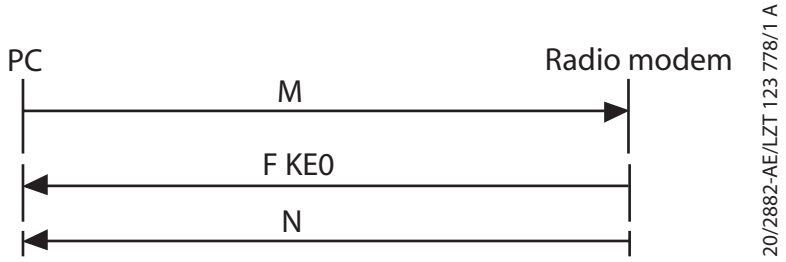


Figure 22 Direction of N-command without sequence number.

If no sequence number is used, the radio modem has to send an F K-command containing the appropriate error code, followed by the returned packet in an N-frame. The N-command indicates to the PC that the MPAK has not been sent by radio (communication failure or transmission interrupted by F O- or F I-command). The radio modem can indicate the reason for not sending the MPAK over the radio, by adding the error code.

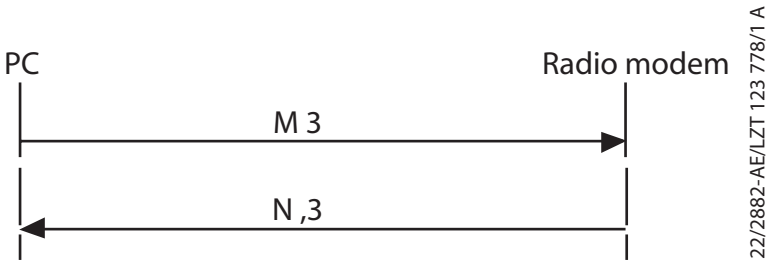


Figure 23 Direction of N-command with sequence number, no error code.

If a sequence number (sequ-id) is indicated in the M-frame, then this sequence number should also be in the N-frame.

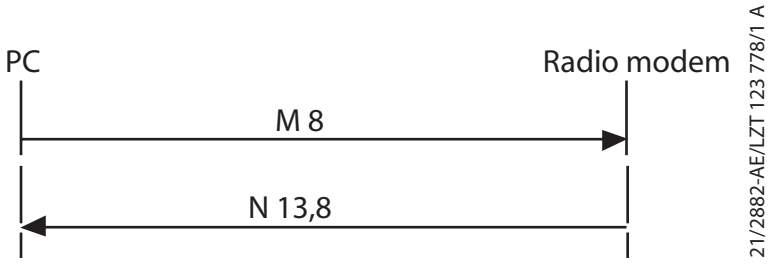


Figure 24 Direction of N-command with sequence number and error code.

When a sequence number is used in the M-frame, the radio modem will only return the packet in an N-frame containing the appropriate error code and sequence number.

If no error code or sequence number is valid, this parameter is not added.

3.4.6 R-command, Return of Incorrect MPAK

Direction: Radio modem to PC

If an R-command is received and no fault is found, the receiving unit is supposed to carry out a restart by sending an INIT frame or a B-command.

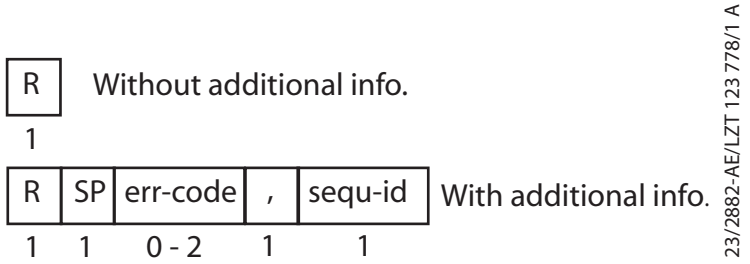


Figure 25 Structure of the R-command text field.

SP	indicates that an error code and a sequence number are added. If there is no SP then there is no error code or sequence number.
err-code	is a 2-digit ASCII coded hexadecimal number between 00 and FF. Error codes are described in *chapter 3.4.52 Network Status and Error Messages*.
sequ-id	is a 1-digit ASCII coded decimal number between 0-9. This sequence number is an identity of the MPAK.

If no sequence number is used, the radio modem will send an F K-command containing the appropriate error code, followed by the returned packet in an R-frame.

Figure 26 Structure of the data field for the R-command.

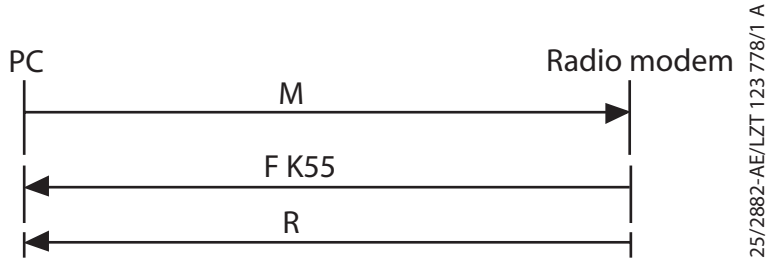


Figure 27 Direction of R-command without sequence number

The radio modem uses the R-command to return an MPAK which was received with the M-command and which does not comply with the format and the rules set by the network and link layers of Mobitex terminals.

The radio modem can indicate the reason for not accepting the MPAK by adding the error code.

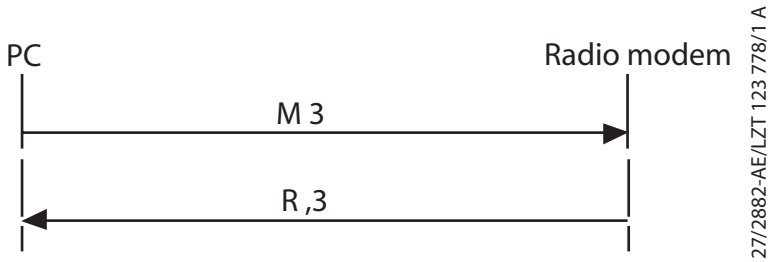


Figure 28 Direction of R-command with sequence number, no error code

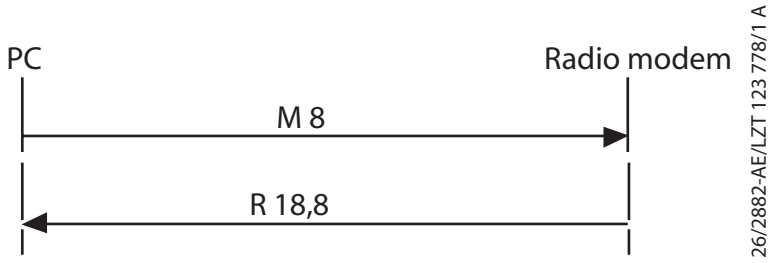


Figure 29 Direction of R-command with sequence number and error code.

When a sequence number (sequ-id) is used in the M-frame, the radio modem will only return the packet in an R-frame containing the appropriate error code and sequence number.

3.4.7 S-command, The PC sends an MPAK to a specified output port of the radio modem

Direction: PC to Radio modem

This command is only required in radio modems with more than one communication port.

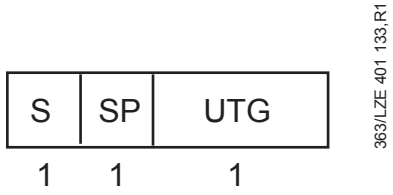


Figure 30 Structure of the S-command text field.

Figure 31 Structure of the data field for the S-command.

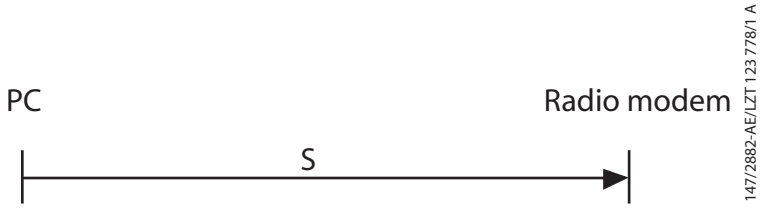


Figure 32 Direction of the S-command.

UTG is a single digit ASCII coded hexadecimal number which states to which output MPAK is to be sent.

When receiving the S-command, the radio modem sends MPAK to the output stated by UTG.

The parameter UTG is to be used as follows:

UTG =	0	direct to default output
	1	printer
	3	alert
	4	terminal device: 1 (MASC protocol)
	5	terminal device: 2
	6	terminal device: 3
	7	terminal device: 4
	8	terminal device: 5
	9	terminal device: 6
	A	
	B	
	C	
	D	
	E	
	F	printer, without printing the MPAK-head

Note: When the parameter UTG = F, the data field consists of printable information except the MPAK-head. The printer should ignore the MPAK-head, this means that the information starts in byte 12.

3.4.8 F- commands, System Control

The F-command is used by a terminal device to execute the specified function in the radio modem. The F-command is used by the radio modem to send information to the terminal.

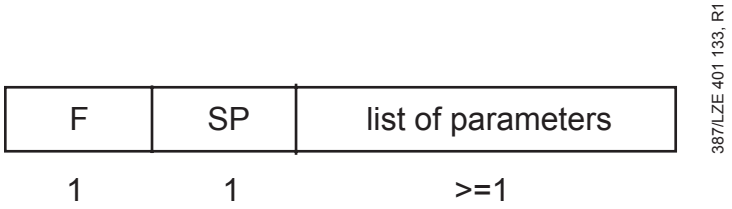


Figure 33 Structure of the F-command text field.

The data field is used only in the F T and F # commands with lists of channel numbers and short numbers.

The list of parameters is composed by the second ASCII character (following the space “SP”) defining the function, plus a sequence of optional parameters in ASCII code as shown below.

3.4.9 F A, Power Save Mode Functions[1]

Direction: Radio modem to PC

PC to Radio modem

The F A-command is used for:

- Power saving mode information (applies to portables)
- Request/reply of roaming value
- Request/reply of battery status
- Request/reply of external power supply status
- Request/reply power supply status on separate transceiver module (only used in non-integrated products)

1.For a description of the power saving mode, see *chapter 7 Important Mobitex Functions*.

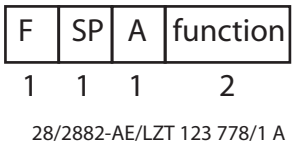


Figure 34 Structure of the text field in the F A-frame, from the PC to the radio modem.

Parameters: TYPE_OF_REQUEST, VALUE

Requests from the PC:

Function	Description
01	Request of Power saving mode information
02	Request Roaming value
03	Request radio modem battery level of a non-integrated product, or whole radio modem battery level of an integrated product
04	Request of external battery status
05	Request radio transceiver battery level (only used in non-integrated products with separate radio modem and radio transceiver)

The roaming value is the average received signal strength indication in the radio modem's radio receiver.

Note: To change the power saving mode, an M-frame including the MODE MPAK or the F Y-command must be used.

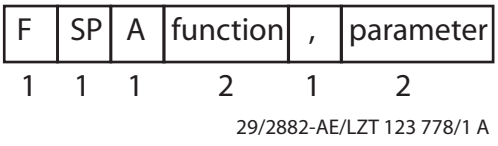


Figure 35 Structure of the F A-frame text field, from the radio modem to the PC. The data field is empty.

Reply from the modem:

Function	Description	Parameter
01	Power saving mode information	01 = Normal mode 02 = Power saving mode
02	Roaming value	RSSI average value, as an ASCII coded hexadecimal number. 00-FF in dBμV emf units.
03	Radio modem battery indication	Radio modem battery value, as an ASCII coded hexadecimal number 00-64, equals 0 to 100% of full battery indication. If the product does not use an internal battery, number 64 should be returned.
04	External battery indication	External battery value, as an ASCII coded hexadecimal number 00-64, equals 0 to 100% of full battery indication.
05	Radio transceiver battery indication	Radio transceiver battery value, as an ASCII coded hexadecimal number 00-64, equals 0 to 100% of full battery indication.

Note: The radio modem inform the PC, with an F A01 indication whenever the radio has changed operating mode.

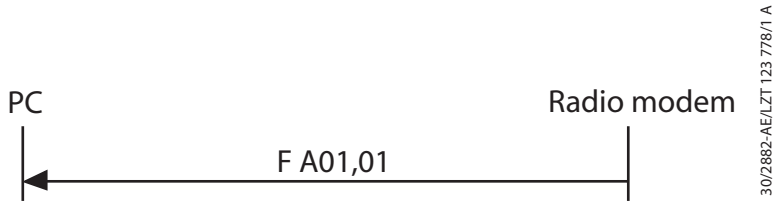


Figure 36 Protocol information from the radio modem.

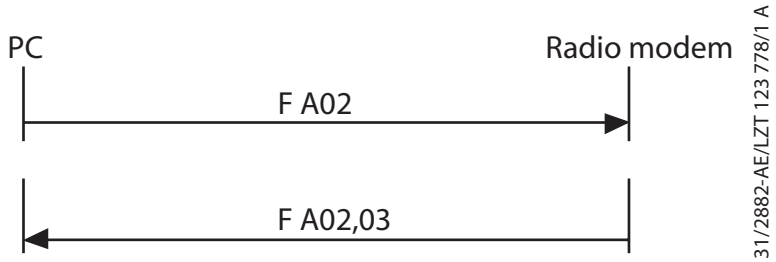


Figure 37 Request RSSI value from the radio modem.

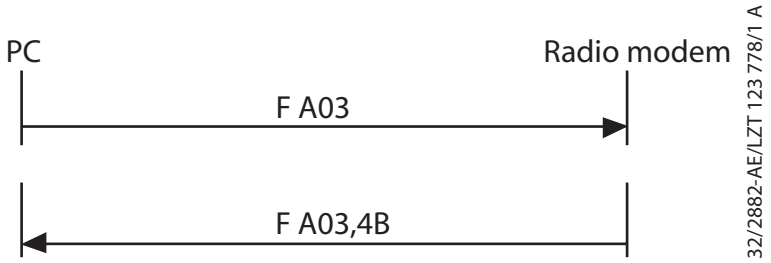


Figure 38 Request battery charge level from the radio modem.

3.4.10 F B, Change to Mobitex Operation Mode

The radio modem sends an ACTIVE packet to the network. This command is used to activate a radio modem when changing from manual radio mode to the Mobitex network.

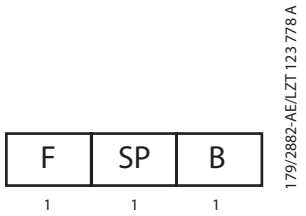


Figure 39 Structure of the F B-frame text field. The data field is empty.

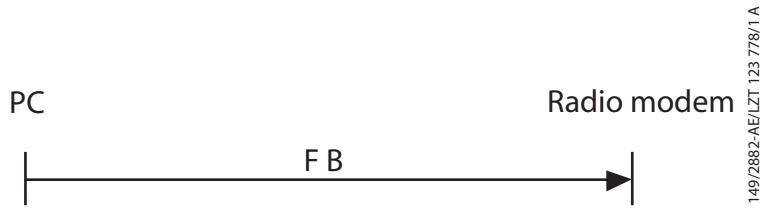


Figure 40 Direction of the F B-frame.

3.4.11 F F, Contact with the Mobitex Network

Direction: Radio modem to PC

The radio modem is in contact with the Mobitex network.

Figure 41 Structure of the F F-frame text field. The data field is empty.

Figure 42 Direction of the F F-frame.

3.4.12 F G, No Contact with the Mobitex Network

Direction: Radio modem to PC

The radio modem has no contact with the Mobitex network and is trying to establish contact again (roaming procedure started).

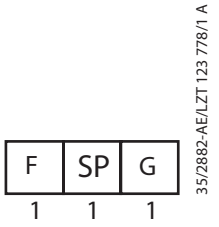


Figure 43 Structure of the F G-frame text field. The data field is empty.

Figure 44 Direction of the F G-frame.

3.4.13 F H, MPAK Sent by Radio to the Network

Direction: Radio modem to PC

Parameter: sequ_id

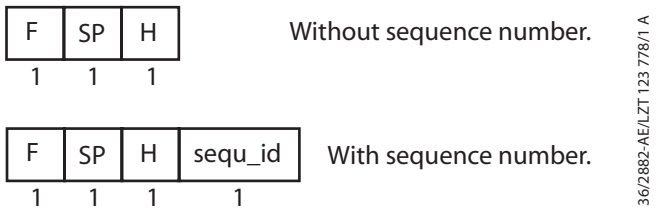


Figure 45 Structure of the F H-frame text field. The data field is empty.

sequ_id is a 1-digit ASCII coded decimal number between 0 - 9

Figure 46 Direction of the F H-frame.

Figure 47 Direction of the F H-frame with sequence number.

The radio modem informs that MPAK has been sent to the network. The parameter sequ-id is added if sequ-id was included in the M-command.

3.4.14 F I, Cancel Previous Transmission of MPAK

Direction: PC to Radio modem

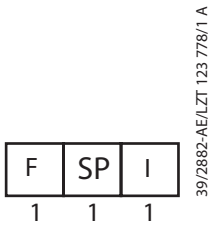


Figure 48 Structure of the F I-frame text field. The data field is empty.

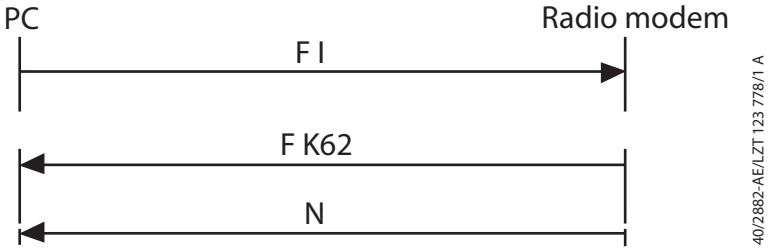


Figure 49 Direction of the F I-frame.

Previously activated transmission of MPAK is cancelled. The MPAK is to be returned to the terminal by an N-command.

If this command is sent from the PC after the radio modem has transmitted the MPAK to the network, the radio modem will answer with either an N-command (not acknowledged by the Mobitex network) or an F H-command (accepted by the network). If this command is sent from the PC and there are no MPAKs in the transmit buffer, the radio modem will respond with an F H-command.

If no MPAK has been sent to the radio modem and the application sends an F I-command the response from the radio modem should be F H.

3.4.15 F J, Print Out Current MANs from Terminal

Direction: PC to Radio modem

Print current MANs in terminal on printer (terminal subscription MAN, group MANs (group_list) and personal subscription MANs (flex_list) in that order. The F K-command may sporadically be sent from the radio modem to the PC on detection of errors.

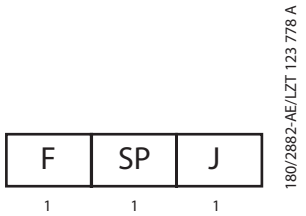


Figure 50 Structure of the F J-frame text field. The data field is empty.

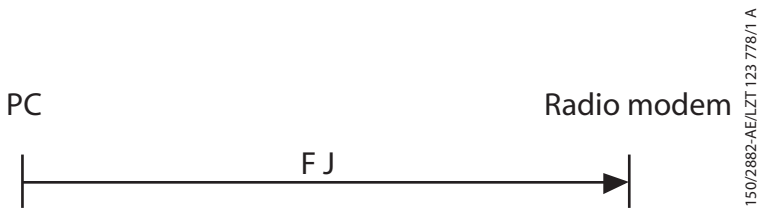


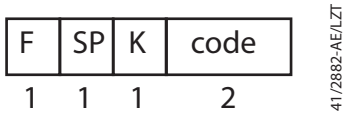
Figure 51 Direction of the F J-frame.

3.4.16 F K, Error Message about a Fault Situation

Direction: Radio modem to PC

Parameter: code

Error message where code is the error number in ASCII coded hexadecimal digits 00 - FF (0-255).



41/2882-AE/LZT 123 778/1 A

Figure 52 Structure of the text field for the F K-command, from the radio modem to the PC.
The data field is empty.

code — The error codes are listed in *3.4.52 Network Status and Error Messages*.

42/2882-AE/LZT 123 778/1 A

Figure 53 Direction of the F K-command.

Note: The F K-command is used when it is not possible to return the error code in the N-command.

3.4.17 F L, Activate External Call Indication

Direction: PC to Radio modem

Activate external indication (that is, horn) for 2 seconds.

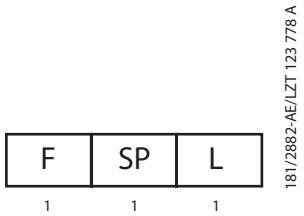


Figure 54 Structure of the text field. The data field is empty.

Figure 55 Direction of the F L-command.

3.4.18 F M, Transmitter on/off

Direction: PC to Radio modem

Parameter: x

Function	Description
01	Transmitter off
02	Transmitter on

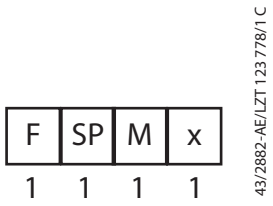


Figure 56 Structure of the F M-command text filed. The data field is empty.

Figure 57 Direction of the F M-command.

Note: When the radio modem's transmitter is turned off, the radio modem, if required, will follow the same roaming algorithm and select the best base station. However, the radio modem will not attempt to transmit either ROAM or ACTIVE, or any other packets, when a cell change is performed.

When the radio modem transmitter is inhibited the radio modem has to discard received M-frames from the network and must not present them to the PC, except when the M-frames are addressed to a group subscription MAN or the all terminals group MAN.

Packets received from the PC during transmitter off has to be returned to the PC in an N-frame with the error code set to F8. When the radio transmitter is turned on again, it will transmit either an ACTIVE or ROAM packet to the network, as described in the roaming algorithm. The state of the transmitter will be stored at power down.

3.4.19 F N, Change to MANUAL RADIO Mode

Direction: PC to Radio modem

The radio modem sends an INACTIVE packet to the network. This command is used to deactivate a radio modem in the Mobitex network when changing to an other radio mode.

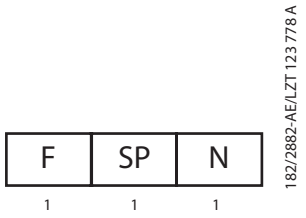


Figure 58 Structure of the F N-command text field. The data field is empty.

Figure 59 Direction of the F N-command.

3.4.20 F O, Prepare to Close Down the Radio Modem

Direction: PC to Radio modem

Radio modem to PC

This command is used to properly shutdown the radio modem.

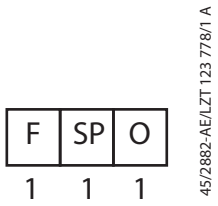


Figure 60 Structure of the F O-command text field. The data field is empty.

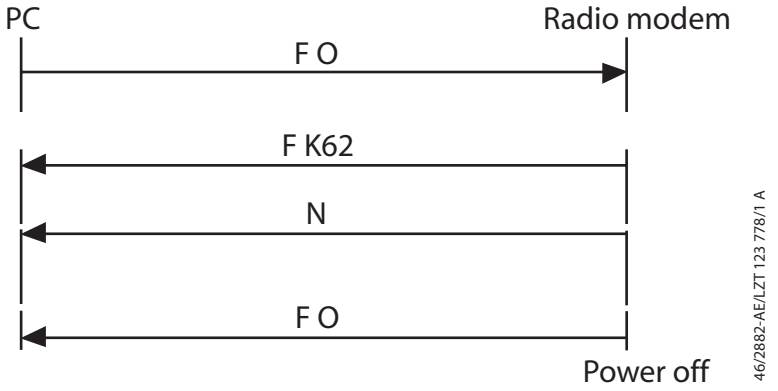


Figure 61 Direction of the F O-command.

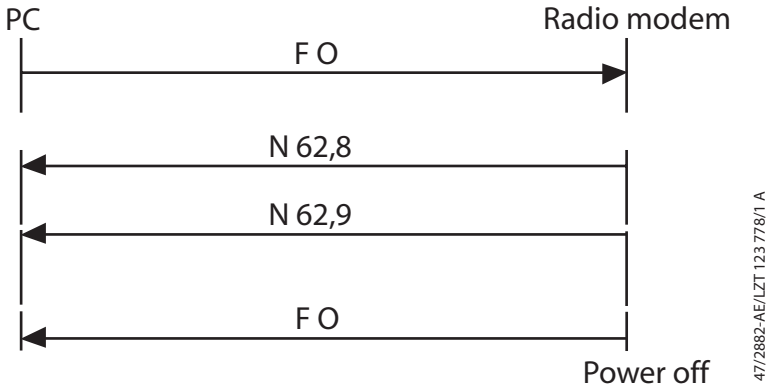


Figure 62 Direction of the F O-command.

From the terminal: Command to prepare closing down (switching off) the radio modem The radio modem clears buffers of stored MPAKs. An MPAK currently being transmitted to the network will be completed. All other MPAKs will be returned to the terminal via the N-command.

If there is no contact with the network, MPAKs to the network are returned by the N-command. The radio modem will store its network layer parameters, i.e., DIE/ LIVE state, GROUPLIST, FLEXLIST, AREALIST. Then the radio modem sends an INACTIVE packet to the network. Finally the radio modem confirms that its buffers are empty by sending an F O-command to the terminal.

From the radio modem: The radio modem's buffers are empty and the modem is powered down.

Note: If more than one device is connected, the F O-command from the radio modem should be sent to all devices.

3.4.21 F P, Terminal MAN request/answer

Direction: Radio modem to PC

PC to Radio modem

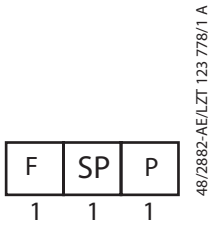


Figure 63 Structure of the F P-frame text field, from the PC to the radio modem. The data field is empty.

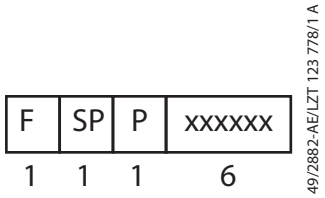


Figure 64 Structure of the F P-frame text field, from the radio modem to the PC. The data field is empty.

F P — Request from the terminal subscription MAN.
When the F P-command is sent during the initialization process, the radio modem will return the F Q-command, followed by the GROUPLIST and FLEXLIST.
When the F P-command is sent any time, but not during the initialization process, the radio modem will only return the appropriate MAN response.

F Pxxxxxx — Terminal subscription MAN from the radio modem to terminal as response to the request.
xxxxxx is the MAN as a 6 digit ASCII coded hexadecimal number.

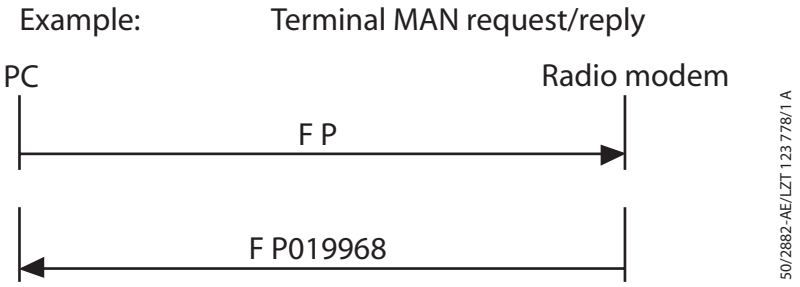


Figure 65 Direction of the F P-frame.

At start-up, after responding on the F P request by sending F Pxxxxxx, the radio modem may spontaneously inform the application about, for example, MASC device identity, GROUPLIST, FLEXLIST etc.

3.4.22 F Q, MASC Device Identity

Direction: Radio modem to PC

Parameter: xxx

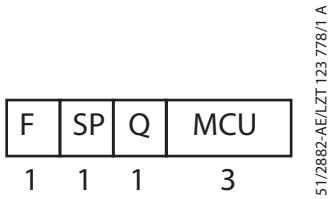


Figure 66 Structure of the F Q-frame text field. The data field is empty.

Figure 67 Direction of the F Q-command.

Type of device handling the MASC protocol. F Q (MASC_DEVICE) is information to other units connected to this MASC interface.

xxx = MCU
xxx = MOX

3.4.23 F R, Change Network Identification

Direction: PC to Radio modem

Parameters: xxxx
yyyy

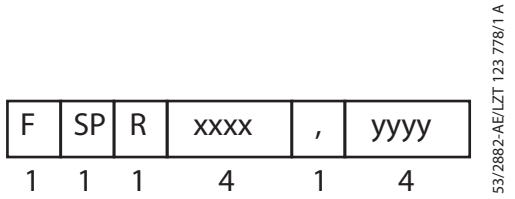


Figure 68 Structure of the text field for the F R-command. The data field is empty.

xxxx is new network_ID for mobile tx in ASCII coded hexadecimal number

yyyy is new network_ID for mobile rx in ASCII coded hexadecimal number

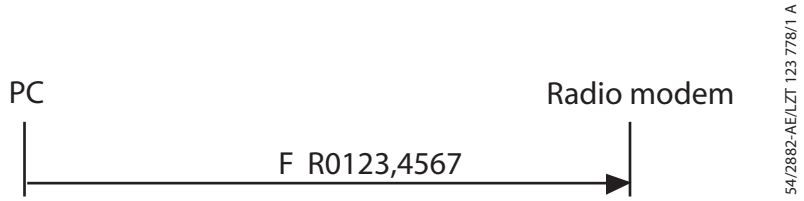


Figure 69 Direction of the F R-command.

Note: The F R-command is to be used to indicate a change of network ID. If more than one set of parameters is prestored with the same network ID or the network ID cannot be recognised by the radio modem, the radio modem will invoke a standard list of parameters and channels if available. If the standard list is not available, the last set of parameters will be used.

3.4.24 F S, Change of Traffic-Area

Direction:	Radio modem to PC
Parameters:	outside command

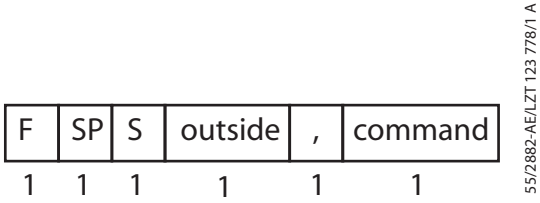


Figure 70 Structure of the text field for the F S-command. The data field is empty.

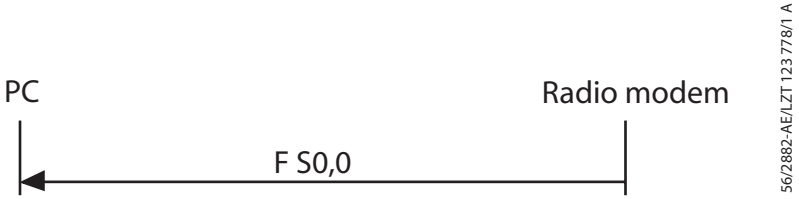


Figure 71 Direction of the F S-command.

Indication given by the radio modem when the modem enters or leaves subscribed traffic area. At start-up the radio modem has to indicate:

F S0,0	When entering a subscribed traffic area and the mobile terminal is only allowed to access subscribed traffic areas.
F S0,1	When entering a subscribed traffic area, the mobile terminal is allowed to access all traffic areas, but may be charged a different fee when outside the subscribed traffic areas.
F S1,0	When no subscribed traffic area is available and the mobile terminal is only allowed to access subscribed traffic areas.
F S1,1	When no subscribed traffic area is available and the mobile terminal is allowed to access all traffic areas, but may be charged a different fee when outside the subscribed traffic areas.

During continuous operation, the F S indication will be sent when there is a change in the traffic area status, that is, when changing between two subscribed traffic areas F S will not be indicated.

Note: No F S indication will be sent when the modem goes in or out of coverage on the same base station.

outside = 0	The mobile terminal has entered a subscribed traffic area.
outside = 1	The mobile terminal has left a subscribed traffic area.
command	See definition of AREALIST in *5.3.20 AREALIST*

The PC cannot request the status of the valid area.

The F S1,x response will only be used for actions where the radio modem actually roams out of a subscribed traffic area (for example, the case where the AREALIST of the radio modem is restricted). An out-of-coverage condition should not initiate an F S1,x since there is no traffic area change.

The F S1,x will be used each time the radio modem sends an F F-command, or does a seamless roaming into a new traffic area.

The F S-command value will match the AREALIST of the radio modem command value. The default value is 1.

3.4.25 F T, Change TEMP_DEFAULT_LIST

Direction:	PC to Radio modem
Parameters:	tnum num Optional channels

This command is used to initiate, activate and deactivate the temporary default list in the radio modem.

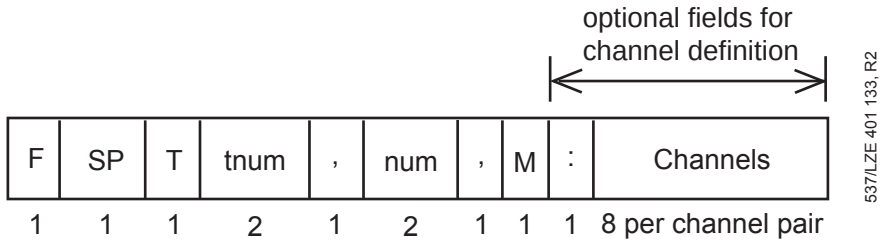


Figure 72 Structure of the text field for the F T-command.

tnum	Total number of channel pairs in the temporary default list. If tnum is zero, inactivate and delete the temporary default list and return to the default list.
num	Number of channel pairs defined in this command (num =tnum).
M	0= No more channels are defined in the next command. If tnum>0 the use of the temporary default list is activated. 1= Not used. 2= The temporary default list is used as a replacement for the default list. If more channels are to follow in the subsequent F T-commands, each subsequent F T-command will have the same M value (i.e. M=2). 3= The temporary default list is used in addition to the default list. If more channels are to follow in the subsequent F T-commands, each subsequent F T-command will have the same M value (i.e. M=3).
Channels	Channels in the list are given in pairs and in order of up-channel and down-channel (no comma between two consecutive channels). Channels are only defined when M=2 or M=3.

Both upfreq and dofreq must be specified for each channel.

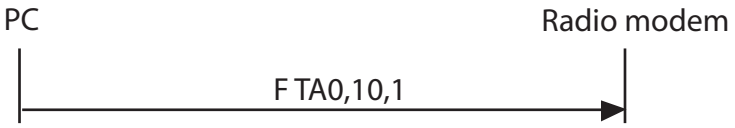


Figure 73 Direction of the F T-command Use new TEMP_DEFAULT_LIST.

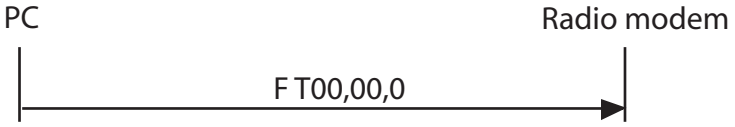


Figure 74 Direction of the F T-command Delete TEMP_DEFAULT_LIST.

The scanning mode of the channel lists can be set up in two ways. The temporary default list can either be used in replacement of the default list or it can be used in addition to the default list. An F T-command with M=0 must be supplied to indicate the end of the channel list, regardless of whether num is equal or less than tnum.

Parameters tnum, num and M are in ASCII coded hexadecimal digits. The list itself is sent in the data field of the frame.

The data field (channels) includes the channel list. Each channel occupies two bytes (four ASCII coded hexadecimal characters). The channels are entered in terms of channel numbers and are ordered as follows:

1	Channel #1 upfreq (the frequency used to send to the base station)
2	Channel #1 dofreq (the frequency used to receive from the base station)
3	Channel #2 upfreq
4	Channel #3 dofreq
5	etc.

Note: When tnum = 0, both num and M has to be set to zero.

Example 1, The temporary default list is initiated.
F T03,03,2:01E60E1601E70E1701E80E18

Example 2, The temporary default list is activated.
F T,03,00,0

Example 3, The temporary default list is deactivated and deleted.
F T,00,00,0

3.4.26 F U, Power Control of Separate Radio Transceiver Module

Direction: PC to Radio modem

Radio modem to PC

Parameters: TYPE_OF_REPLY or TYPE_OF_COMMAND

This command is used to request the radio transceiver power ON/OFF(STANDBY) status, and to command the radio transceiver to switch ON or OFF(STANDBY). The F U-command is only used with non-integrated radio modem products (with separate radio transceiver module).

Status request from the PC

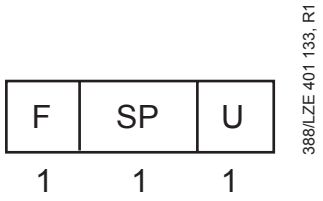


Figure 75 Structure of the F U-command text field in request from the PC to the radio modem.

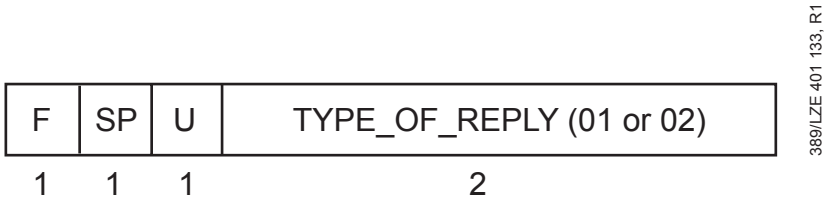


Figure 76 Structure of the F U-command text field in reply from the radio modem to the PC.

TYPE_OF_REPLY	Description
01	Radio transceiver ON
02	Radio transceiver OFF (STANDBY)

PC command to switch the radio transceiver power ON or OFF (STANDBY).

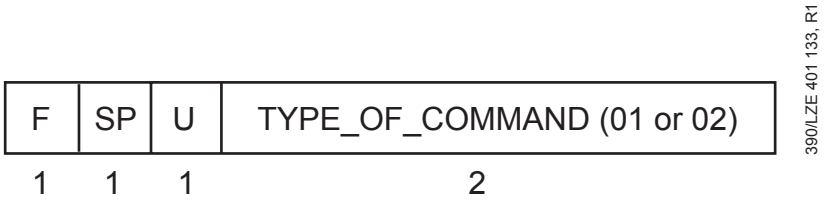


Figure 77 Structure of the F U-command text field in a switch command from the PC to the radio modem.

TYPE_OF_COMMAND	Description
01	To switch radio transceiver ON
02	To switch radio transceiver OFF (STANDBY)

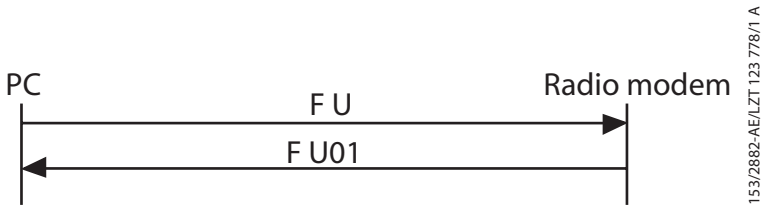


Figure 78 Direction of the F U-command.

On the reception of a OFF (STANDBY) state F U-command order from the PC, the RM should send an INACTIVE packet to the network before it turns the radio transceiver module to OFF (STANDBY) state. The RM should send an ACTIVE packet to the network on the reception of an ON F U-command order after the radio transceiver module is turned on.

3.4.27 FW, Configuration of CCITT-V.24 RLSD (DCD) Signal

Direction:	PC to Radio modem
	Radio modem to PC
Parameter:	TYPE_OF_CONFIGURATION

This command is used by the PC to configure the CCITT-V.24 “RECEIVE LINE SIGNAL DETECTOR” (RLSD) signal also commonly known as “DATA CARRIER DETECT (DCD), in the radio modem, and to request the current configuration of the RLSD signal. If the RLSD signal or command is not implemented, the radio modem should send the E-command as a response.

Configuration status request from the PC

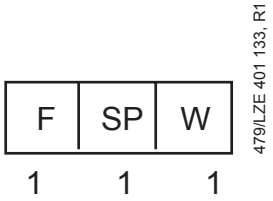


Figure 79 Structure of the F W-command text field in request from the PC to the radio modem.

Answer from the radio modem:
RLSD signal configuration command from the PC:

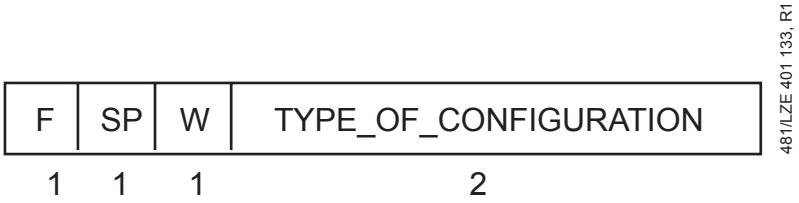


Figure 80 Structure of the F W-command text field in command from the radio modem to the PC.

TYPE_OF_CONFIGURATION	Description
00	No condition (always asserted)
01	Network coverage status (asserted only when the radio modem is in coverage)

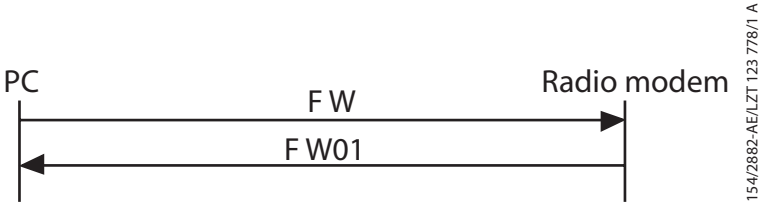


Figure 81 Direction of the F W-command.

3.4.28 F X, Change MASC Communication Parameters

Direction: PC to Radio modem

Radio modem to PC

The F X-command is used for setting the data bitrate on the MASC interface between the radio modem and the PC when the link is in operation.

The PC requests a new bitrate by sending an F X-command (F X-request) and the radio modem answers with an F X-command (F X-answer) indicating which bitrate it can accept.

If the radio modem cannot accept the requested bitrate it must answer with a **lower** suggested bitrate. If the PC receives an answer which is different from the proposed, it will send a new proposal with either the suggested bitrate from the radio modem or a lower bitrate.

If the proposed bitrate is accepted, the radio modem will send an F X-answer with the same bitrate. When the radio modem receives a link ACK on the F X-answer, the communication parameter is set and the link is restarted. When the PC receives an F X-answer which is identical with the proposed bitrate, it will set the communication parameters and the link is restarted.

The PC will suspend the transmission of M-frames when it sends the F X-request. The radio modem will suspend the transmission of M-frames when it receives the F X-request. If the radio modem has an unacknowledged link frame, it has to be acknowledged by the PC before the radio modem sends the F X-answer. The PC and the radio modem resume traffic when the link connection is re-established (by the exchange of INIT/IACK frames or B/ACK frames).

If the link layer and physical layer indicate a link restart (DSR/DTR : inactive), the communication will be re-established using the new bitrate. The new bitrate will not be saved when powering off the radio modem or the PC. After power up of the PC or the radio modem, the default bitrate will be used.

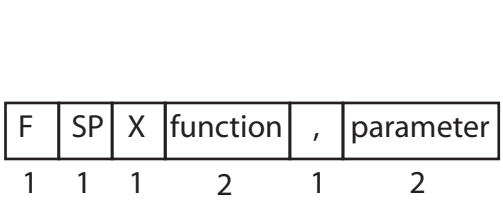


Figure 82 Structure of the text field in the F X-frame. The data field is empty.

Parameter values that can be set:

Function	No	Description	Parameter
F X command from the PC (request)	01	Request to set new bitrate from PC	01 = 1200 bps
			02 = 2400 bps
			03 = 4800 bps
			04 = 9600 bps
F X command from the radio modem (answer)	01	Bitrate that may be accepted by the radio modem	01 = 1200 bps
			02 = 2400 bps
			03 = 4800 bps
			04 = 9600 bps

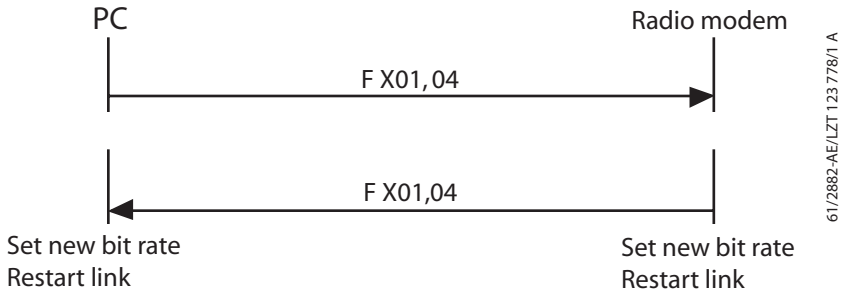


Figure 83 Direction of the F X-command.

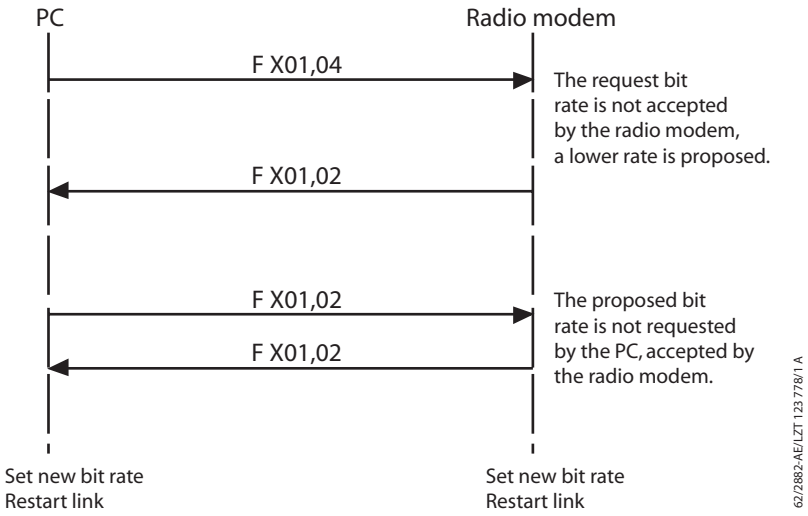


Figure 84 Bitrate negotiation.

3.4.29 F Y, Battery Saving Mode Control

Direction:	PC to Radio modem
	Radio modem to PC
Parameter:	Mode

The F Y-command is used to change the operating mode of the radio link layer in the radio modem. If the radio modem cannot change to the requested operating mode an F Y-command will be sent back to the PC stating the actual operating mode. This response may not be immediate as the mode change in the radio modem involves communication with the network (sending a Mode packet to the network). If the radio modem is unable to handle the F Y-command, it will send an E frame to the PC.

F Y-command from the PC (order)

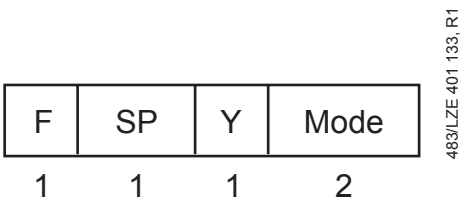


Figure 85 Structure of the F Y-command text field.

Mode	Description
00	The radio modem is ordered to change to “Normal mode”.
01	The radio modem is ordered to change to “Battery saving mode”

F Y-frame from the radio modem (response)

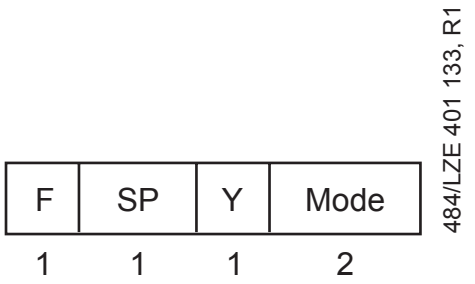


Figure 86 Structure of the F Y-frame text field.

Mode	Description
00	The radio modem has changed to “Normal mode”.
01	The radio modem has changed to “Battery saving mode”.

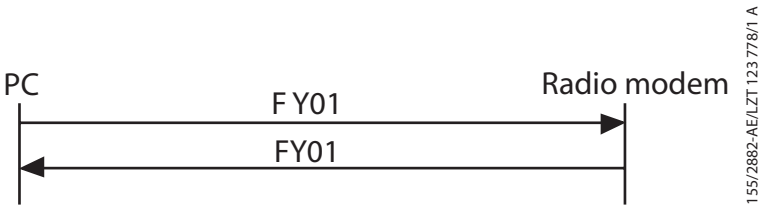


Figure 87 Direction of the F Y-frame.

E frame from radio modem to PC

The radio modem is unable to handle the Battery saving protocol or cannot interpret the F Y-command.

3.4.30 F Z, Product Information Request/Answer

Direction: PC to Radio modem

Radio modem to PC

Parameter: TYPE_OF_REQUEST

This command is used to request the product information from a radio modem. The product information listed here includes software identification, software version and physical serial number.

Request from the PC

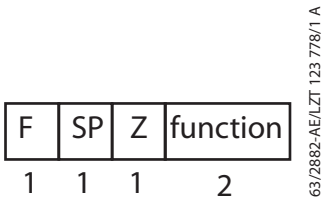


Figure 88 Structure of the text field in the F Z-frame in request from the PC.

Function	Description
01	Request software identification
02	Request software version
03	Request of physical serial number
04	Request radio information

Answer from the radio modem

The product information field is a variable field used for manufacturer-specific information.

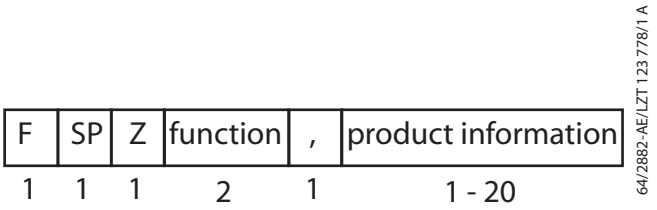
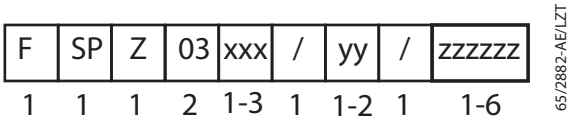


Figure 89 Structure of the F Z-frame text field containing software information from the radio modem to the PC (F Z01 and F Z02).

Function	Description
01	Software identification
02	Software version

Answer from the radio modem

The physical serial number consists of three fields:
xxx/yy/zzzzzz.



65/2882-AE/LZT 123 778/1 A

Figure 90 Structure of the F Z-frame text field containing physical serial number from the radio modem to the PC (F Z03). The data field is empty.

xxx	is the manufacturer´s code.
yy	is the model number.
zzzzzz	is the identification number.

Function	Description
03	Physical serial number

The physical serial number is stored in the radio modem in its fixed format, that is, 001/02/000003 but may be conveyed on the MASC link by suppressing leading zeros, that is, F Z031/2/3.

Answer from the radio modem

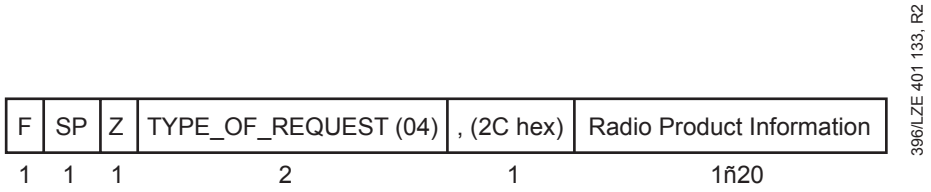


Figure 91 Structure of the text field in reply from the radio modem to the PC.

Function	Description
04	Radio product information

The Radio Product Information is a variable field used for manufacturer specific transceiver information.

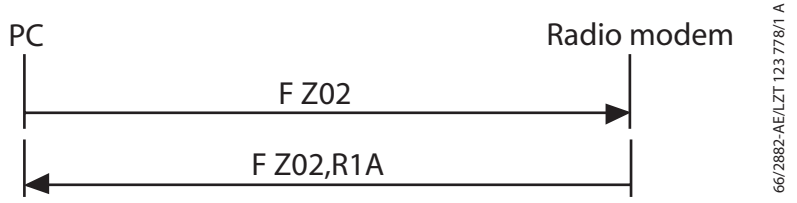
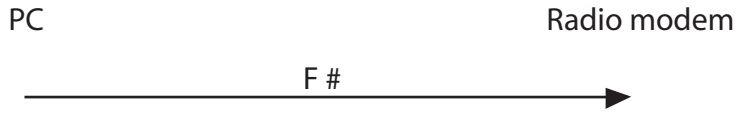


Figure 92 Direction of the F Z-command.

3.4.31 F#, Short Number List

This command is only required in radio modems with more than one communication port.

F#	Request from terminal for short number list.
F#	XXList of short numbers from the radio modem or PC. The list contains short numbers which are common to the radio modem and all connected terminals (general short numbers). It is sent by the terminal to set up this list and by the radio modem as a reply to the F# request command from the terminal. XX is the number of short numbers in the list in ASCII coded hexadecimal digits in the range 00-32 (0-50 decimal). The list itself is sent in the data field of the frame. In the list, the actual numbers corresponding to each short number from 1 and up are given as ASCII coded digits with a maximum of 20 digits each. The numbers are separated by the character , (comma).



148/2882-AE/LZT 123 778/1 A

Figure 93 Direction of the F #-command.

Note: Only the “one-character function” can be included in an F command, for example, F P123456.

3.4.32 F 01, Request/List Network Contact Status

This command gives the PC possibility to get information from the radio modem concerning network contact and whether the modem is allowed to send a message or not.

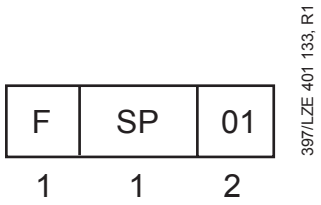


Figure 94 Structure of the F 01-command text field in request for parameters from the PC to the radio modem.

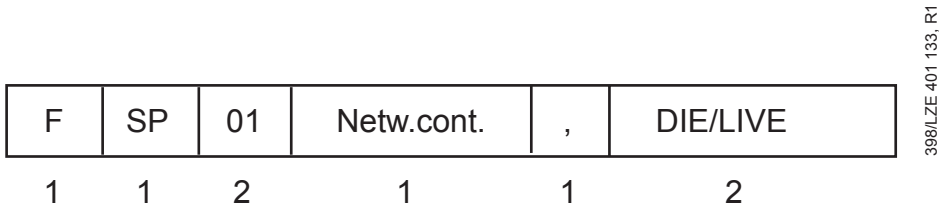


Figure 95 Structure of the text field in reply from the radio modem to the PC.

The parameters can either be 1 or 2 in ASCII.

Mobitex Network Contact

1=No contact with the network.
2=Contact with the network.

LIVE/DIE mode in the radio modem

1 = Die
2 = Live

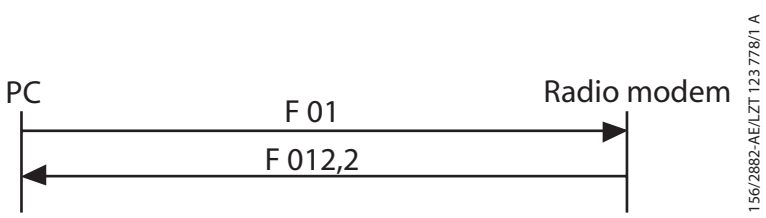


Figure 96 Direction of the F 01-command.

3.4.33 F 02, Request/List Subscription Information

This command gives the PC information about terminal MAN, personal subscription logged in and which groups that the terminal is member of.

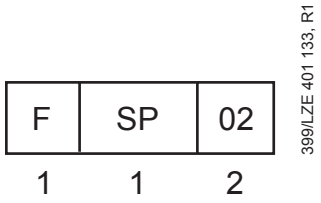


Figure 97 Structure of the F 02-command text field in request for parameters from the PC to the radio modem.

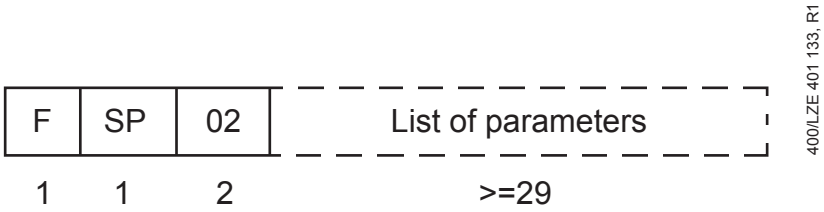


Figure 98 Structure of the F 02-command text field in reply from the radio modem to the PC.

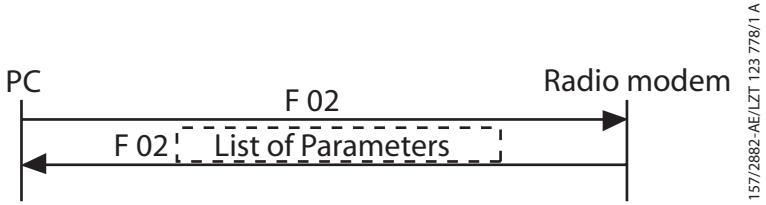


Figure 99 Direction of the F 02-command.

The list of parameters consists of a number of ASCII coded hexadecimal numbers separated by , (comma). If a parameter is not available or not given, this parameter is not included. The parameters are sent in the following order:

Parameter	No of bytes
Terminal MAN	3
Flexlist (MAN 1-7)	21
Grouplist (MAN 1-15)	45

3.4.34 F 03, Change Network Request/Reply

Direction:	PC to Radio modem
	Radio modem to PC
Parameters:	No of Bytes / No of ASCII characters
NID synchronization pattern when receiving from base station (BASE):	2/4
Network operator name:	1-8

The F 03-command is used for changing the network the radio modem is operating on and also to select the DEFAULT LIST associated with a specific operator. Three parameters are associated with using this command: The network ID (NID) synchronization patterns from BASE to MOB, the operator name and the pre-programmed DEFAULT LISTs. The command can also be used to request the current setting of NID and operator name. The network ID's are administrated by MOA.

Note: The F 03-command is used to change both the network ID and associated parameters for the named network prestored in the radio modem. If the network operator's name is not stored or not available, or if the network ID and network operator's name are mismatched, the radio modem will issue an error code (recommended F K66 - Illegal Network ID) and remain on the current network.

Request the current setting from the PC to the radio modem

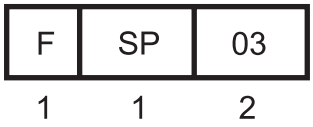


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Figure 100 Structure of the F 03-command text field in request from the PC to the radio modem.

Answer from the radio modem to the PC

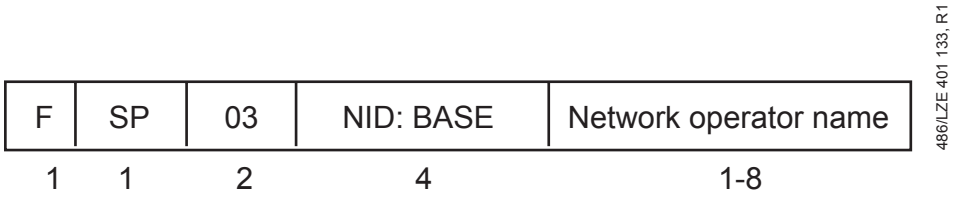

Figure 101 Structure of the F 03-command text field in answer from the radio modem to the PC.

Command from the PC to change the current setting

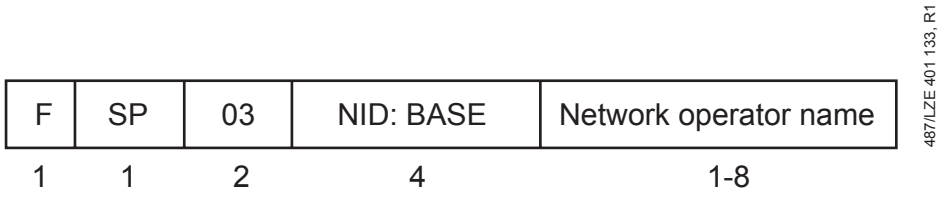

Figure 102 Structure of the text field in command from the PC to the radio modem.

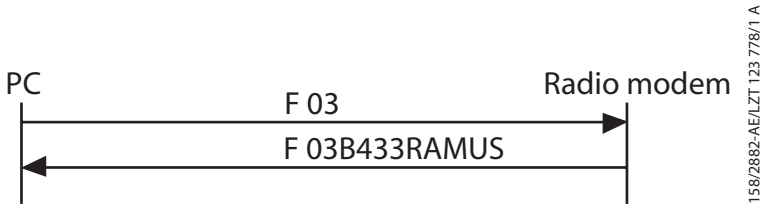

Figure 103 Direction of the F 03-command.

3.4.35 F 04, Mobitex Time Packet Filter

Direction: PC to Radio modem

Radio modem to PC

The F 04-command is used for enabling/disabling the Mobitex Time Packet Filter. When the Mobitex Time Packet Filter is enabled all MPAK TIME packets received from the Mobitex network should be discarded (that is, the packets should not be sent to the PC). Furthermore the command can be used by the application to request the current setting of the Mobitex Time Packet Filter.

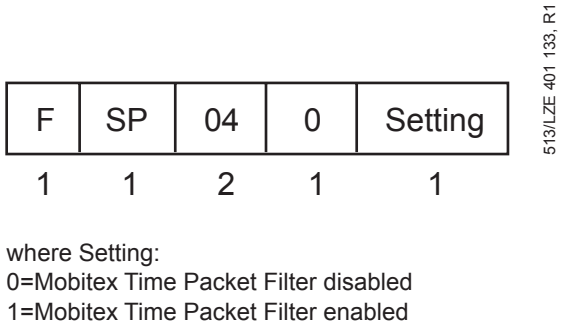

Figure 104 Structure of the text field sent from the PC to the radio modem to enable or disable the setting of the Mobitex Time Packet filter.

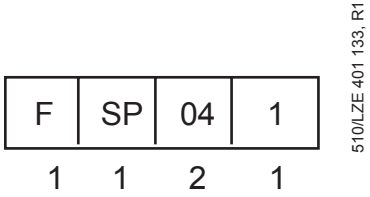

Figure 105 Structure of the text field sent from the PC to the radio modem to request the current setting of the Mobitex Packet Filter.

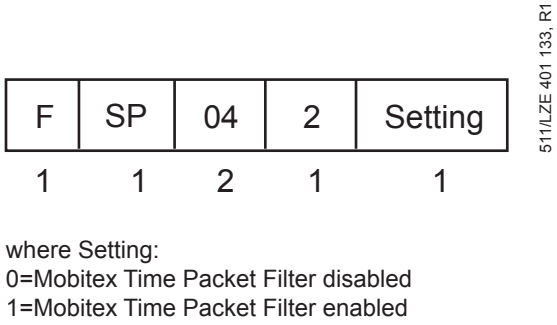

Figure 106 Structure of the text field sent from the radio modem to the PC as a response to the request for current setting of the Mobitex Time Packet Filter.

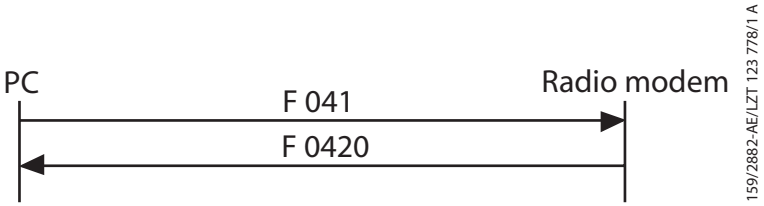

Figure 107 Direction of the F 04-command.

3.4.36 QA01-command, Request/List AREA LIST Information (8kbps Only)

The command is used by the terminal to get AREALIST information.

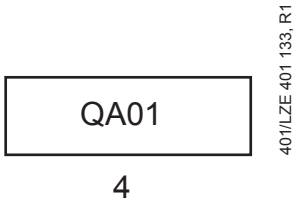

Figure 108 Structure of the text field in request for parameters from the PC to the radio modem.

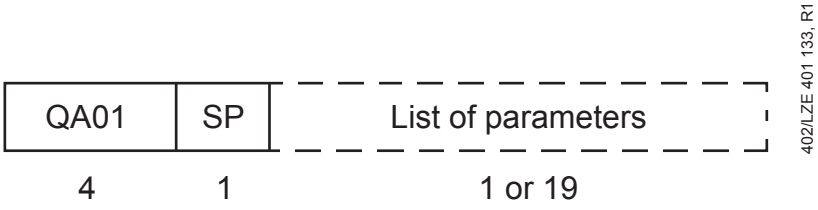

Figure 109 Structure of the text field in reply from the radio modem to the PC.

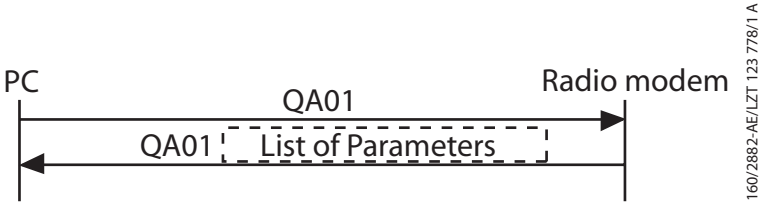

Figure 110 Direction of the QA01-command.

The list of parameters consists of a number of ASCII coded hexadecimal numbers separated by , (comma). If a parameter is not available or not given, this parameter is not included. The parameters are sent in the following order:

Parameter	No of bytes
Arealist	8
Command	1

For more information please refer to *5.3.20 AREALIST*.

3.4.37 QA02-command, Request/List Roaming Parameters (8 kbps Only)

The command is used by the terminal to get roaming parameter information.

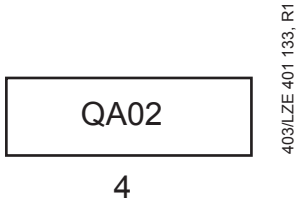

Figure 111 Structure of the QA02-command text field in request for parameters from the PC to the radio modem.

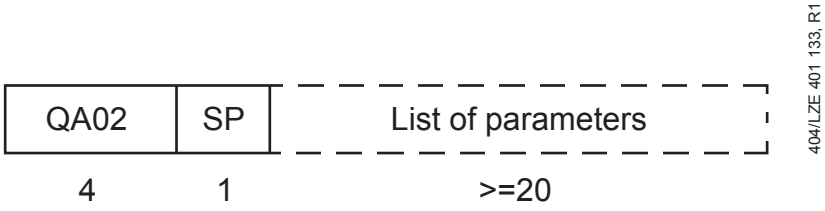

Figure 112 Structure of the text field in reply from the radio modem to the PC.

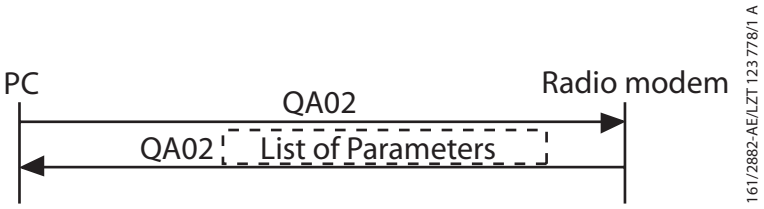

Figure 113 Direction of the QA02-command.

The list of parameters consists of a number of ASCII coded hexadecimal numbers separated by the comma character (,). If a parameter is not available or not given, this parameter is not included. The parameters are sent in the following order:

Parameter	Note	No of bytes
Frame sync, mobile rx		2
RSSI_PROC	0=frame mode	1
	1=continous mode	
RSSI_PERIOD	100ms	1
SCAN_TIME	1200ms	1
Number of bases in table		1
Current base_id		1
Current area_id		1
roaming_value		1
List:		
Base_id (if Frame mode)		1
Area_id (if Frame mode)		1
or Dofreq (if CONTINUOS mode)		2
roaming value	dbµVemf	1

3.4.38 QA03-command, Request/Reply Radio Modem Locking to Specific Up and Down Channel Numbers

This command is used by a PC to lock or unlock the radio modem to specific up and down channel numbers.

When the radio modem locking is invoked, the base evaluation process in both normal channel monitoring and quick scan modes is disabled until the unlock command is issued. The radio modem will listen for the base and area IDs in ROAM frames on the specified down-link frequency, and then send a ROAM packet if the newly locked channels are different from the original ones.

The radio modem in locking state must not be reset during a power-cycle. While in locking state, the radio modem has to accept and react properly to the link channel change order (<BKD>) or fleet division orders (<SVP2>) and (<SVP4>) from the base station.

The radio modem will notify the PC when it goes in and out of network coverage with MASC F F and F G commands. Only the PC or application can determine when locking or unlocking is required.

Note: The use of this command may cause the radio modem to lose the network contact for a prolonged period of time due to shadowing affects of the base station, change of frequency planning and rearrangement of channel numbers by the network operator, etc.

How to lock the radio modem to specific up and down channel numbers.

Figure 114 Structure of the text field in request from the PC to the radio modem.

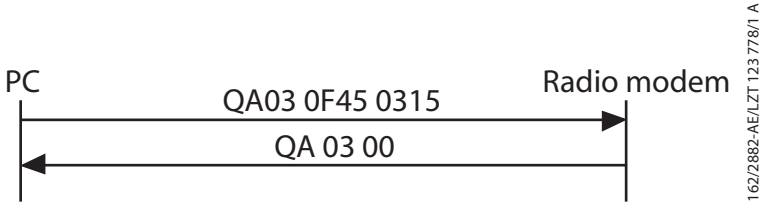

Figure 115 Direction of the QA03-command.

All parameters are in ASCII coded hexadecimal numbers.

Parameter	Description	No of bytes/No of ASCII characters
UP_FREQ	Channel number for the up-link frequency; range 0001 - 1FFF (decimal 0001 - 8191)	2/4
DO_FREQ	Channel number for the down-link frequency; range 0001 - 1FFF (decimal 0001 - 8191)	2/4

Note: The UP_FREQ and DO_FREQ must be in pairs with a fixed network dependent frequency separation.

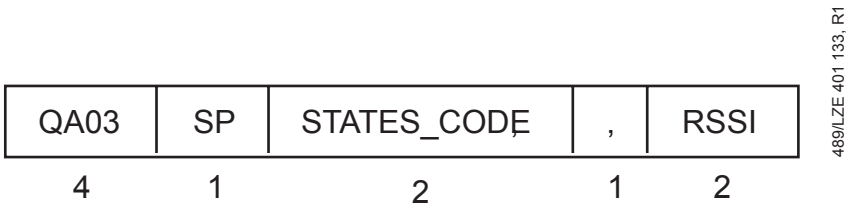

Figure 116 Structure of the text field in reply from the radio modem to the PC.

Parameter	Description	NO of bytes/No of ASCII characters
STATUS_CODE	Status for locking request in bitmapped ASCII coded hexadecimal format:	1/2
	00 - invalid UP_FREQ and DO_FREQ; request aborted (see NOTE)	
	01 - invalid DO_FREQ; request aborted (see NOTE)	
	10 - invalid UP_FREQ; request aborted (see NOTE)	
	11 - locked OK	
RSSI	Average RSSI value of locked base station in ASCII coded hexadecimal format, ranging from 00-FF in dBµV emf units. The parameter is only included when STATUS_CODE is “11”	1/2

Note: An invalid parameter indicates that the stated parameter is not a valid Mobitex channel, or a low RSSI value prevents the radio modem from locking onto the base (in case of invalid DO_FREQ), or unsuccessful transmission on the specified UP_FREQ. The radio modem will return to the original state when request is aborted.

The radio modem and the PC will suspend the transmission of MPAKs on the MASC interface until the QA03 reply is sent by the radio modem.

How to unlock the radio modem locking state.

Direction: PC to Radio modem

This command will cause the radio modem to unlock and resume/continue normal operation.

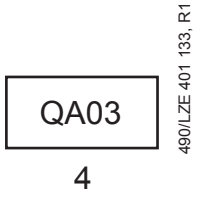

Figure 117 Structure of the text field in request from the PC to the radio modem.

3.4.39 F !-command, Change Operation Mode

This command is required in radio modems supporting the battery saving functionality. The F ! command is used to change the operation mode (the MODE parameter) and the SKIPNUM parameter in the radio modem. If the radio modem is unable to handle the F ! command, it has to send an E frame to the PC.

Example:
The command given from the PC in this example sets the MODE parameter to *battery saving mode*, the SKIPNUM parameter to eight and the command orders the radio modem to report the new parameter to the radio base station:

F !113

Orders from the PC to the Radio modem.

Figure 118 Structure of the F ! command text field sent from the PC to the radio modem. This structure also applies to the response sent from the radio modem to the PC.

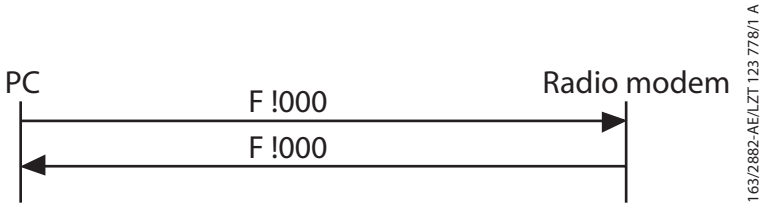

Figure 119 Direction of the F !-command.

Report (one ASCII character)

The parameter *Report* in this command is used to determine whether an MPAK MODE or MPAK LOWPOWER, subtype MODE, is to be sent to the Mobitex network.

0	do not send MODE to the Mobitex network. This value is only used for test purposes.
1	send MODE to the Mobitex network. This value must be used by all applications using the MASC interface.

MODE (one ASCII character)

0	The radio modem is ordered to change to *Normal Mode.*
1	The radio modem is ordered to change to *Battery Saving Mode*.

SKIPNUM (one ASCII character)

0, 1, 2, 3 or 4

SKIPNUM = 2^n, where *n* is the value passed in this MASC command. For example, if the value three is passed in the command then the SKIPNUM value shall be set to eight. The radio modem is ordered to change the given SKIPNUM value. If any other value than those specified here is given, the radio modem shall respond with an E frame.

Responses from the radio modem to the PC.

Figure 120 Structure of the F ! command text field sent from the radio modem to the PC. This structure also applies to the response sent from the PC to the radio modem.

The figure above shows the layout of the response from the radio modem to the PC. The fields will be interpreted as described below.

Report

0	The new parameters were successfully set. No MPAK MODE or MPAK LOW_POWER was sent to the base radio station.
1	The new parameters were successfully set. The new parameters were reported to the base radio station.

Mode

The response states the actual operation mode.

0	The radio modem is ordered to change to *Normal Mode.*
1	The radio modem is ordered to change to *Battery Saving Mode*.

SKIPNUM

The response states the actual SKIPNUM value.

SKIPNUM = 2^n, where *n* is the value given in the response.

E-frame from the Radio Modem to the PC

An E-frame sent from the radio modem to the PC indicates that the radio modem is unable to handle the battery saving protocol or illegal values were given to the parameters in the command.

3.4.40 P-command, Request/List Parameters

These functions are considered *type test functions* (the radio modem must comply with these functions).

Note: These functions should only be used during type testing and must be disabled for normal use.

Figure 121 Structure of the P-command text field in request for internal parameters from the PC to the radio modem. The data field is empty.

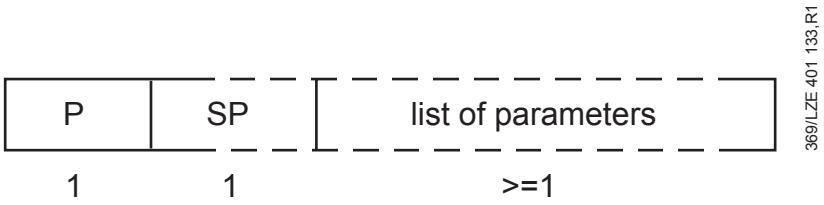

Figure 122 Structure of the text field in reply from the radio modem to the PC (list of parameters).

The P-command is used by the terminal to request radio protocol parameters and by the radio modem to send these parameters as a reply to the request.
The list of parameters consists of a number of ASCII coded hexadecimal numbers separated by , (comma). The parameters are to be sent in the following order:

Parameter	No of bytes
Slot_length	1
Timeout_short	1
Timeout_long	1
Free_slots	1
Rand_slots	1
Current_base (internal parameters in the radio modem)	2
Chosen_slot (internal parameters in the radio modem)	1

Parameter	No of bytes
Max_access	1
Max_rep	1
Priority (internal parameter in the radio modem)	1
Sequential number up (term. MAN)	1
Sequential numbers down (term. MAN + 15 groups)	16
Upfreq (current)	2
Dofreq (current)	2
Flexlist (MAN 1- 7)	21
Grouplist (MAN 1 - 15)	45

3.4.41 PA01-command, Request/List Radio Parameters

Direction: PC to Radio modem

Radio modem to PC

The PA01 command is set by a terminal to the radio modem to request radio protocol parameters. If any of the parameters are unavailable, the radio modem may present either zeros or a blank (empty) in the corresponding location. The terminal sends PA01 to the radio modem which responds with the following:

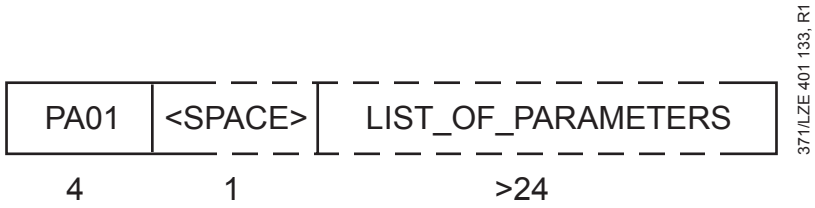

Figure 123 Structure of the PA01-command text field. The data field is empty.

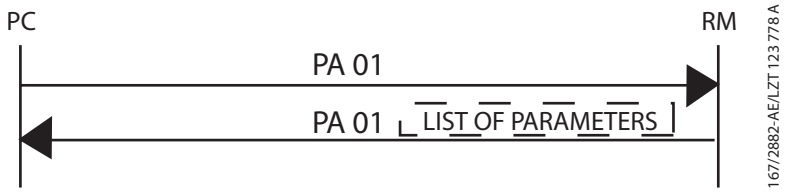

Figure 124 Direction of the PA01-command.

PA01,TIMEOUT, SLOT-LENGTH, FREE-SLOTS, RAND-SLOTS, MAX-ACCESS, MAX-SPEECH, TXPOWQ, RSSI-PROC, RSSI-PERIOD, SCAN-TIME, BAD-BASE, GOOD-BASE, BETTER-BASE, QPOS, CURRENT-BASE

All values are given in ASCII coded Hexadecimal numbers:

Parameter	Source	Size	Definition
TIMEOUT	<BKD>	1 byte	When attempting to access a traffic channel, the original channel if no ACK is received within TIMEOUT seconds. Value is 1-255 seconds.
SLOT_LENGTH	<FRI>	1 byte	The length of each slot in a <FRI> cycle. Value is (32/bitrate)x SLOT_LENGTH.

Parameter	Source	Size	Definition
FREE_SLOTS	<FRI>	1 byte	The total number of slots available in a <FRI> cycle
RAND_SLOTS	<FRI>	1 byte	The total number of random slots available in i <FRI> cycle.
MAX_REP	<FRI>	1 byte	The maximum number of retransmissions before a packet is considered failed. If no acknowledgement is received after MAX_REP retransmissions, the radio modem starts evaluating other base stations.
MAX_ACCESS	<FRI>	1 byte	The number of blocks that may be sent in an <MRM> frame without using access request.
MAX_SPEECH	<FRI>	1 byte	The number of blocks that may be sent in a line connection request without using access request.
TXPOW	<SVP>	1 byte	The decrease in output power (0-255 dB below nominal level) to be used by the mobile. 0 is used until the signal is received.
RSSI_PROC	<SVP>	1 byte	The method of signal strength measurement: 0 = FRAME; 1 = Continuous.
RSSI_PERIOD	<SVP>	1 byte	Time used by the roaming algorithm (0-255x20ms).
SCAN_TIME	<SVP>	1 byte	The length of time when the radio modem scans surrounding system channels (0-255x100ms).
BAD_BASE	<SVP>	1 byte	Used by the roaming algorithm to define the lowest signal strength from the current base station that is considered usable.
GOOD_BASE	<SVP>	1 byte	Used by the roaming algorithm to determine when a base station signal is acceptable as a current base.
BETTER_BASE	<SVP>	1 byte	Used by the roaming algorithm to determine when to roam to a better base station signal. This is the signal strength improvement above which the radio modem should switch to a new current base.
QPOS	<VKT>	1 byte	Current position in the queue, waiting for speech.

Parameter	Source	Size	Definition
CURRENT_BASE	<SVP>	2 byte	Base and Area ID of the base station to which the radio modem is currently roamed. Derived from the frame head of a ROSI frame sent from the base. (Bits 0-5=AREA_ID, bits 6-11=BASE_ID, bits 12-15=0).
CHOSEN_SLOT		1 byte	A random slot is chosen by the radio modem. Internal to the radio modem.
PRIO	<FRI> <SVP> <TST>	3 bits	Used to give access only to mobile terminals above a stated priority level. A radio modem belongs to one of four priority groups. Each group will be either in a normal or raised state. The sending radio modem will change to a raised state when MAX_REP is exceeded.
UPFREQ	<SVP>	2 bytes	The channel on which the base station is receiving.
DOFREQ	<SVP>	2 bytes	The channel on which the base station is transmitting.
ACCESS_CHANNEL_UPFREQ	<BKD>	2 bytes	The channel on which the base station will receive after switching to a traffic channel in response to a change channel order.
ACCESS_CHANNEL_DOFREQ	<BKD>	2 bytes	The channel on which the base station will transmit after switching to a traffic channel in response to a change channel order.
NETWORK ID (TX)	<SVP>	2 bytes	The network ID of the base station to which the radio modem is transmitting. This ID is derived from the frame head of a ROSI frame sent from the base.
NETWORK ID (RX)	<SVP>	2 bytes	The network ID of the base station from which the radio modem is receiving. This ID is derived from the frame head of a ROSI frame sent from the base.
Area ID	<SVP>	1 byte	The Area ID of the base station with which the radio modem is communicating. This ID is derived from the frame head of a ROSI frame sent from the base.

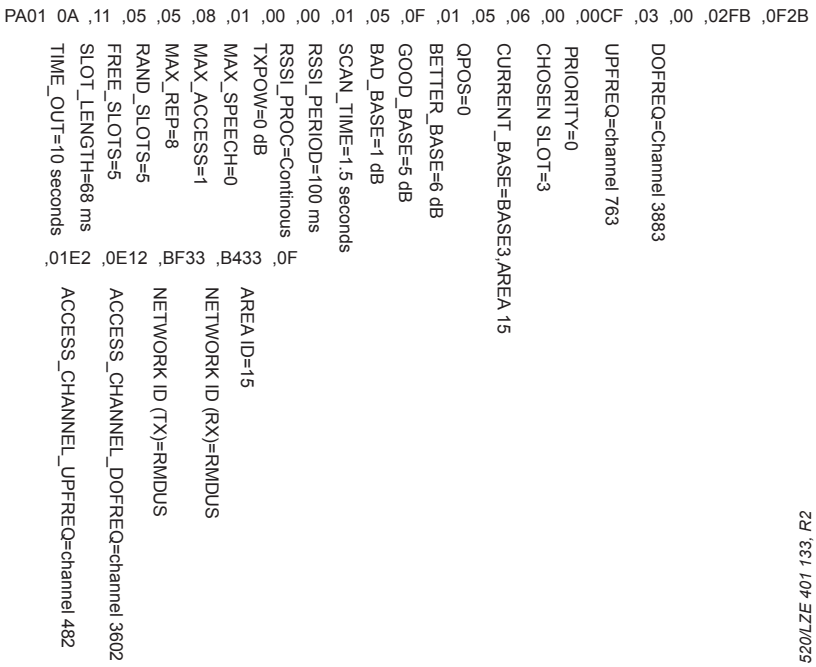

Figure 125 Example of a response to PA01.

3.4.42 PA02-command, Request/List Identity Parameters

Direction: PC to Radio modem

Radio modem to PC

The PA02 command is sent by a terminal to the radio modem to request identity parameters. If any of the parameters are unavailable, the radio modem may present either zeros or a blank (empty) in the corresponding location. The terminal sends a PA02 to the radio modem which responds with the following:

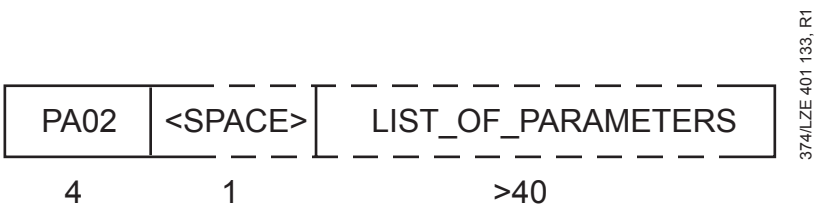

Figure 126 Structure of the PA02-command text field. The data field is empty.

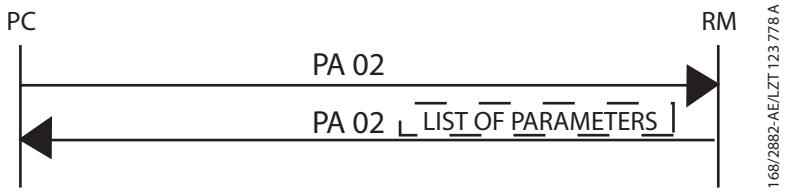

Figure 127 Direction of the PA02-command.

PA02, Terminal MAN, ESN, FLEXLIST, GROUPLIST.....SEQ_NUM_UP, SEQ_NUM_DO1.....SEQ_NUM_DO15

All values are given in ASCII coded Hexadecimal numbers:

Parameter	Size	Definition
Terminal MAN	3 bytes	24-bit number stored in the radio modem. Programmable by the network operator.
ESN	4 bytes	32-bit Electronic Serial Number programmed by the radio modem manufacturer. Manufacturers Code = 8 bits (0-255), Model Number = 6bits (0-63), Security number = 18 bits displayed using an algorithm.
FLEXLIST	21 bytes	A list of up to seven Personal MANs stored in the radio modem.
GROUPLIST	45 bytes	A list of up to 15 Group MANs stored in the radio modem.
SEQ_NUM_UP	1 byte	Contains the next sequence number to be used for transmitting from the radio modem to the base station (0-14). This number is incremented by one for each new <MRM> frame that is transmitted.
SEQ_NUM_DO1-15	16 bytes	Contains the next sequence number of the last <MRM> frame received from the base station. The sequence numbers are stored for the Terminal MAN and each of the 15 possible Group MANs.
Terminal MAN	3 bytes	A 24-bit number stored in the radio modem. The number is programmable by the network operator.
ESN	4 bytes	A 32-bit Electronic Serial Number programmed by the radio modem manufacturer. Manufacturers Code = 8 bits (0-255), Model Number = 6 bits (0-63), Security number = 18 bits displayed using an algorithm.
FLEXLIST	21 bytes	A list of up to seven Personal MANs stored in the radio modem.
GROUPLIST	45 bytes	A list of up to 15 Group MANs stored in the radio modem.

Parameter	Size	Definition
SEQ_NUM_UP	1 byte	Contains the next sequence number to be used for transmitting from the radio modem to the base station (0-14). This number is incremented by one for each new <MRM> frame that is transmitted.
SEQ_NUM_DO1-15	16 bytes	Contains the next sequence number of the last <MRM> frame received from the base station. Sequence numbers are stored for the Terminal MAN and each of the 15 possible Group MANs.

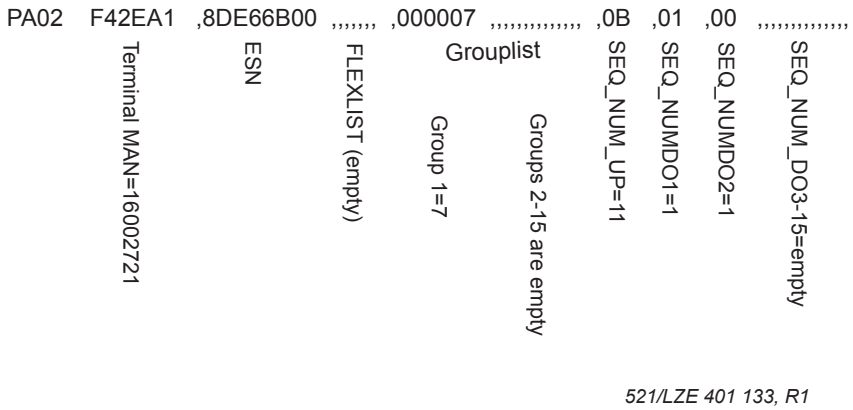

Figure 128 Example of a response to PA02.

3.4.43 PA03-command, Request/List Channel Parameters

Direction: PC to Radio modem

Radio modem to PC

The PA03 command is sent by a terminal to the radio modem to request default channel list parameters. If any of the parameters are unavailable, the radio modem may present either zeros or a blank (empty) in the corresponding location. The terminal sends PA03 to the radio modem which responds with the following:

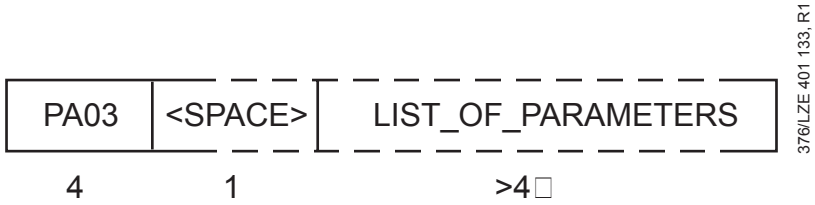

Figure 129 Structure of the PA03-command text field. The data field is empty.

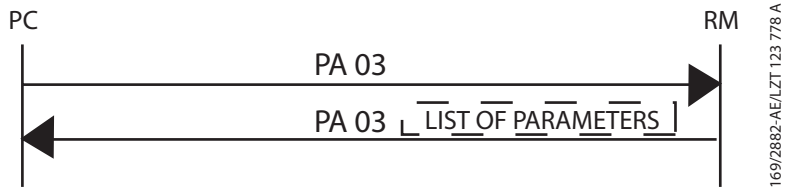

Figure 130 Direction of the PA03-command.

PA03, CHANNEL-LIST, NO-CHAN-IN-LIST, NO-CHAN-IN-COM, CH1-UPFREQ, CH1-DOFREQ.....

All values are given in ASCII coded Hexadecimal numbers:

Parameter	Size	Definition
CHANNEL_LIST	1 byte	Represents the contents of the following list. 01 = DEFAULT_LIST 02 = CURRENT_LIST 03 = TEMP_DEFAULT_LIST The radio modem responds with the list it is currently evaluating.
NO_CHAN_IN_LIST	2 bytes	The total number of channels included in the following list. In cases such as the DEFAULT_LIST, multiple <MRM> frames are used to send the list.

Parameter	Size	Definition
NO_CHAN_IN_COM	1 byte	When multiple <MRM>s are used to send a list, this is the number of channels included in the current <MRM> frame.
For DEFAULT_LIST:		The order of the channels in the default list is determined by the manufacturer.
CH1_UPFREQ	2 bytes	Receive channel of the first base station in the default list.
CH1_DOFREQ	2 bytes	Transmit channel of the first base station in the default list.
.	.	.
.	.	.
.	.	.
CHn_UPFREQ	2 bytes	Receive channel of the last base station in the default list.
CHn_DOFREQ	2 bytes	Transmit channel of the last base station in the default list.
For CURRENT_LIST		Received by the mobile terminal in the <SVP> frame and lists the system channels used by neighbouring base radio stations. Used in Normal channel monitoring when scanning other system channels. The channels in the CURRENT_LIST are in signal strength order. The list contains the channel numbers that are currently being scanned by the radio modem.
CH1_UPFREQ	2 bytes	Receive channel of the first base station in the current list.
CH1_DOFREQ	2 bytes	Transmit channel of the first base station in the current list.
.	.	.
.	.	.
.	.	.
CHn_UPFREQ	2 bytes	Receive channel of the last base station in the current list.
CHn_DOFREQ	2 bytes	Transmit channel of the last base station in the current list.
For TEMPORARY DEFAULT_LIST		A shortened list stored in the radio modem that replaces or supplements the default list when scanning. Used to speed up the roaming procedure.
CH1_UPFREQ	2 bytes	Receive channel of the first base station in the temporary default list.
CH1_DOFREQ	2 bytes	Transmit channel of the first base station in the temporary default list.

Parameter	Size	Definition
.	.	.
.	.	.
.	.	.
CHn_UPFREQ	2 bytes	Receive channel of the last base station in the temporary default list.
CHn_DOFREQ	2 bytes	Transmit channel of the last base station in the temporary default list.

Example 1

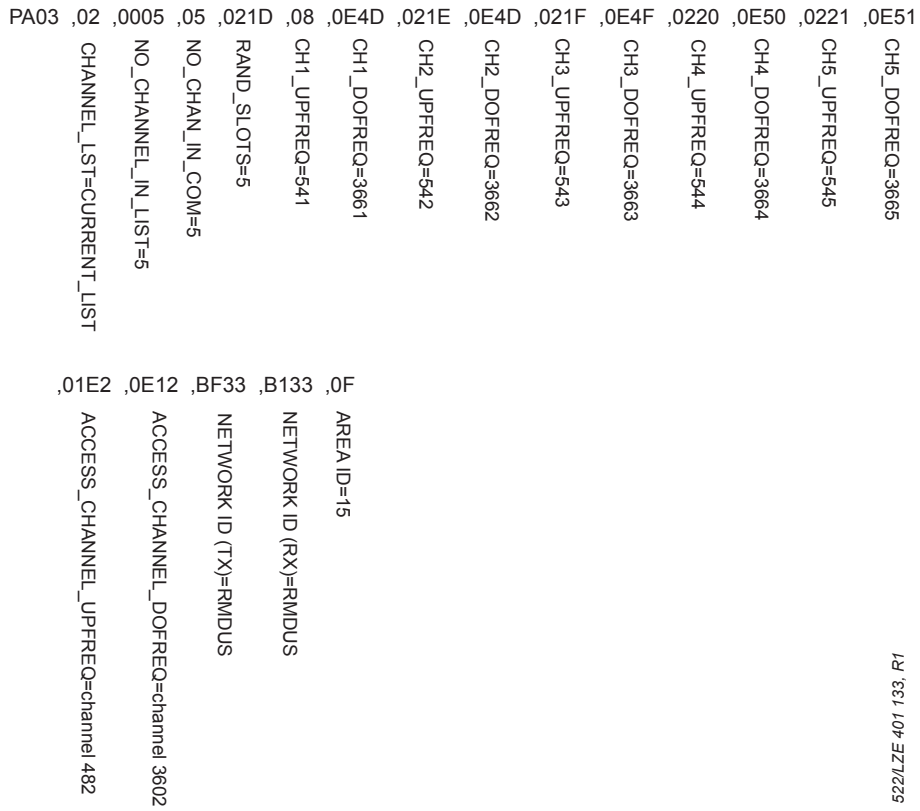

Figure 131 Example of a response to PA03 (CURRENT_LIST with five neighbouring base stations).

Example 2

Example of a response to PA03 (DEFAULT_LIST):

PA03 01, 0014, 0A, O1E1, OE11, 01E2, 0E12, 01E3, 01E4, 0E14, 01E5, 0E15, 01E6, 0E16, 01E7, 0E17, 01E8, 0E18, 01E9, 0E19, 01EA, 0E1A

PA03 01,0014, 0A, 01FT, 0E25, 01F6, OE26, 01F7, 0E27, 01F8, 0E28, 01F9, 0E29, 01FA, 0E2A, 01FB, 0E2B, 01FC, 0E2C, 01FD, 0E2D, 01FE, 0E2E

Example 3

Example of a response to PA03 (TEMPORARY_DEFAULT_LIST):

PA03 03, 00A, 0A, 01E1, 0E11, 01E2, 0E12, 01E3, 0E13, 01E4, 0E14, 01E5, 0E15, 01E6, 0E16, 01E7, 0E17, 01E8, 0E18, 01E9, 0E19, 01EA, 0E1A

3.4.44 PA04-command, Request/List Power Control Parameters

Direction: PC to Radio modem

Radio modem to PC

The PA04 command is used to request the radio modem power control parameters.

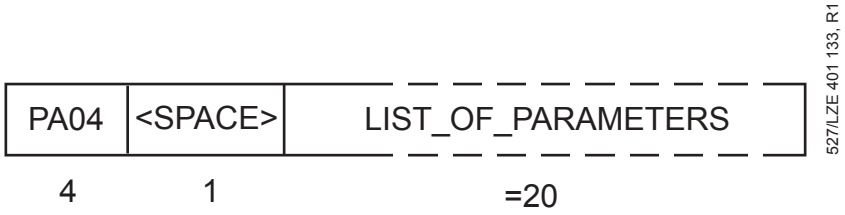

Figure 132 Structure of the PA04-command text field.

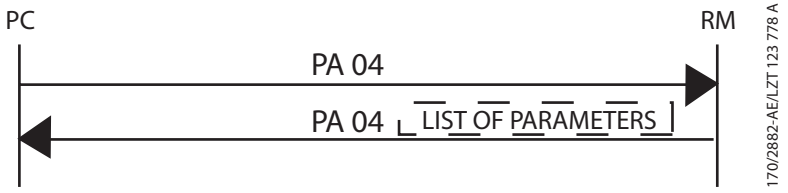

Figure 133 Direction of the PA04-command

All values are given in ASCII coded Hexadecimal numbers:

Parameter	Size	Definition
P_{max} (dBm)	1 byte	Maximum output capability of the radio modem.
RSSI_OFFSET	1 byte	The RSSI_OFFSET is the calculated offset added to the GOOD_BASE and BAD_BASE parameters due to the radio modem having an output power lesser than the stated nominal output power in the network.
ROAM_VALUE (dBµV)	1 byte	The ROAM_VALUE is the latest Roam Value (RV) of the CURRENT_BASE
GOOD_BASE (dBµV)	1 byte	This is the current threshold used in the roaming algorithm. The GOOD_BASE value in the answer includes the RSSI_OFFSET correction.
TXADJ (dB)	1 byte	This parameter is used in the dynamic output power control algorithm and is a programmable parameter in the radio modem.
TXPOW (dB)	1 byte	This is a power reduction order sent from the base station in the <SVP> frames.
P_{out}(dBm)	1 byte	The P_{out} parameter is the current actual output power of the radio modem after the dynamic output power control is applied.

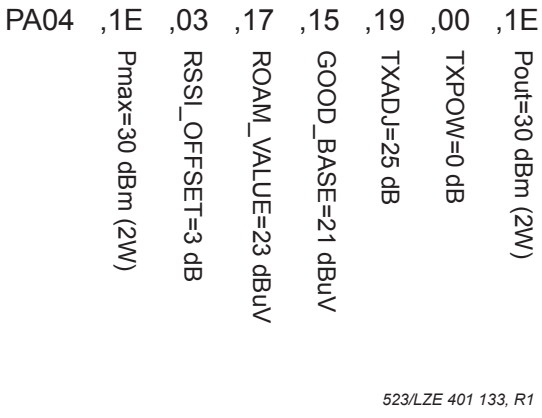

Figure 134 Example of a PA04-command.

3.4.45 PA05-command, Request/List Roaming Parameters

Direction: PC to Radio modem

Radio modem to PC

The PA05 command is sent by a terminal to the radio modem to request parameters. The response shows the channel numbers currently evaluated and scanned by the radio modem. If any of the parameters are unavailable, the radio modem may present either zeros or a blank (empty) in the corresponding location. The terminal sends a PA05 to the radio modem which responds with the following:

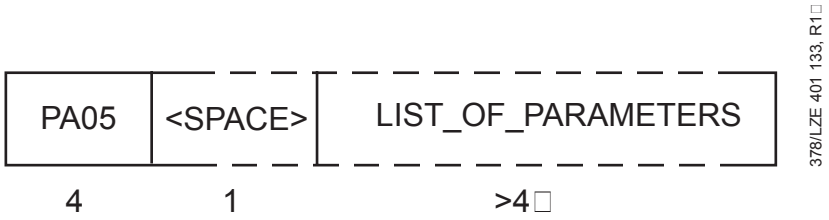

Figure 135 Structure of the PA05-command text field. The data field is empty.

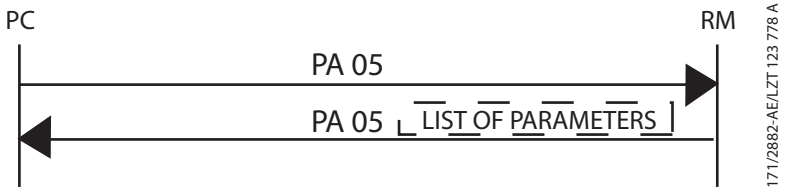

Figure 136 Direction of the PA05-command.

PA05 NO_BASE_IN LIST, CURRENT_BASE_ID, ROAMING_VALUE, DO_FREQ_CH1, ROAMING_VALUE_CH1.....DO_FREQ_CHxx, ROAMING_VALUE_CHxx

All values are given in ASCII coded Hexadecimal numbers, except CURRENT_BASE_ID:

Parameter	Size	Definition
NO_BASE_IN_LIST	1 byte	The total number of channels in the following list.
CURRENT_BASE_ID	2 bytes	Area Base ID of the base station to which the radio modem is currently roamed.

Parameter	Size	Definition
ROAMING_VALUE_CURRENT	1 byte	Average value of the received signal strength of CURRENT_BASE.
DO_FREQ_CH1	2 bytes	Transmit channel of a base station that is being monitored by the radio modem.
ROAMING_VALUE_CH1	1 byte	Average value of the received signal strength of CH1.
.	.	.
.	.	.
.	.	.
DO_FREQ_CHn	2 bytes	The last transmit channel of a base station that is being monitored by the radio modem.
ROAMING_VALUE_CHn	1 byte	Average value of the received signal strength of CHxx.

Note: ROAMING_VALUE_CH1 through ROAMING_VALUE_CHxx will be in descending order. The DO_FREQ_XX or Base IDs need not to be entirely in the current list.

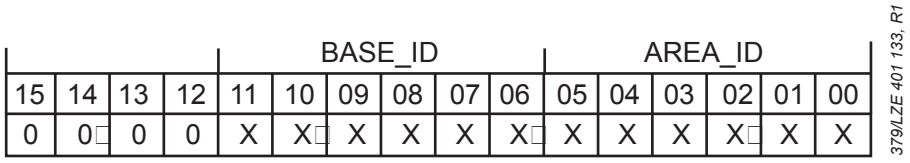

Figure 137 Data representation of parameter CURRENT_BASE_ID.

Example 1

Parameter CURRENT_BASE_ID

Value of parameter CURRENT_BASE_ID	Base ID	Area ID
00CF	3	15

Example 2

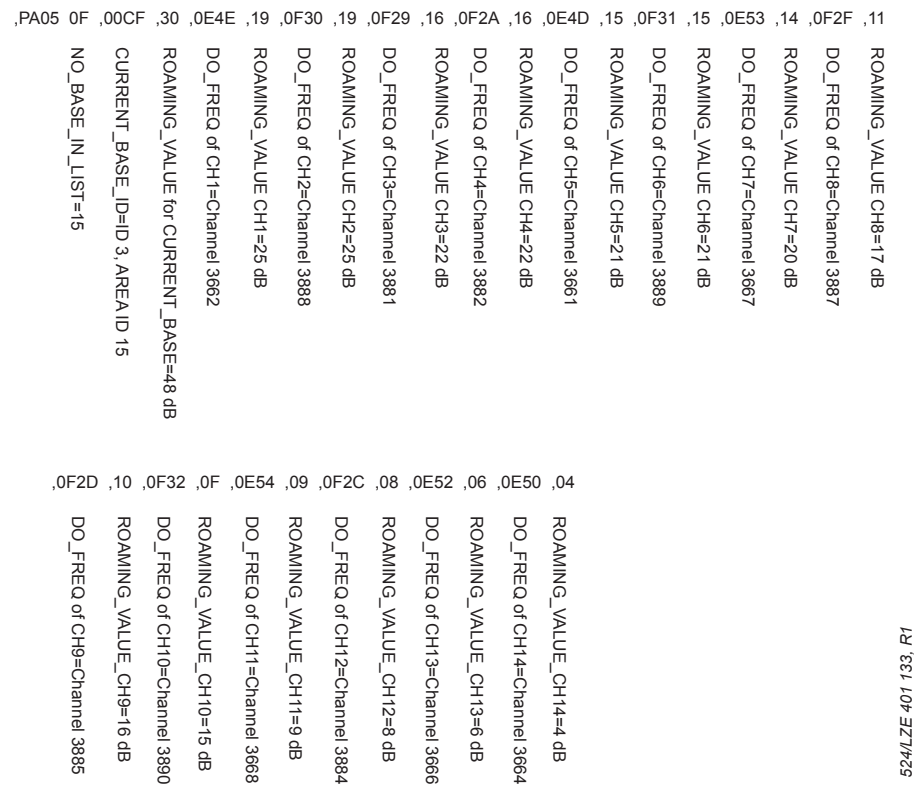

Figure 138 Example of a response to a PA05-command.

3.4.46 PA 06-command, Request/List Test Parameters

Direction: PC to Radio modem

Radio modem to PC

The PA06 command is sent by the terminal to the radio modem to request radio protocol parameters and to perform special radio tests.

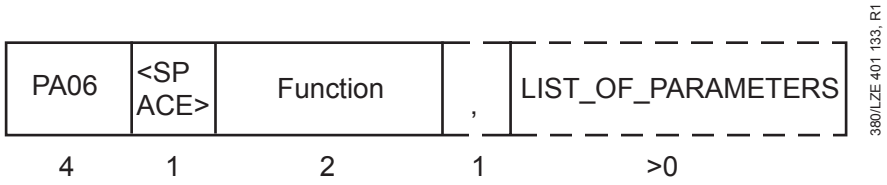

Figure 139 Structure of the PA06-command text field. The data field is empty.

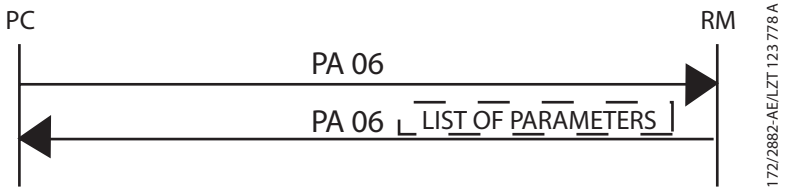

Figure 140 Direction of the PA06-command.

The function is an ASCII coded decimal number ranging between 00 to 99, and is used to describe a specific request or reply. The LIST_OF_PARAMETER consists of ASCII coded hexadecimal numbers separated by the character comma (,). The parameter will not be included if it is not available or not provided.
The table below describes how to use the parameters FUNCTION and LIST_OF_PARAMETERS.

Function	Description	Parameter	Size
01	Request current_base information		0
	Reply current_base information	N/A	2 bytes
02	Set current_base[1] (Request the RM to lock.	An ASCII coded hexadecimal number area and base IDs of the current_base	2 bytes

Function	Description	Parameter	Size
03	Disable base_search_mode[2] (The base evaluation process in normal channel monitoring and quick scan is disabled.)	N/A	0
04	Enable base_search_mode (The base evaluation process is re-invoked and the RM reverts to normal operation.)	N/A	0
05	Clear all dynamic Mobitex parameters[3].	N/A	0
06	Enable copy REPMAP when receiving or transmitting <REB>. The RM spontaneously replies with a copy REPMAP for every <REB> received or sent until a “PA06 07” command is received or at power down[4].	An ASCII coded hexnumber for each bit set to “1” in <REB>. The numbers are separated by commas.	Varied
07	Disable copy REPMAP	N/A	0
08	Enable loudspeaker	N/A	0
09	Disable loudspeaker	N/A	0
10	Request a NUMRET value	N/A	0
	The RM replies with the current value of NUMRET found in <ABD>, <ABT> or <ABL>[5].	An ASCII coded hexadecimal number of NUMRET value	1 byte
11	Start transmission of scrambling sequence[6].	N/A	0
12	Stop transmission of scrambling sequence[6].	N/A	0

[1] The CURRENT_BASE is not permanently set and may be changed by the base evaluation process in the roaming algorithm.

[2] This function will cause the radio modem to lock on to a specific base station as currently defined in CURRENT_BASE and not to roam to other base stations. The lock state is maintained until a “PA06 04” command is issued or the radio modem is powered down.

[3] This command will set the dynamic parameters to defined states as follows:

Parameters	Set to
AREA LIST	ALL AREAS
NETID	The first NETID according to the operator configuration

Parameters	Set to
TEMP_DEFAULT_LIST	The list is set to contain zero (“0”) number of entries
CURRENT_LIST	The list is set to contain zero (“0”) number of entries
UP/DOWN frame sequence number	1/1
OPERATING MODE	NORMAL MODE
BORN/UNBORN	UNBORN (The first message that will be sent to the network is BORN.)
Received/send buffers	Erased zero (“0”) entries.

All other non-dynamic parameters (such as ESN, TTI, FBI, TXADJ, channel class,...) are set to their manufacturer and operator value.

[4] This function enables the radio modem to copy the REPMAP field from all received or sent <REB> frames to the PC. After this command is issued by the PC, the radio modem should spontaneously send the “PA06 06” reply to the PC for every <REB> received or sent. For example, the code “0F” indicates that the 15th bit is set in REPMAP and represents a retransmission request for block 15. Every bit set in REPMAP is represented in the same way separated by commas. This state is maintained until the radio modem receives a “PA06 07” command or is switched off.

[5] This function will enable the radio modem to copy the current value of NUMRET to the PC, where NUMRET is a link layer parameter that is included in access frames such as <ABD>, <ABT> and <ABL>. This parameter represents the number of retransmission attempts completed when accessing a channel, and is always set to zero at the initial attempt. For instance, a “PA06 10,02” command indicates to the PC that the second retransmission attempt has been completed.

[6] This function will cause the radio modem to continuously transmit the scrambling sequence (or pseudo-random sequence pattern) until a “PA06 12” command is received from the PC or the radio modem is powered down. The command is used for testing the physical layer in the radio modem, and must only be activated in a test environment. A radio modem’s transmitter may be damaged if this function is being tested for a prolong period of time.

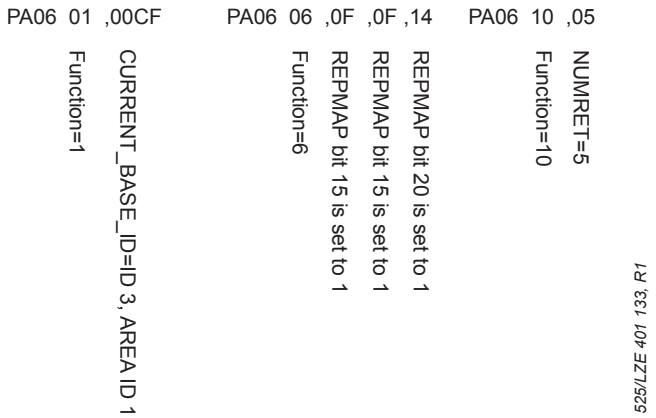

Figure 141 Example of a response to a PA06-command.

3.4.47 PA07-command, Request/List Battery Saving Protocol Parameters

Direction: PC to Radio modem

Radio modem to PC

The PA07 command is sent by a terminal to the radio modem to request battery-saving protocol parameters. If any of the parameters are unavailable, the radio modem may present either zeros or a blank (empty) in the corresponding location. The terminal sends a PA07 to the radio modem which responds with the following:

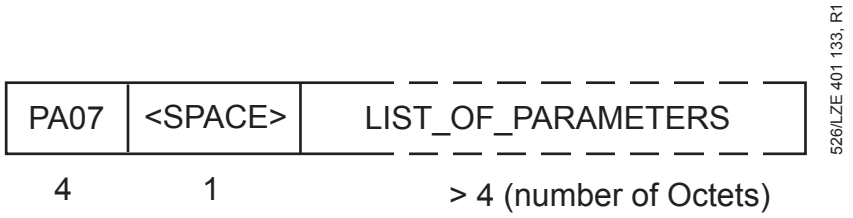

Figure 142 Structure of the PA07-command text field. The data field is empty.

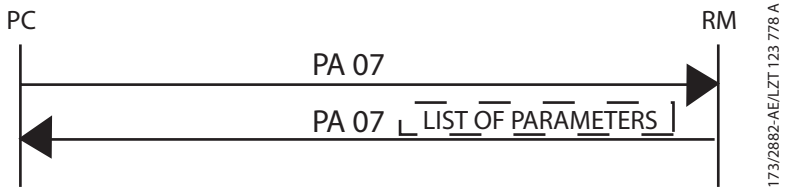

Figure 143 Direction of the PA07-command.

PA07 CYCLE_TIME, TIME_TO_NEXT, TRANSACTION_TIME, EVAL_CURRENT, EVAL_OTHERS

All values are given in ASCII coded Hexadecimal numbers:

Parameter	Size	Definition
CYCLE_TIME	1 byte	The time between the start of the operated states in the radio modem. Value is 0-255 x 250ms.
TIME_TO_NEXT	1 byte	The time measured from the first bit of the frame head of the received <SVP6> to the time the radio modem should enter the Operating state. Value is 0-255 x 250 ms.
TRANSACTION_TIME	1 byte	The amount of time the radio modem will stay in the Operating state after receiving or transmitting an <ACK>. Value is 0-255 x 250ms.
EVAL_CURRENT	1 byte	Time used to evaluate base stations on the CURRENT_SYSTEM_CHANNEL. Value is 0-255 sec.
EVAL_OTHERS	1 byte	Time used to evaluate base stations on other channels. Value is 0-255 RSSI periods.

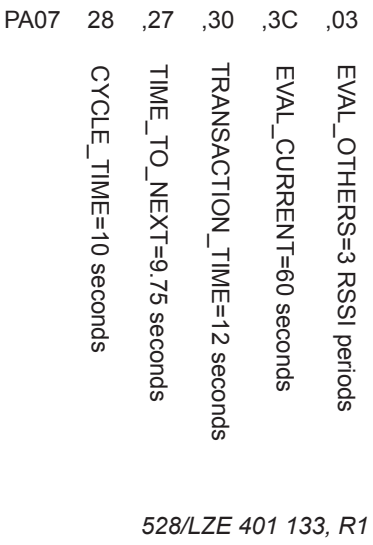

Figure 144 Example of a response to a PA07-command.

3.4.48 PA09-command, Request/Reply INVALID_LIST Parameters

Direction: PC to Radio modem

Radio modem to PC

The PA09 command is used by the terminal to request the INVALID_LIST parameter used in the repetitive roaming prevention algorithm. The list of parameters consists of ASCII coded hexadecimal numbers separated by commas (,).

A parameter is excluded from the list if it is not available or not given.

If the INVALID_LIST is empty, the value of COUNT is zero and only the MAXREJ and REJTIM is given.
All values are given in ASCII coded Hexadecimal numbers:

Parameter	Size	Definition
MAXREJ	1 byte	This parameter states the maximum number of rejections on a channel or a base station before it is marked in the INVALID_LIST.
REJTIME	1 byte	This states the maximum time in 5 minute steps where a channel or base station can be marked in the INVALID_LIST.
RSSI_PROC	1 byte	This parameter is set to 00 if FRAME mode is used and set to 01 if CONTINOUS mode is used in the network.
COUNT	1 byte	The parameter COUNT states the number of base stations in the list.
base ID/CH#1	2 bytes	A base station is identified by the channel number in CONTINOUS mode and by the base ID in FRAME mode. The channel number is presented with the FBI bits excluded in channel number, that is, the FBI bits are set to zero. The base ID is presented in the second byte of the field and all the bits in the first byte is set to zero.
REPCOUNT#1	1 byte	The parameter REPCOUNT states the current value of the repetition counter.
REPTIME#1	1 byte	This parameter states the elapsed number of 5 minutes steps of the REJTIME.
.	.	.
.	.	.
.	.	.
base ID/CH#N	2 bytes	
REPCOUNT#N	1 byte	
REPTIME#N	1 byte	

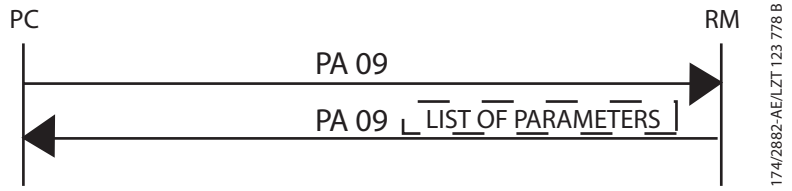

Figure 145 Direction of a PA09-command.

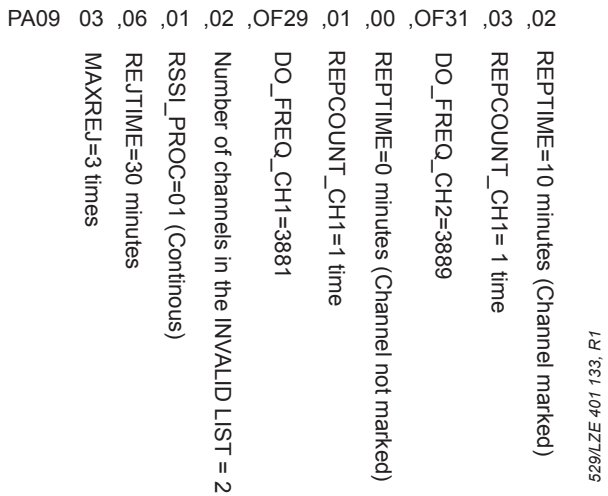

Figure 146 Example of a response to a PA09-command.

3.4.49 PA10-command, Setting the MODE/SKIPNUM Parameters

Direction: PC to Radio modem

Radio modem to PC

This command is required in radio modems supporting the battery saving protocol. The command is used to retrieve the setting of the MODE and SKIPNUM parameters in the radio modem.

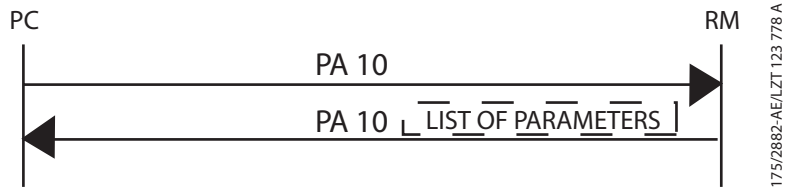

Figure 147 Direction of a PA10-command.

MODE (X)	SKIPNUM (n)
1= Normal mode	SKIPNUM=2n, where n=0-4
2=Battery Saving Mode	

3.4.50 K-command, Receive/Transmit Frequency Number

Direction: PC to Radio modem

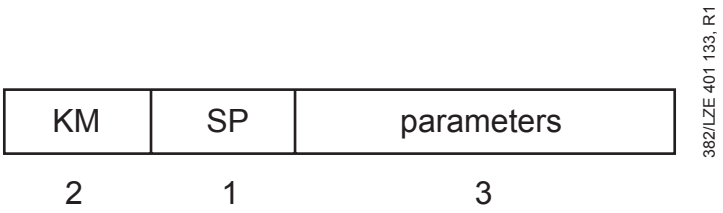

Figure 148 Structure of the text field to frequency number reception. The data field is empty.

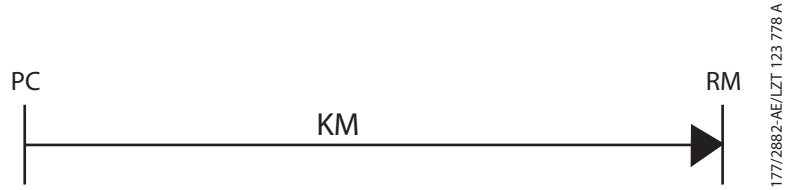

Figure 149 Direction of the command.

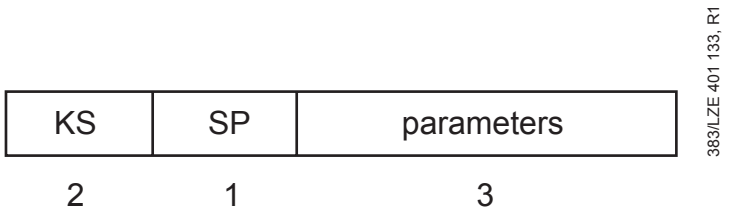

Figure 150 Structure of the text field to frequency number transmission. The data field is empty.

Figure 151 Direction of the command.

The parameter field states the frequency number. The number is given as the ASCII codes of the hexadecimal digits of the frequency number in hexadecimal notation.

The K command is used to set up the frequency pair to be used for reception and transmission. The frequency number range is hexadecimal 001-617 (decimal 0001-1559).

If the frequency number included in the frame is not implemented in the equipment, the radio modem will respond with an E command (error function).

3.4.51 KA-commands, Set/Receive Transmit Frequency Band and Number

Direction: PC to Radio modem

These commands are used to force the radio modem to lock on specific transmit channel, receive channel and FBI (frequency band information) for test purposes. The up and down frequencies can be set independently and with any restriction to fixed duplex spacing. This frequency locking overrides and disables the roaming algorithm, and link layer channel orders, such as <BKD>, <BKT> and <BBT>. The radio modem is locked on the specified frequencies until it is powered down. If the FBI or frequency (channel) number included in the frame is not implemented in the equipment, the radio modem will respond with an E command (error function).

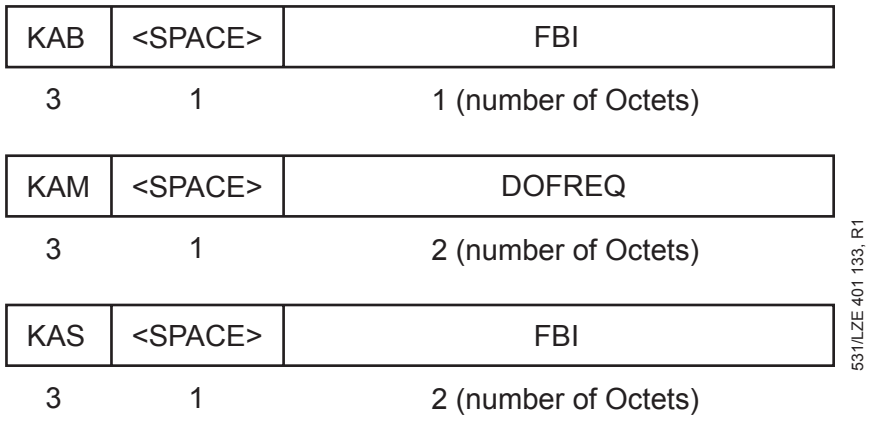

Figure 152 Structure of the text field for the KA-commands.xxxx 531 LZE

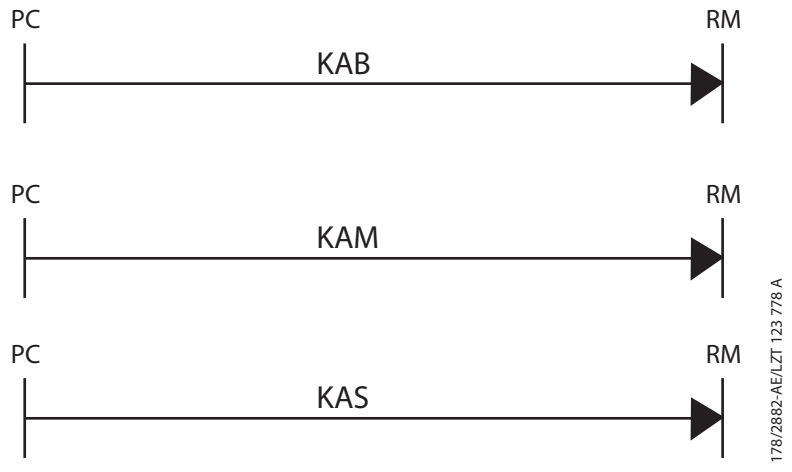

Figure 153 Direction of the KA-commands.

All values are given in ASCII coded Hexadecimal numbers:

Parameter	Size	Definition
FBI	1 byte	The frequency band information, FBI, is used in conjunction with the DOFREQ and UPFREQ on the airlink. The actual FBI information in the INFO MPAK is not affected by this setting.
DO_FREQ	2 bytes	
UP_FREQ	2 bytes	

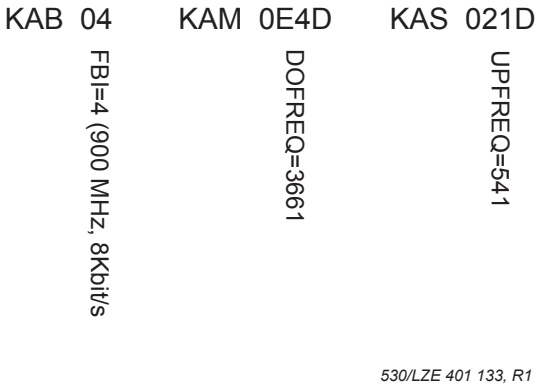

Figure 154 Example of KA-commands.xxxx 530 LZE

3.4.52 Network Status and Error Messages

Certain network status and radio modem conditions, as well as fault situations, cause error messages.

This is a recommendation for error messages from the radio modem to the connected terminal device using a MASC interface.

An error message indicates a fault situation in the radio modem and can either be sent by the radio modem as a response to a command from the PC or it can be sent sporadically. The error codes that can be sent sporadically in idle state are marked with a 1 and error codes that are sent sporadically during other states (that is, buffer full conditions) are marked with a 2. The error message is sent as an error number contained in an F K-command.

Error numbers 0 - 4F are reserved for specific meaning. Error numbers above 50 - FF are free to use except those listed in the table below.

Error Code No.	(1)	Description
01	*	DIE mode. Ordered from the network.
02	*	LIVE mode. Ordered from the network.
03		
04		MANUAL mode. The radio modem is in manual mode and not in contact with the Mobitex network.
05		Reserved
06		Reserved
07		Reserved
08		Reserved
09		Reserved
0A	*	Transmit buffer space upper limit reached: the last MPAK was added to the transmit buffer queue, but there is now insufficient space left for another full size MPAK. The radio modem cannot receive more MPAKs from the network.
0B	*	Buffer/memory free. The radio modem can receive MPAKs from the network.
0C		Receiver buffers for data from PC are full.
0D	#	Receiver buffers for data from PC are free.
0E		Reserved
0F		Reserved
10		Returned command during DIE mode.
11		Returned command during SPEECH mode.
12		Returned command during MANUAL mode.
13		The radio modem returns MPAK to PC during transmit due to transmit memory space buffer full condition, that is, the memory space in Kbytes allocated for transmit buffer is used up, so the last MPAK could not be queued.
14		Reserved
15		Reserved
16		Login request denied, MAN already exists in the FLEXLIST.
17		Login request denied. The FLEXLIST is full.
18		MPAK sender MAN is not the TMAN nor in the FLEXLIST.
19		Reserved

Error Code No.	(1)	Description
1A		Reserved
1B		Reserved
1C		Reserved
1D		Reserved
1F		Reserved
20-4F		Reserved
51		Illegal MPAK type, must not be transmitted.
52		Illegal MPAK state.
53		Illegal MPAK flags.
54		Illegal sendlist.
55		Illegal MPAK length.
56		Illegal addressee in MPAK.
61		TEMP_DEFAULT_LIST received from PC is incorrect.
62		MPAK returned on command (frame FI or FO).
63		User tries to change into already ACTIVE mode (normal/battery saving mode).
64		
65		Mode change already in progress. The message will be sent or displayed if two equal mode change orders are received consecutively.
66		Invalid network ID.
A0		Transmit buffer full. Not enough memory in the buffer to hold an MPAK of maximum length.
E0		Unsuccessful radio transmission.
F0		Transmit buffer full condition, that is, the number of MPAKs in the transmit buffer has exceeded the maximum allowable number of MPAKs. The last MPAK could not be added to the transmit buffer. Note that this error is not the same as the F K13 frame because it deals with the number of MPAKs in the buffer instead of total memory space allocated for the transmit buffer.
F1	*	Modem battery OK. This message is sent when the battery level has been restored in the radio modem or in the modem module of a non-integrated radio modem.
F8		The radio modem’s transmitter has been turned off.
F9	*	Incompatible radio transceiver module. This error is only used in non-integrated radio modems (separate radio modem and radio transceiver).

Error Code No.	(1)	Description
FA	*	Radio transceiver low battery. This error is sent when low battery is detected in the radio transceiver of a non-integrated radio modem.
FB	*	Modem battery low. This error is sent when low battery is detected in the radio modem or in the modem module of a non-integrated radio modem.
FC	*	Fatal radio error (unrecoverable fault in the radio transceiver).
FD	*	Other error. The radio modem is not able to transmit any MPAKs.

(1) These error codes may be sent unsolicited by the radio modem in F K commands.

"*" indicates that an F K command with this error code may be received by the PC during any state.

"#" indicates that an F K command with this error code may be received by the PC during specific states like buffer full conditions but not directly as a response to a packet sent from the PC.

4 MPAK Protocol Description - General

This chapter describes the general structure of the information packets used in the radio modem.

4.1 The Network Layer

The Mobitex network protocol defines the data communications and control functionality provided by the network to the user applications and mobile terminal equipment.

All information interchange between the radio modem and the surrounding region must comply with the protocol.

4.1.1 Mobitex Packet, MPAK

Information is stored in packets called MPAKs which are embedded in the information frames of the MASC protocol. As you can see from the previous chapter, the information frames that may contain MPAKs are the M, N, and R frames.

The following table shows which MPAKs you must be able to handle in your PC. The table also shows the transfer direction of different MPAKs between the PC, the radio modem, and the Mobitex network.

Packet class	MPAK	Remarks
PSUBCOM:	TEXT	Bi-directional
	DATA	Bi-directional
	STATUS	Bi-directional
	HPDATA	Bi-directional
	EXTPAK	Bi-directional
DTESERV:	LOGINREQ	Directed from the mobile terminal to the network
	LOGINGRA	Directed from the network to the mobile terminal
	LOGINREF	Directed from the network to the mobile terminal
	LOGOUT	Directed from the mobile terminal to the network
	LOGOUTORD	Directed from the network to the mobile terminal
	BORN	Directed from the mobile terminal to the network
	ACTIVE	Directed from the mobile terminal to the network

Packet class	MPAK	Remarks
	INACTIVE	Directed from the mobile terminal to the network
	DIE	Directed from the network to the mobile terminal
	LIVE	Directed from the network to the mobile terminal
	ROAMORD	Directed from the network to the mobile terminal
	ROAM	Directed from the mobile terminal to the network
	GROUPLIST	Directed from the network to the mobile terminal
	FLEXREQ	Directed from the network to the mobile terminal
	FLEXLIST	Bi-directional
	INFOREQ	Directed from the network to the mobile terminal
	INFO	Directed from the mobile terminal to the network
	TIME	Directed from the network to the mobile terminal
	AREALIST	Directed from the network to the mobile terminal
	ESNREQ	Directed from the network to the mobile terminal
	ESNINFO	Directed from the mobile terminal to the network
	MODE	Directed from the mobile terminal to the network
	LOWPOWER	Directed from the mobile terminal to the network

4.1.2 Packet Classes

MPAKs are divided into different classes depending on how the information they contain is to be used. These classes are:

- PSUBCOM, for packet-switched subscriber communication
- DTESERV, for data-terminal service communication

A third class of MPAKs is called PSOSCOM for circuit-switched subscriber and alert communication. MPAKs of this class are not used in radio modems that are used for data communication only. Packets of this type are not described in this manual.

4.1.3 PSUBCOM

Five different MPAKs belong to this packet class: TEXT, DATA, STATUS, HPDATA and EXTPAK.

The first four MPAKs are packets transferred between subscribers within the Mobitex network, while EXTPAK is used for communication between external networks and subscribers in the Mobitex network.

All of these packets are used for communication between the mobile terminal and the network.

The difference between the packets are described in detail in *chapter 5 MPAK Protocol Description - Packet Formats*.

4.1.4 DTESERV

The DTESERV packets transfer information between a subscriber or mobile terminal and the network.

The purpose of DTESERV packets is to update the data necessary for network traffic switching in the mobile terminal or network.

4.2 Description of MPAKs

4.2.1 MPAK Format and Structure

This section describes the parts of the MPAK that are common to all types of packets. A description of the design of the various type-dependent parts of the packets in found later on in the Packet Formats chapter.

4.2.2 Packet Length

An MPAK may be up to 560 bytes long.

4.2.3 Packet Components

Each packet is divided into various components:

- Common component, that is, components that is common to all MPAKs.
- Address list, included in some types of PSUBCOM MPAKs. The PC creates the MPAK with an address list. The radio modem transmits it to the network which, in turn, copies the common and type-dependent components and forms a number of new MPAKs. These new MPAKs are sent to the addressees on the address list.
- Type-dependent components, included in all PSUBCOM, (PSOSCOM) and most DTESERV MPAKs. The size and application depends on the packet in question. Please refer to *chapter 5 MPAK Protocol Description - Packet Formats*.

The figure below describes the contents of the components that are common to all MPAKs, and the placement of the type-dependent components.

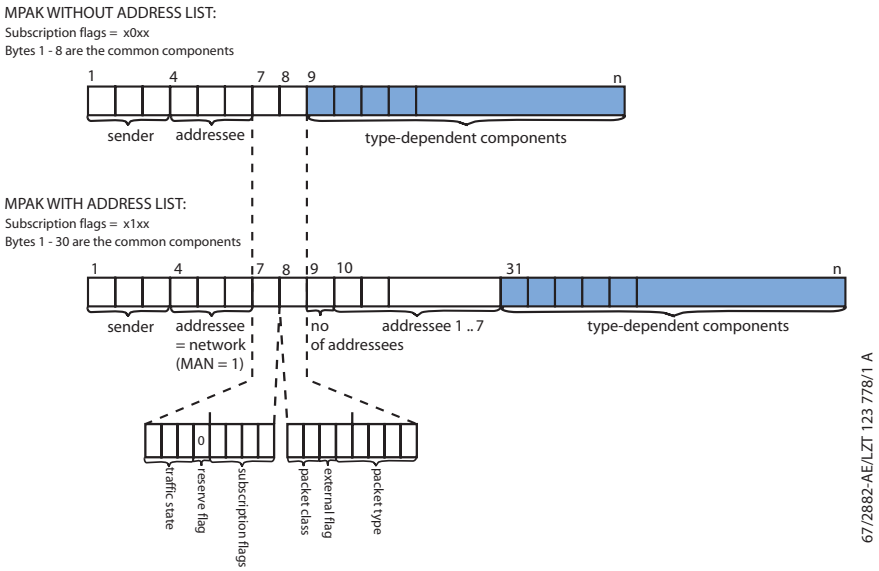

Figure 155 The contents of the common components

4.2.4 Mobitex Subscription Number, MAN

In this manual, the Mobitex subscription number is referred to as the MAN.

The MANs are reserved as follows:

0	Must not be used
1	The Mobitex network
2-6	External networks
7	All-Terminals Group MAN
8-20	External networks
21 - 99 999	Future network use
100 000 - 16 777 216	Subscriptions and groups

The PC should be capable of storing the following MANs:

- 1 MAN for the terminal's own subscription
- 1 MAN for the All-Terminals Group
- 14 MANs for optional individual group subscriptions
- 7 MANs for personal subscriptions

The MANs constitute sender identification when MPAKs are sent and addressee identification when they are received.

4.2.5 Components Common to all MPAKs

The common components of the MPAK are included in all packets transferred between the mobile terminal and the network.

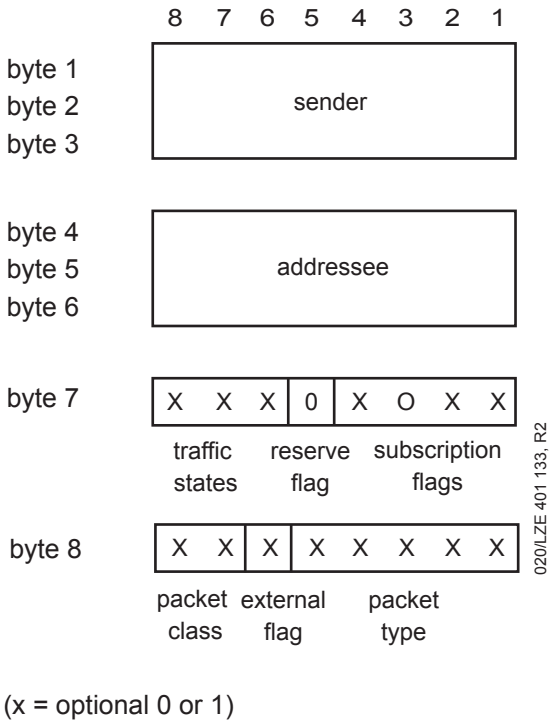

Figure 156 Common components in all MPAK.

Sender (bytes 1 - 3)

The sender is the originating subscription or network.
The sender's MAN is given in binary code in bytes 1-3.
The sender's MAN is either a terminal subscription, a personal subscription or a network MAN.[1]

Addressee (bytes 4 - 6)

The addressee is the subscription, group or network originally intended as the receiver - the original destination.
The addressee's MAN is given in binary code in bytes 4 - 6.
The addressee's MAN is either a terminal subscription, a personal subscription, a group or a network MAN.

Note: The SENDER and ADDRESSEE fields always indicate the original sender and addressee, that is, the contents of these fields are not swapped in return messages.

1.For a description of the different subscription types, see *chapter 7 Important Mobitex Functions*.

Subscription flags (byte 7, bits 1 - 4)

A subscription or mobile terminal can raise a number of flags in the common component of an MPAK. A flag is raised to the logical value one when its content is applied. Flags are raised independently of each other.

Flag 1, MAILBOX_F (byte 7, bit 1)	
MAILBOX_F = 0:	The message must not be placed in the network mailbox
MAILBOX_F = 1:	The message may be placed in the network mailbox

Flag 2, POSACK_F (byte 7, bit 2)	
POSACK_F = 0:	No positive acknowledgement
POSACK_F = 1:	Positive acknowledgement requested

Flag 3, SENDLIST_F (byte 7, bit 3)	
SENDLIST_F = 0:	Address list not included
SENDLIST_F = 1:	Address list included

Flag 4, UNKNOWN_F (byte 7, bit 4)	
UNKNOWN_F = 0:	Normal position
UNKNOWN_F = 1:	Subscriber not here

Reserve Flag (byte 7, bit 5)

This flag, which may be assigned a particular function in the future, must always be set to zero.

Traffic State (byte 7, bits 6 - 8)

The packet's traffic state is indicated by 3 bits which makes it possible to have seven different states.

The traffic state must always be set to zero when a packet is to be sent.

In the following table, the action paragraph states the action that an application is expected to perform when a packet is received.

A received packet will be in one of the following eight states:

State = 0:	OK
Meaning:	"OK" No problems have occurred during switching.
Action:	Display the message to the user. The traffic state does not need to be displayed.

State = 1:	FROM_MAIL
Meaning:	"From mailbox" This message comes from the network mailbox. For packets requesting positive acknowledgement that have been put in the addressee's mailbox, this message is an acknowledgement of the packet having been delivered to the addressee.
Action:	The message is displayed in the same way as other received messages. The traffic state, as well as the time of the day when the message was placed in the mailbox, should be displayed.

State = 2:	IN_MAIL
Meaning:	"Has been placed in mailbox" The addressee cannot be reached at the moment. The message has been placed in the network mailbox.
Action:	The message is a returned copy and should be displayed in the same way as other received messages. In certain cases, the presentation of the text and data in the type-dependent component may be omitted. The traffic state should be displayed.

State = 3:	NO_TRANSFER
Meaning:	"The addressee cannot be reached" The message can neither be transferred nor put in the network mailbox.
Action:	The message is returned from the network and should be displayed in the same way as other received messages. In certain cases, the presentation of the text and data in the type-dependent component may be omitted. The traffic state should be displayed.

State = 4:	ILLEGAL
Meaning:	The message could not be switched by the network.
Action:	The message is returned from the network and should be displayed in the same way as other received messages. In certain cases, the presentation of the text and data in the type-dependent component may be omitted. The traffic state should be displayed.

State = 5:	CONGEST
Meaning:	Line or radio channels are congested
Action:	The message is returned from the network and should be displayed in the same way as other received messages. In certain cases, the presentation of the text and data in the type-dependent component may be omitted. The traffic state should be displayed.

State = 6:	ERROR
Meaning:	"Technical error" The message cannot be transferred because of a technical error.
Action:	The message is returned from the network and should be displayed in the same way as other received messages. In certain cases, the presentation of the text and data in the type-dependent component may be omitted. The traffic state should be displayed.

Note: States 2, 3, 4, 5 and 6 indicate returned messages in which the SENDER and ADDRESSEE fields have not been swapped. When the terminal receives a packet with one of these states, the SENDER field contains one of the mobile terminal's own MANs (messages returned to original sender).

Packet type (byte 8, bits 1 - 5)

Within packet class = 0, that is, PSUBCOM:

EXTERN_F = 0:	Packet type 1:	TEXT
	Packet type 2:	DATA
	Packet type 3:	STATUS
	Packet type 4:	HPDATA
EXTERN_F = 1:	Packet type 1:	EXTPAK

Within packet class =3, that is, DTESERV:

EXTERN_F = 0:	Packet type 1:	LOGINREQ
	Packet type 2:	LOGINGRA
	Packet type 3:	LOGINREF
	Packet type 4:	LOGOUT
	Packet type 5:	LOGOUTORD
	Packet type 6:	BORN
	Packet type 7:	ACTIVE

Packet type 8:	INACTIVE
Packet type 9:	DIE
Packet type 10:	LIVE
Packet type 11:	ROAMORD
Packet type 12:	ROAM
Packet type 15:	GROUPLIST
Packet type 16:	FLEXREQ
Packet type 17:	FLEXLIST
Packet type 18:	INFOREQ
Packet type 19:	INFO
Packet type 20:	TIME
Packet type 21:	AREALIST
Packet type 22:	ESNREQ
Packet type 23:	ESNINFO
Packet type 24:	MODE
Packet type 31:	LOWPOWER

External Flag (byte 8, bit 6)

The external flag is raised to indicate that the packet is being used in traffic with an external network.

The flag must be lowered to indicate internal traffic in Mobitex.
EXTERN_F = 0: Internal traffic
EXTERN_F = 1: External traffic

Packet Class (byte 8, bits 7 - 8)

This 2-bit field in the common component of the MPAK, indicates the class to which the packet belongs. The packet class can thus have the decimal value 0-3. Three classes are implemented. There are four classes, but only three are implemented in the radio modem.

The three classes are:
Packet class = 0: PSUBCOM
Packet class = 3: DTESERV

4.3 Address List

In order to increase network efficiency, messages with more than one designated addressee should be sent to the network along with an address list containing all the MANs of the addressees. A maximum of seven addressees may be listed in one MPAK. An address list is included in transmitted messages; received messages, on the other hand, do not usually contain an address list.

A packet with an address list is usually converted by the network to a number of packets, one for each addressee. These packets are identical except for the addressee information.

If an address list is included in the MPAK, it must be indicated by a raised flag, SENDLIST_F, in the common component of the MPAK.

The address list must always begin with byte 9 and end with byte 30.

Note: The address list is always 22 bytes long, irrespective of how many addresses the sender wishes to send.

The address list always starts with a field called “number of addresses” which indicates how many of the following seven address fields hold valid addresses.

The “number of addresses” field is 1 byte long while the address fields are 3 bytes.

The empty address fields must be filled with zeroes.

4.3.1 Type-Dependent Component

If an address list is included in the MPAK, the type-dependent component begins with byte 31. Otherwise it begins with byte 9, immediately after the common component of the MPAK.

The fields of the type-dependent components are described in detail in *chapter 5 MPAK Protocol Description - Packet Formats*.

4.4 Protocol

The protocol used for the interchange of packets between a mobile terminal and the Mobitex network is described in this chapter. Packet interchange is carried out in the form of dialogues in the network layer. The main theme of these dialogues will be outlined in this section. Examples of dialogues of this type are given later in *chapter 6 Mobitex Dialogues*.

Some packets sent by the mobile terminal should be transferred to another subscriber, while others are meant for the network itself.

Only packets containing an address or sender included in the radio modem's own list of MANs will be handled. If a packet with an address that does not exist in the radio modem's list of MANs reaches the radio modem's network layer, it will be returned to the network with the subscription flag UNKNOWN_F set to 1. See the Flags paragraph in *chapter 4.4.4 How to Use the Common Component Fields of the MPAK*.

4.4.1 Traffic Handling Principles

Negative Acknowledgement

In Mobitex, negative acknowledgement is used, that is, packets that have reached their addressees are not acknowledged at the network layer level. Packets that have not reached its addressees will be returned to the sender, and an indication of the reason for return will be given in the traffic state field of the packet.

Positive Acknowledgement

In some cases, the sender of data, or the application, will require acknowledgement of data that has been successfully transferred. This calls for positive acknowledgement. Nowadays positive acknowledgement is implemented in quite a few networks.

Note: Positive acknowledgement is not available in all networks. Please refer to the network operator to find out if positive acknowledgement is implemented. Positive acknowledgement is only available to mobile subscribers.

If positive acknowledgement is available, two conditions must be met in order to use it:

- The sender must have the service included in his subscription.
- The service must be ordered for each packet data transmitted.

The function is activated by raising the flag POSACK_F in packets of the types TEXT, DATA, HPDATA, and STATUS. The addressee may only be a mobile terminal, or a personal subscriber who is logged in to a mobile terminal.

Positive acknowledgement cannot be used for packets sent to groups, fixed terminals, or personal subscribers who are logged in to fixed terminals.

When positive acknowledgement is requested, the transmitted packet will be returned with the POSACK_F flag raised when the addressee has received the packet. The returned packet is the acknowledgement. If the addressee is unreachable at the time of the packet being transmitted from the sender, if he has subscribed to the mailbox service, and if the MAILBOX_F flag is raised on the outgoing packet, the acknowledgement packet will be transmitted to the sender when the addressee becomes active in the network and receives the packets stored in the mailbox.

Packets sent with both sendlist and positive acknowledgement activated, will receive an acknowledgement from every addressee.

A positive acknowledgement returned to the sender will not be put in the mailbox.

A positive acknowledgement that cannot be returned to the original sender, will be discarded by the network.

4.4.2 Activation/Inactivation

In order to avoid transmission attempts to contact terminals which cannot be reached, an activation/inactivation procedure is included at the terminals.

Inactivation

The terminal should deactivate itself by automatically transmitting an INACTIVE packet to the network:

- Before it is powered off.
- When the terminal's message buffer is full and the terminal is incapable of handling more packets from the network.

A terminal may also be deactivated by the network. This occurs if the network repeatedly fails to reach the terminal with traffic.

The terminal and its personal subscriptions are then regarded as inactive by the network until it receives any packet from the terminal. When a subscription is inactive, traffic to it is forwarded to the network mailbox, or returned to the sender without attempting to reach the terminal. Messages are stored in the network mailbox according to the principle described in *4.4.3 Mobitex Network Mailbox*.

If contact is lost during an attempt to transmit the INACTIVE packet no further attempts are made. If contact is already lost when INACTIVE is to be sent, no transmission at all is attempted.

Activation

The terminal should activate itself by automatically transmitting an ACTIVE packet to the network:

- When it is switched on.
- When the terminal's buffer has space for at least 6 messages of maximum length.
- When the data link layer in the mobile terminal indicates that the terminal should activate itself. This situation arises when the data link layer has lost contact with the radio base station, and the contact is re-established with the same base station again (while in express mode). Also in all cases when a

mobile terminal roams to or from a donor base station and its corresponding Frequency Translation Repeater.

4.4.3 Mobitex Network Mailbox

The mobitex mailbox facility is an optional service that the Mobitex operator may include in a terminal or personal subscription.

A message that cannot reach its addressee may be stored in the mailbox if:

- The addressee subscribes to the mailbox service
- The sender of the message has indicated the possibility by raising the flag MAILBOX_F

Note: Both conditions must be fulfilled.

If the message is stored in the mailbox, a copy will be returned to the sender with the traffic state set to IN_MAIL (state 2).

When the subscription becomes activated again, packets stored in the mailbox will be sent to the subscription. Packets stored with OK traffic state (state 0) will be given the new traffic state FROM_MAIL (state 1). Packets stored with other traffic states will pass the mailbox unchanged.

No other changes will be made in packets forwarded through the mailbox.

4.4.4 How to Use the Common Component Fields of the MPAK

This section gives guidelines for using the fields in the common component of the MPAKs.

Traffic States

The purpose of the traffic state is to inform the PC of the state of each individual packet. The traffic state field of a returned packet contains information explaining why the packet was returned.

A packet, originated from an MPAK that has an address list included, may be returned without the address list. When this occurs, it means that the network has tried to forward the individual message to the correct addresses. Otherwise, the original MPAK, with the address list included, will be returned.

The following rules apply:

- It is not possible to indicate more than one traffic state in the traffic state field.
- A traffic state relates only to the packet in which it is included.
- A packet should always have the traffic state “OK” when it is generated by a PC.
- The PC must never change the traffic state of a packet.

Flags

The PC must be able to raise a number of flags in the MPAK common component. The flags are:

- MAILBOX_F
  This flag is used by the sending PC to indicate to the network that it is allowed to store the packet in the network mailbox. The packet is stored in the mailbox if it cannot be forwarded to the addressee. MAILBOX_F should be raised when ordered by the user; however, it may also be raised by default.
- POSACK_F
  This flag is raised by the PC to request a positive acknowledgement in packets of the types TEXT, DATA, HPDATA, and STATUS.
- SENDLIST_F
  This flag indicates an MPAK with an address list. SENDLIST_F is raised by the PC when the sender gives more than one address for a message.
- UNKNOWN_F
  The receiving mobile terminal raises this flag if the addressee (or the sender in case of returned packets, traffic states 2, 3, 4, 5 and 6) of a received message is not in the mobile terminal’s list of subscriptions. The message is then returned to the last sender.
- EXTERN_F
  This flag is raised by the sending PC to indicate that the packet belongs to traffic with an external telecommunication network connected to Mobitex.
- RESERV_F
  This flag is not used. It must always be set to 0 by the PC.

Two of the flags in the message received, POSACK_F and EXTERN_F, are important for the PC to read.

4.4.5 Generating MPAKs

The fields in the common components of the MPAK should be used as per the description in this and the following chapters.

4.4.6 Erroneous MPAKs

If the MPAK sent from the PC is erroneous, the radio modem will respond with an FK-frame containing an error code. See *chapter 3.4.16 F K, Error Message about a Fault Situation*.

4.4.7 Receiving MPAKs

Packets are received by the PC for one of the following reasons:

- Normal transmission:
  The packet is sent to the addressee, the ADDRESSEE field matches a MAN stored in the receiving mobile terminal.

  The application should present the message to the subscription that holds the addressee's MAN.

- Packets returned from the network:
  The packet is returned to the original sender, the SENDER field matches a MAN in the mobile terminal.

  In this case, the packet was originally generated by one of the mobile terminal's subscriptions, but for some reason was returned from the network. The traffic state field indicates the reason for return, that is, by indicating one of the traffic states 2, 3, 4, 5 or 6.

  Returned packets must not be sent back to the network. They should be forwarded to the application layer.

  If SENDLIST_F is set, the packet has not been forwarded to any addressee. Either the packet type was not acceptable, or an error occurred before the network unpacked the address list.

  If POSACK_F is set, the packet is a positive acknowledgement of a request sent earlier. If the traffic state is either "OK" or "FROM MAIL", the message has been forwarded to the addressee.

- Packets sent to subscribers not listed in the mobile terminal:
  Note 1: The radio modem will perform the following actions automatically, that is, without any assistance from any application program.

  The received packet is addressed to a subscriber who is not in the mobile terminal's list of MANs at present. This may occur if a packet was addressed to a personal subscription that logged out at the instant the packet was received.

  The packet will be returned by the radio modem with the UNKNOWN_F flag raised. All other flags and the SENDER, ADDRESSEE, and TRAFFIC STATE fields will remain unchanged.

Note 2: A packet received by the PC must not be returned unchanged to the radio modem.

4.4.8 MPAKs Returned by the Link Layer

If the link layer in the radio modem has lost contact with the Mobitex network, and a data packet is sent from the PC, the packets will be returned.

Note that although the packets may have been successfully received by the network, the radio modem did not properly receive the acknowledgement.

The contents of the returned packets are not changed.

If this situation occurs, the packets should be considered as not having been transmitted. The application must make another attempt to send the untransmitted packets.

4.4.9 MPAKs Returned by the Network Layer to the Application Layer

The network may send an order to the radio modem to stop sending user traffic.

The PC is notified by the radio modem via an F K-frame. The application layer should then be notified that the order has been received. When the radio modem enters this state, no data packets will be transmitted from the radio modem. Data packets cannot be transmitted until the radio modem receives a “resume user traffic” order from the network.

The order from the network that contains “resume user traffic” is sent to the PC as an FK-frame. The information should be forwarded to the application layer, to indicate that user traffic may resume.

4.4.10 Message Buffers

The radio modem has one reception buffer for packets received from the network but not yet read by the PC, and one transmission buffer for packets sent by the PC but not yet transmitted to the network.

Reception Buffer

If the reception buffer becomes full, an INACTIVE packet is sent to the network. Traffic sent to the deactivated mobile terminal will be placed in the mailbox or returned to the sender.

When the radio modem’s buffer is full, the PC is informed by an F K-frame.

An ACTIVE packet is sent to the network as soon as the buffer has been emptied. Normal traffic between the mobile terminal and the network will be resumed.

Sending Traffic while the Buffer is Full

The application may send user traffic (PSUBCOM) when the reception buffer is full. The packets will be queued in the radio modem's transmission buffer and transmitted as soon as the radio modem becomes active again, that is, when the reception buffer has been emptied.

Transmission Buffer

The size of the transmission buffer is enough to store at least one packet of maximum length. If the transmission buffer is full, the PC will be notified by an F K-frame (F KA0).

If a packet is sent to the radio modem from the PC when the transmission buffer is full, it will be returned in an N-frame.

4.5 Text/Data/HP-data/Status Message

The following section explains the different uses of the information part of type-dependent components of the MPAK.

4.5.1 Text Messages

The information part of a text message must be coded according to international ASCII standards, ISO 646. The maximum size of a text message is 512 characters of user information.

4.5.2 Data Messages

Data messages can be used instead of text messages when information is to be transferred in formats other than ASCII. In contrast to text messages, the information parts of data messages may be freely coded by the individual application. A data message can consist of maximum 512 bytes of user information.

4.5.3 HP-data Messages

HP-data (that is, higher protocol data) can for example handle messages that exceed the maximum size for text or data messages. In the transport layer (in the user application), the original message is disassembled into several sub-messages. Each sub-message can consist of a maximum of 512 bytes of user information and one byte of protocol identification. The sub-messages are transmitted as HP-data MPAKs by the network layer.

The transport layer of the receiving PC reassembles the sub-messages back into the complete message.

Note: The order in which the different sub-messages are sent to the receiving PC is controlled by the network.

4.5.4 Status Messages

A status message consists of a numerical code between 0 and 255, which provides 256 different status messages that can be transferred. These are coded by the subscriber as per the user application. Coding the message provides extra security.

5 MPAK Protocol Description - Packet Formats

This chapter gives an individual description of the structure of the type-dependent components in each MPAK.

The state of the different flags in the common components is also shown in this chapter.

Descriptions of the structure of all other components are found in the previous chapter, *chapter 4 MPAK Protocol Description - General*.

5.1 Fields Common to Several Packet Types

The following fields appear in the type-dependent components of several packet types.

5.1.1 MAN

Always uses 3 bytes. The MAN is in the range of 1-16,777,215 (decimal notation), see also *4.2.4 Mobitex Subscription Number, MAN*.

The MAN is always given as a 24-bit binary-coded number.

Example: MAN 12345678 (decimal) equal BC614E hexadecimal. The binary equivalent will be:

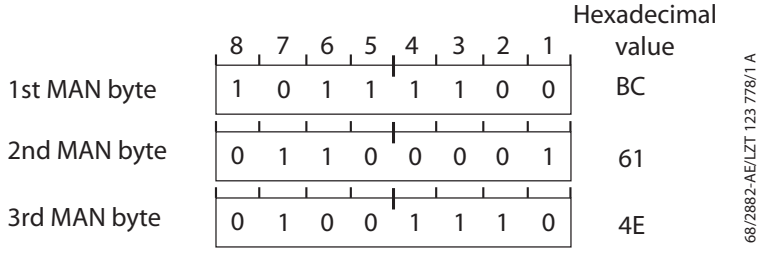

Figure 157 MAN bit representation.

5.1.2 Time

The time field must be set to zero when a message is sent from a PC. The time information is inserted by the network when the packet enters the first node. Time information may be used by the PC when it receives an MPAK.

The time is given as *Mobitex Minute* in 3 bytes, indicating how many minutes have elapsed since 12.31.1984 at 12:00 midnight, *Mobitex Local Time*. The time indication is given as a hexadecimal number.

Description of formulas for calculating *Mobitex Minute* to *Mobitex Local Time*:

hour =	(Mobitex_minute MOD 1440) DIV 60
minute =	(Mobitex_minute MOD 1440) MOD 60
MD =	Mobitex_minute DIV 1440
MT =	(4291 + 10 * (MD - (36525 * ((100 * MD + 30690) DIV36525)) DIV100)) DIV10
year =	1984 + (100 * MD + 30690) DIV 36525 + MT DIV 429
month =	(100 * MT) DIV 3061 - 1 - 12 * (MT DIV 429)
day =	MT - ((100 * MT) DIV 3061 * 3061) DIV 100

Note that the calculated time of day is given in 24-hour format.

In the formulas above, DIV is the integer of a division while MOD is the remainder of the division (7 DIV 3 = 2 and 7 MOD 3 = 1)

Example: We assume that the time is given as 876241 in decimal notation (0D5ED1 hexadecimal) The time-indicating field looks like this:

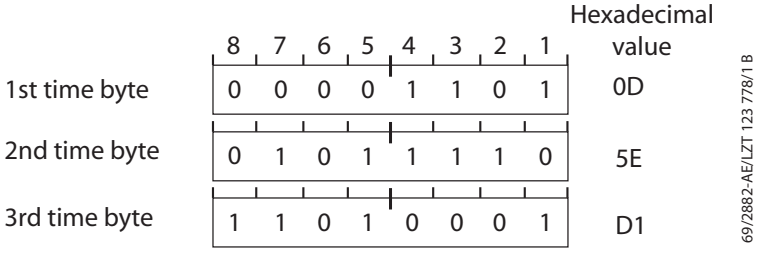

Figure 158 Time bit representation.

Using the formulas given above, the following values will apply:

hour = 12
minute = 1
MD = 608
MT = 307
year = 1986
month = 9
day = 1
Thus, the time is 12:01 PM (one minute after noon) on September 1st, 1986.

5.1.3 Protocol Identification

1 byte (0-255 decimal) selected by the sender.

Description

The field is used in the HPDATA MPAKs to indicate that a protocol above the network layer is in use.

The decimal number 0 implies that no protocol is being used.

The decimal number 1 to 127 is regulated by the *Mobitex Operator's Association (MOA).*

Protocols that are registered by the network operator use decimal numbers 128 to 255. For more information refer to the *Mobitex Interface Specification (MIS).*

5.2 PSUBCOM

This part of the description deals with MPAKs in the packet class 0, “Packet Subscriber Communications” or PSUBCOM.

The following applies to all PSUBCOM packets except EXTPAK:

Designated Sender

A terminal or personal subscription.

Designated Addressee, MPAKs without Address List

Terminal subscription, personal subscription or group.

Designated Addressee, MPAKs with Address List

The network is stated in the ordinary addressee field.

The intended message receivers are indicated in the address list.

Raised Flags, MPAKs without Address List

MAILBOX_F and POSACK_F are optional.

Raised Flags, MPAKs with Address List

SENDLIST_F is compulsory. MAILBOX_F and POSACK_F are optional.

MPAK Structure

Accompanying each description is a structure diagram of the unique fields of each packet. For fields not shown, see *chapter 4.2 Description of MPAKs*.

Time Field

The time field must always be set to 0 (zero) by the sending PC. The network will insert the time as the packet reaches the network’s first node.

5.2.1 TEXT Message without Address List

Criteria for Generating the Packet

The user or application wants to send text information. See also *chapter 4.5 Text/ Data/HP-data/Status Message*.

The Network's Normal Action when Receiving a Packet

The network dispatches the packet to the designated address.

The PC's Normal Action when Receiving a Packet

The information in the packet is stored, processed and presented, or just presented, to the user of the addressed subscription.

Length of the Packet

The length varies between 12 and 523 bytes.

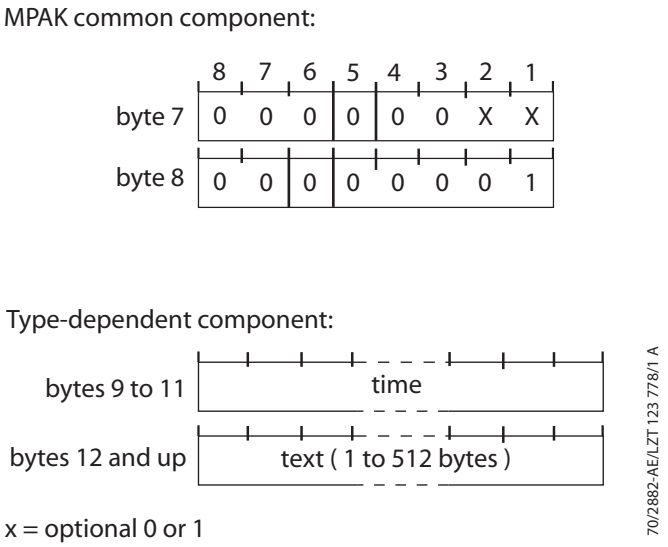

Figure 159 TEXT without address list generated by a PC.

5.2.2 TEXT Message with Address List

Criteria for Generating the Packet

The user or application wants to send text information to a number of designated addresses. See also *chapter 4.5 Text/Data/HP-data/Status Message*.

The Network's Normal Action when Receiving a Packet

The network will make up a new MPAK (without an address list) for each addressee on the address list. The new packet will have an address field containing one of the addresses from the address list in the original packet.

The PC's Normal Action when Receiving a Packet

The PC only receives this packet as a returned packet.

Length of the Packet

The length varies between 34 and 545 bytes.

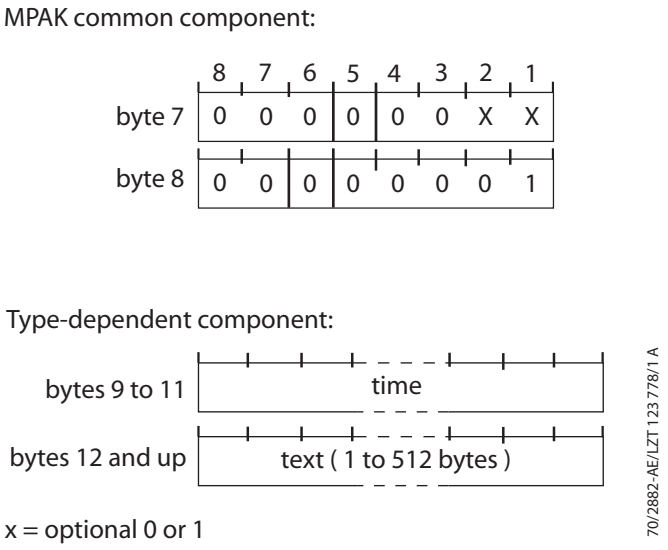

Figure 160 TEXT with address list generated by a PC.

5.2.3 DATA Messages without Address List

Criteria for Generating the Packet

The user or application wants to send data information. See also *chapter 4.5 Text/ Data/HP-data/Status Message*.

The Network's Normal Action when Receiving a Packet

The network dispatches the packet to the designated address.

The PC's Normal Action when Receiving a Packet

The information in the packet is stored, processed and presented, or just presented, to the user of the addressed subscription.

Length of the Packet

The length varies between 12 and 523 bytes.

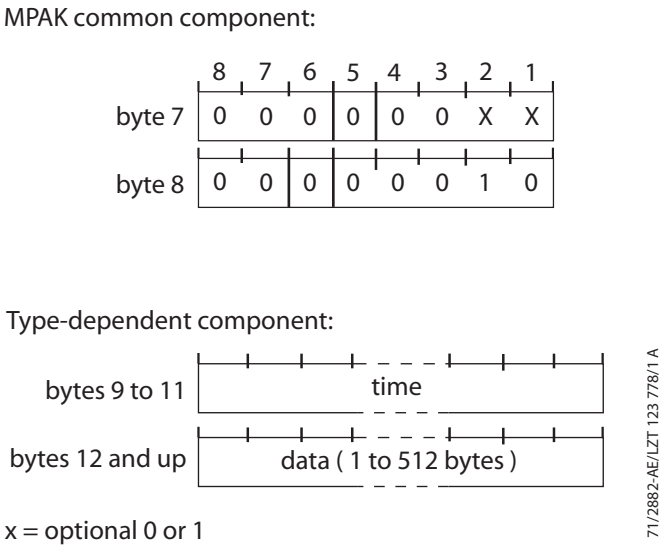

Figure 161 DATA without address list generated by a PC.

5.2.4 DATA Messages with Address List

Criteria for Generating the Packet

The user or application wants to send data information to a number of designated addresses. See also *chapter 4.5 Text/Data/HP-data/Status Message*.

The Network's Normal Action when Receiving a Packet

The network will make up a new MPAK (without an address list) for each addressee on the address list. The new packet will have an address field containing one of the addresses from the address list in the original packet.

The PC's Normal Action when Receiving a Packet

The PC only receives this packet as a returned packet.

Length of the Packet

The length varies between 34 and 545 bytes.

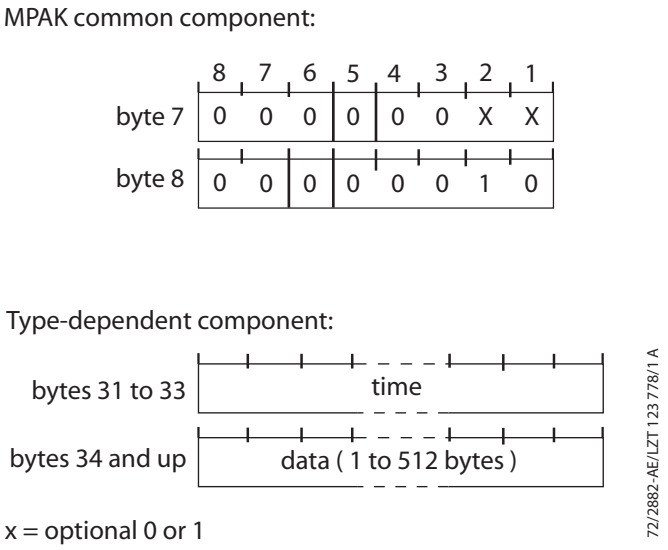

Figure 162 DATA with address list generated by a PC.

5.2.5 STATUS Messages without Address List

Criteria for Generating the Packet

The user or application wants to send status information. See also *chapter 4.5 Text/ Data/HP-data/Status Message*.

The Network's Normal Action when Receiving a Packet

The network dispatches the packet to the designated address.

The PC's Normal Action when Receiving a Packet

The information in the packet is stored, processed and presented, or just presented, to the user of the addressed subscription.

Length of the Packet

The length is 12 bytes.

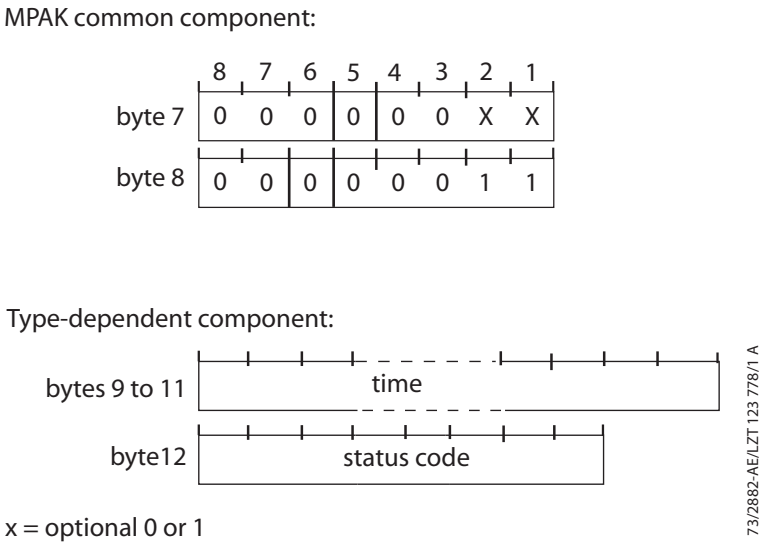

Figure 163 STATUS without address list generated by a PC.

5.2.6 STATUS Messages with Address List

Criteria for Generating the Packet

The user or application wants to send status information to a number of designated addresses. See also *chapter 4.5 Text/Data/HP-data/Status Message*.

The Network's Normal Action when Receiving a Packet

The network will make up a new MPAK (without an address list) for each addressee on the address list. The new packet will have an address field containing one of the addresses from the address list in the original packet.

The PC's Normal Action when Receiving a Packet

The PC only receives this packet as a returned packet.

Length of the Packet

The length is 34 bytes.

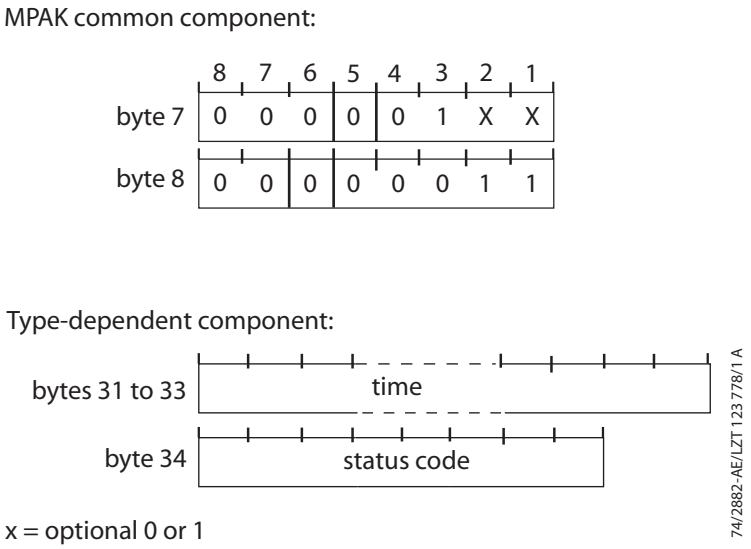

Figure 164 STATUS with address list generated by a PC.

5.2.7 HPDATA without Address List

Criteria for Generating the Packet

The user or application wants to send HP-data (data message with higher protocol identification) information. See also *chapter 4.5 Text/Data/HP-data/Status Message*.

The Network's Normal Action when Receiving a Packet

The network dispatches the packet to the designated address.

The PC's Normal Action when Receiving a Packet

The information in the packet is stored, processed and presented, or just presented, to the user of the addressed subscription.

Length of the Packet

The length varies between 13 and 524 bytes.

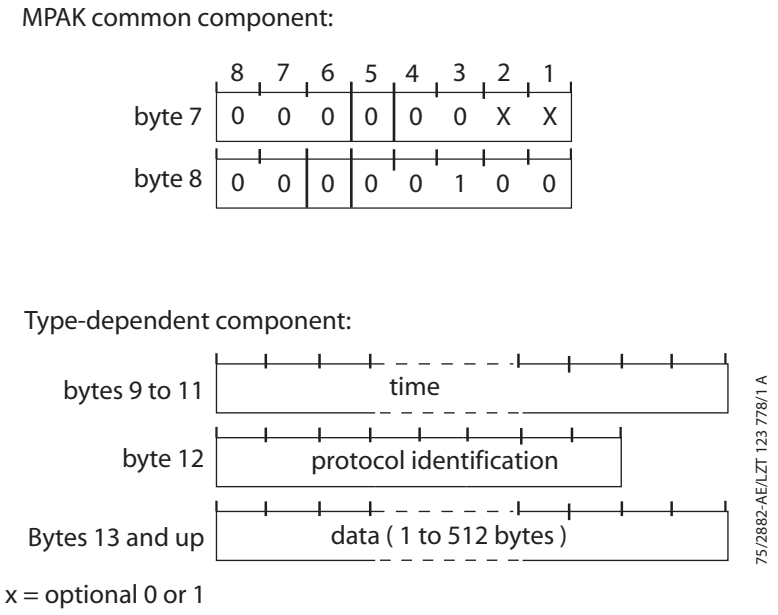

Figure 165 HPDATA without address list generated by a PC.

5.2.8 HPDATA with Address List

Criteria for Generating the Packet

The user or application wants to send HP-data (data message with higher protocol identification) information to a number of designated addresses. See also *chapter 4.5 Text/Data/HP-data/Status Message*.

The Network's Normal Action when Receiving a Packet

The network will make up a new MPAK (without an address list) for each addressee on the address list. The new packet will have an address field containing one of the addresses from the address list in the original packet.

The PC's Normal Action when Receiving a Packet

The PC only receives this packet as a returned packet.

Length of the Packet

The length varies between 35 and 546 bytes.

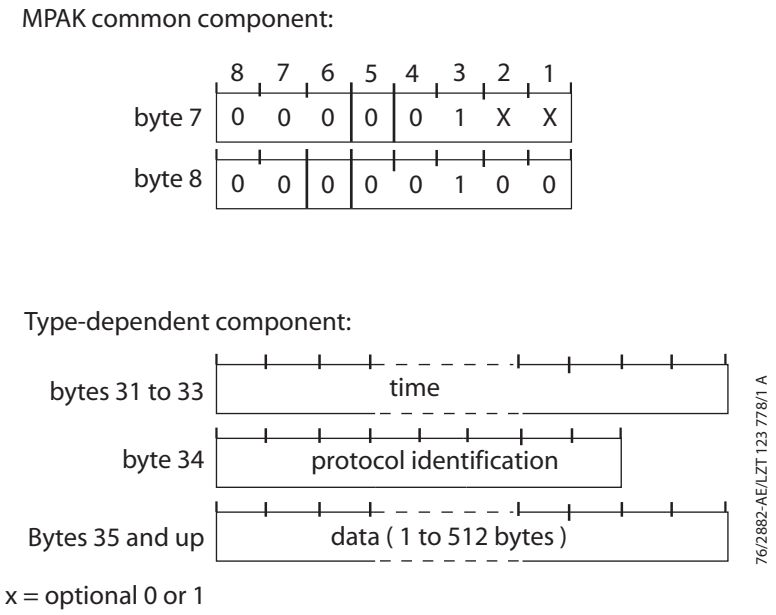

Figure 166 HPDATA with address list generated by a PC.

5.2.9 EXTPAK (External Packet)

Designated Sender

Terminal subscription, personal subscription or external network.

Designated Addressee

Terminal subscription, personal subscription, group or external network.

Raised Flags

EXTERN_F must be raised.

Criteria for Generating the Packet

- The user or application wants to send information to an external telecommunications network.
- An external network sends information to a user in the Mobitex network.

The Network's Normal Action when Receiving a Packet

An EXTPAK from a Mobitex subscriber will be dispatched to the designated external network, which will send the packet to the addressee.

An EXTPAK from an external network will be dispatched to the addressee in Mobitex.

The PC's Normal Action when Receiving a Packet

The information in the packet is stored, processed and/or presented to the user of the addressed subscription.

Length of the Packet

The length varies between 12 and 560 bytes.

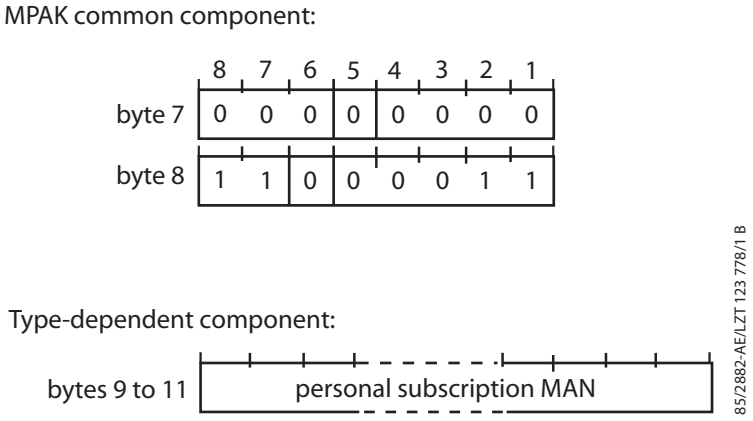

Figure 167 EXTPAK generated by a PC.

Data, byte 12 and up, 1 to 549 complete bytes

The coding of this field is optional since the Mobitex network layer is transparent to all EXTPAK packets.

The use of EXTPAK and the contents and format of this component is defined by the operator of the external network.

5.3 DTESERV

This part of the description deals with the MPAKs in the packet class 3, *Data Terminal Service Communication* or DTESERV. Only those packets applicable to Mobidem are described.

5.3.1 General

In this section the following applies:

- If the heading Raised Flags is left out, this means that no flags are raised.
- If one of the headings *"The network's normal action..."* or *"The PC's normal action..."* is omitted, it means that the network or the mobile terminal does not normally receive the packet in question.

5.3.2 LOGINREQ (Login Request)

Designated Sender

The terminal subscription.

Designated Addressee

The network.

Criteria for Generating the Packet

A user or the application requests login of a personal subscription.

Note: LOGINREQ should be sent if there is enough space for another subscriber in the FLEXLIST and/or the subscription is not already present.

If the subscription is already present in the Mobidem's FLEXLIST, the PC will be notified by an FK-frame and the user should be notified that he is already logged in.

The Network's Normal Action when Receiving a Packet

The network checks that the login can take place.

The PC's Normal action when receiving the Packet

The PC does not normally receive the packet. However, if it does, it should be displayed to the user that the login request has failed.

Length of the Packet

19 bytes.

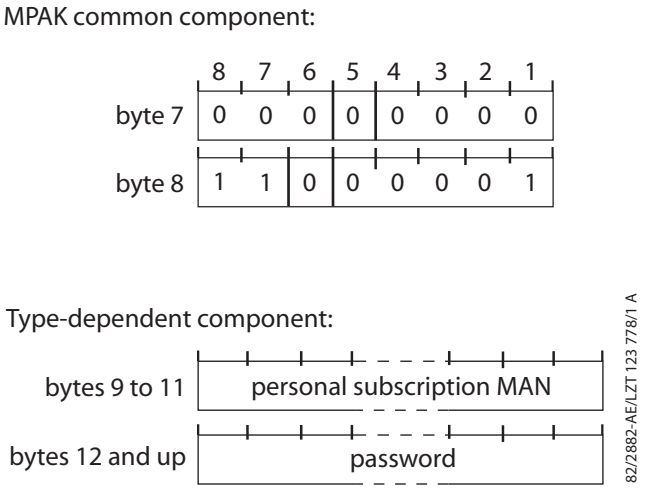

Figure 168 LOGINREQ generated by a PC.

Password, 8 bytes

Selection of 8 ASCII coded characters. Passwords with less than 8 characters should be filled with leading spaces.

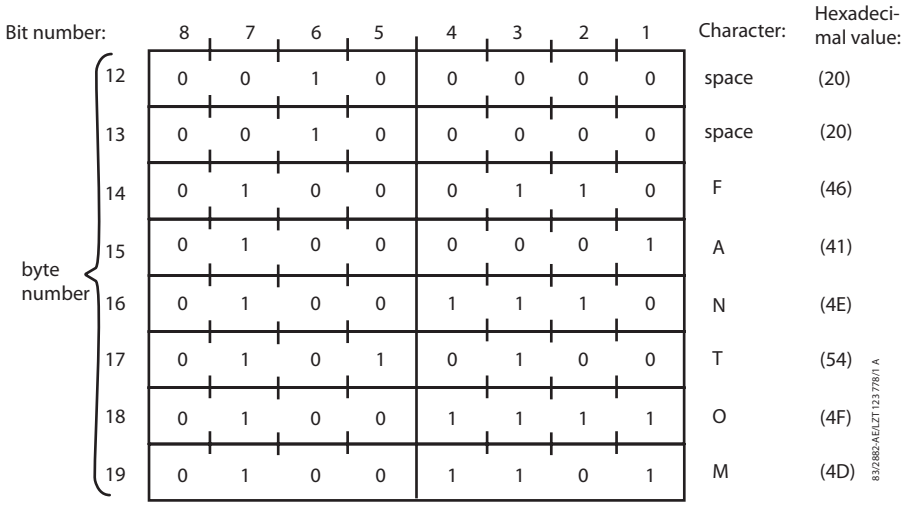

Figure 169 Example: The password FANTOM

5.3.3 LOGINGRA (Login Request Granted)

Designated Sender

The network.

Designated Addressee

The terminal subscription.

Criteria for Generating the Packet

The network approves the previously requested login (LOGINREQ).

The PC's Normal Action when Receiving a Packet

The mobile terminal stores the personal subscription MAN as one for which the mobile terminal may receive packets. When LOGINGRA is received, the application layer should display to the user that login was successful.

Length of the Packet

11 bytes.

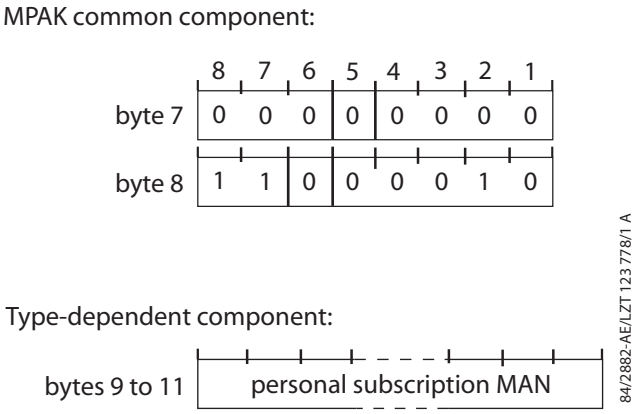

Figure 170 LOGINRA generated by the network.

5.3.4 LOGINREF (Login Request Refused)

Designated Sender

The network.

Designated Addressee

The terminal subscription.

Criteria for Generating the Packet

The network does not permit the requested login.

The PC's Normal Action when Receiving a Packet

The PC notifies the application or user that login has been refused.

Length of the Packet

11 bytes.

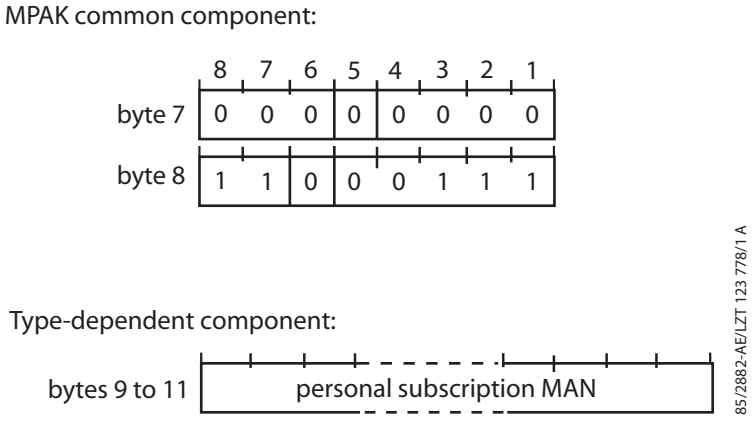

Figure 171 LOGINREF generated by the network.

5.3.5 LOGOUT

Designated Sender

Personal subscription and host group subscription.

Designated Addressee

The network.

Criteria for Generating the Packet

A personal subscription, or a host group subscription, requests logout from the PC. The PC sends the packet only if the subscription is included in the FLEXLIST. After generating the packet, the subscription is deleted from the FLEXLIST.

The Network's Normal Action when Receiving a Packet

The network deletes the login. The subscription is "at rest" until further notice.

Length of the Packet

11 bytes.

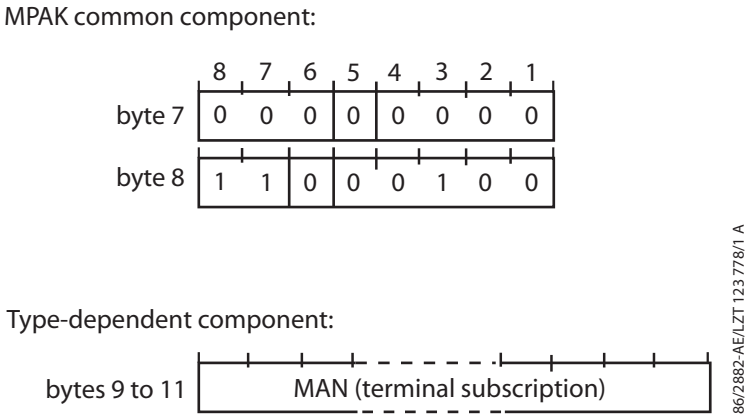

Figure 172 LOGOUT generated by a PC.

5.3.6 LOGOUTORD (Logout Order)

Designated Sender

The network.

Designated Addressee

The terminal subscription.

Criteria for Generating the Packet

A personal subscription can only be logged in to one mobile terminal at a time. If a new login takes place while an old login is still active (no LOGOUT has been sent), the network sends a LOGOUTORD packet to the old mobile terminal. Thus the old login will be logged out.

The PC's Normal Action when Receiving a Packet

The PC deletes the personal subscription from the list of logged in subscriptions. The user will be notified of the logout.

Length of the Packet

11 bytes.

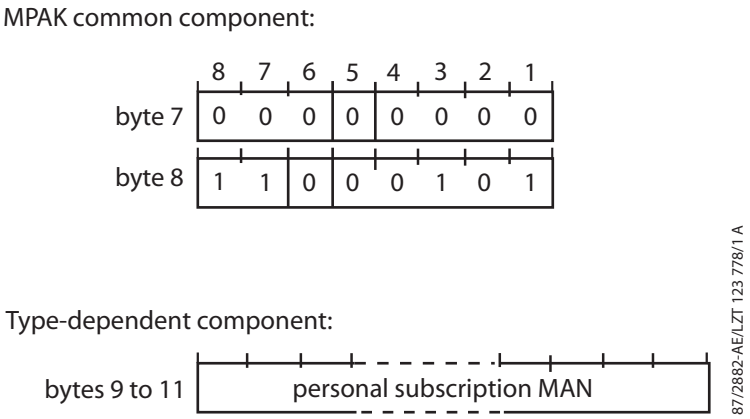

Figure 173 LOGOUTORD generated by the network.

5.3.7 BORN

Designated Sender

The terminal subscription.

Designated Addressee

The network.

Criteria for Generating the Packet

The radio modem is in the *unborn* state. The radio modem is *unborn* when it is powered for the first time, switched to operate on another Mobitex network or when any of its stored network layer parameters (that is DIE/LIVE state, GROUPLIST, FLIEXLIST, AREALIST) have been lost.

If any of the stored network parameters are lost, BORN replaces ACTIVE or ROAM until GROUPLIST is received. In this case the radio modem should clear all “Parameters to be stored at power off” (that is become *unborn*) and personal subscriptions should log-in again.

Note: At power up it is recommended that the information stored in the network layer is checked against the checksum. If the checksum is found to be incorrect, the radio modem will revert to the unborn state and a BORN packet will be sent to the network in order to update the information.

The Network’s Normal Action when Receiving a Packet

The network sends the necessary information to the terminal (that is GROUPLIST).

The network also checks the terminal’s Electronic serial number (ESN).

If the ESN checking is successful the network will send a LIVE, followed by a GROUPLIST, to the terminal. If the ESN checking fails the network will not send any LIVE and GROUPLIST but may send a DIE instead (depending on the network configuration).

Length of the Packet

12 bytes.

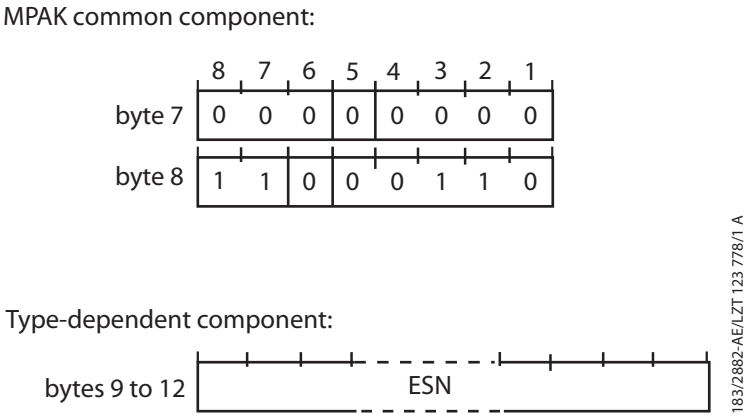

Figure 174 BORN generated by a PC.

5.3.8 ACTIVE

Designated Sender

The terminal subscription.

Designated Addressee

The network.

Criteria for Generating the Packet

There are four different criteria for the radio modem to send an ACTIVE packet:

- When the radio modem is turned on.
- When the reception buffer of the radio modem, after having been full, has been emptied.
- When contact with the network is re-established after having been broken.
- An ACTIVE packet is generated by the PC.

The transmission of ACTIVE may be delayed, see *chapter 4.4.2 Activation/ Inactivation.*

The Network's Normal Action when Receiving a Packet

The network updates the terminal subscription information. Messages stored in mailbox, which are intended for the mobile terminal and subscribers logged in at the mobile terminal, are transmitted to the radio modem.

The network checks the radio modem's electronic serial number (ESN).

Length of the Packet

12 bytes.

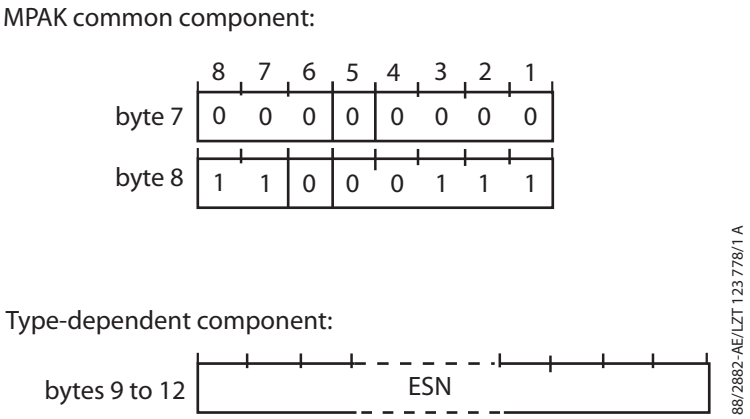

Figure 175 ACTIVE generated by a PC.

Note: The contents of bytes 9 to 12 must be set to 0 (zero) by the application or PC. The electronic serial number will be set by the radio modem.

5.3.9 INACTIVE

Designated Sender

The terminal subscription.

Designated Addressee

The network.

Criteria for Generating the Packet

INACTIVE is sent by the radio modem:

- Before the radio modem is turned off.
- When the reception buffer of the radio modem is full.
- When an INACTIVE packet is generated by the PC.

The Network's Normal Action when Receiving a Packet

The network registers the mobile terminal as inactive. No messages will be sent to the mobile terminal until it is again activated.

Length of the Packet

8 bytes.

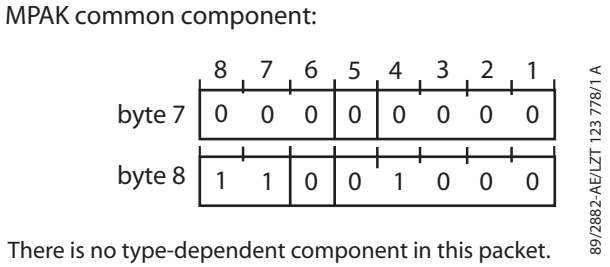

Figure 176 INACTIVE generated by a PC.

5.3.10 DIE

Designated Sender

The network.

Designated Addressee

The terminal subscription.

Criteria for Generating the Packet

The network generates this packet in order to prevent a terminal from sending any user traffic to the network.

The PC's Normal Action when Receiving a Packet

After DIE is received, the terminal must not send any user traffic (PSUBCOM, PSOSCOM). Only DTESERV packets are permitted until a LIVE packet has been received. It should also be shown to the user, that the terminal has received a DIE, and cannot send any user traffic.

Exceptions:
The terminal may return packets to the network with the UNKNOWN_F raised.

Length of the Packet

8 bytes.

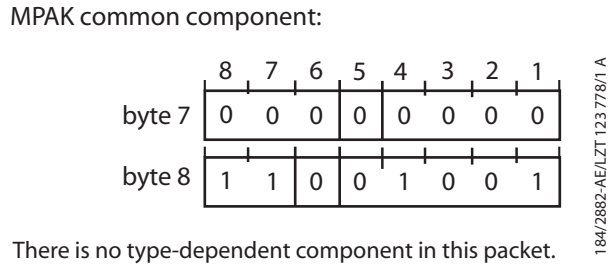

Figure 177 DIE generated by the network.

5.3.11 LIVE (the Terminal may Send Packets again)

Designated Sender

The network.

Designated Addressee

The terminal subscription.

Raised Flags

MAILBOX_F

This packet can be stored in the network mailbox if the addressee cannot be reached even though MAILBOX is not included in the subscription service.

Criteria for Generating the Packet

The terminal has previously received DIE but is now permitted to send user traffic again. The network responds to a BORN packet with correct ESN by sending a LIVE packet.

The PC's Normal Action when Receiving a Packet

The terminal may resume sending user traffic again. It should also be shown to the user, that the terminal has received a LIVE, and can resume sending user traffic.

Length of the Packet

8 bytes.

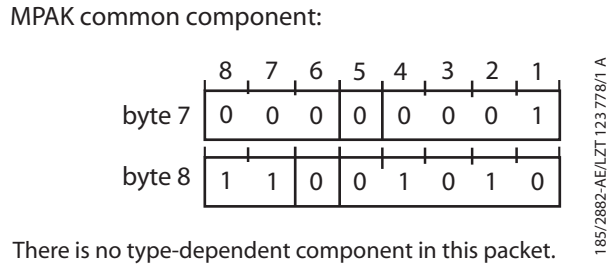

Figure 178 LIVE generated by the network.

5.3.12 ROAMORD

Designated Sender

The network.

Designated Addressee

The mobile terminal subscription or group.

Criteria for Generating the Packet

The network orders the terminal to send ROAM.

The PC's Normal Action when Receiving a Packet

The terminal sends ROAM.

Length of the Packet

8 bytes.

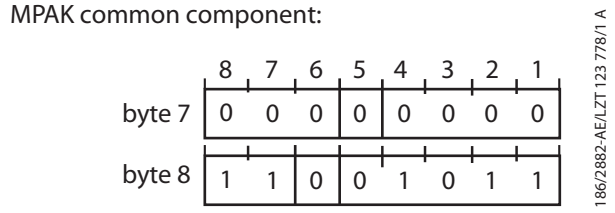

Figure 179 ROAMORD generated by the network.

5.3.13 ROAM

Designated Sender

The mobile terminal subscription.

Designated Addressee

The network.

Criteria for Generating the Packet

The terminal has decided to send ROAM according to the roaming algorithm procedure in the mobile terminal link layer or the terminal has received ROAMORD from the network.

The Network's Normal Action when Receiving a Packet

The network registers *roaming* for the terminal. The network also checks the ESN.

Length of the Packet

12 bytes.

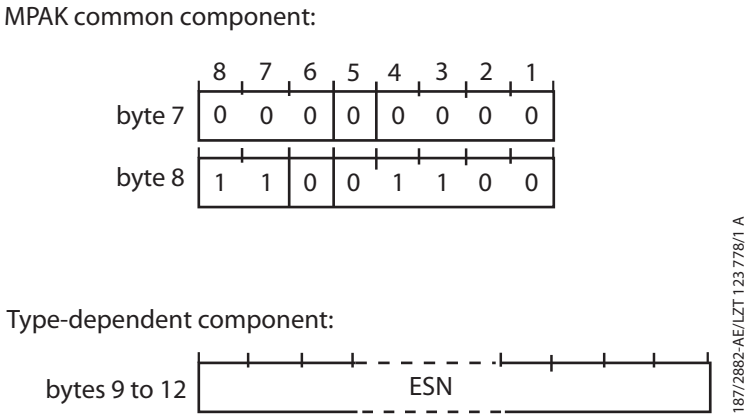

Figure 180 ROAM generated by the terminal.

5.3.14 GROUPLIST

Designated Sender

The network.

Designated Addressee

The terminal subscription.

Raised Flags

MAILBOX_F

The packet may be stored in the network's mailbox if the addressee can not be reached, even if MAILBOX is not included in the subscription service.

Criteria for Generating the Packet

Changes in the subscriber information have taken place, the mobile/fixed terminal has sent BORN.

The PC's Normal Action when Receiving a Packet

The new group list replaces the former stored list of group numbers.

Length of the Packet

54 bytes.

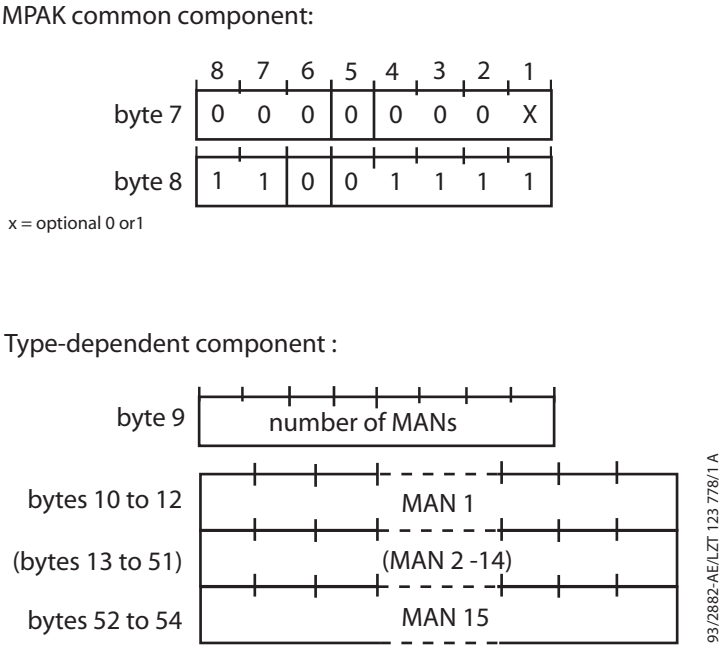

Figure 181 GROUPLIST generated by the network.

Note: MAN 1 (bytes 10 to 12) is used for the *All Terminals Group Number.*

5.3.15 FLEXREQ

Designated Sender

The network.

Designated Addressee

The terminal subscription.

Criteria for Generating the Packet

The network requires current information about which subscription that are logged-in at the terminal.

The PC's Normal Action when Receiving a Packet

The terminal sends current information in the FLEXLIST packet.

Length of the Packet

8 bytes.

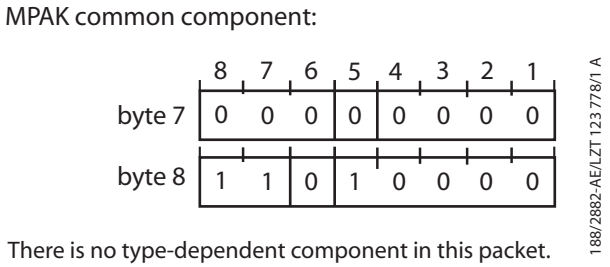

Figure 182 FLEXREQ generated by the network.

5.3.16 FLEXLIST (List of Personal Subscriptions Logged in at the Mobile Terminal)

The procedures described in paragraphs numbered 2 and 3 below do not apply to an application. They are only included for information purposes.

Designated Sender

1. The radio modem.
2. The network.
3. The radio modem.

Designated Addressee

1. The PC.
2. The radio modem.
3. The network.

Criteria for Generating the Packet

1. The radio modem sends FLEXLIST to the PC during the start up procedure.
2. The network: Changes in the information have occurred.
3. The radio modem: The radio modem has received a request for the flexlist from the network. This procedure is handled automatically by the radio modem.

The Network's Normal Reaction on Receiving the Packet

The network checks the list of logged in personal subscriptions at the mobile terminal.

The Radio Modem's or the PC's Normal Reaction on Receiving the Packet

Replace former list of personal subscriptions with a new list.

Length of the Packet

30 bytes

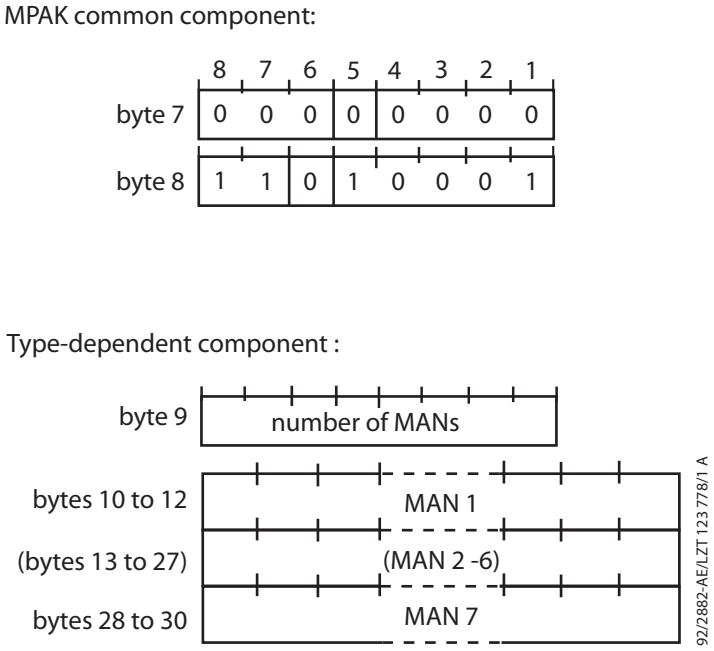

Figure 183 FLEXLIST generated by the radio modem.

5.3.17 INFOREQ

Designated Sender

The network.

Designated Addressee

The mobile terminal subscription.

Criteria for Generating the Packet

The network requires updating on terminal information.

The PC's Normal Action when Receiving a Packet

The terminal sends INFO.

Length of the Packet

8 bytes.

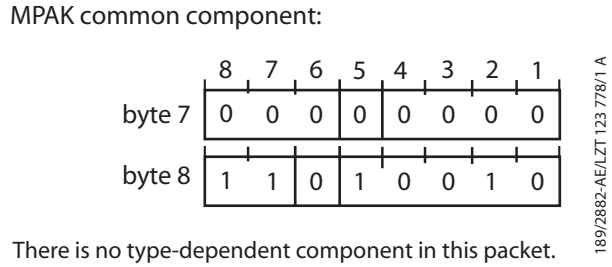

Figure 184 INFOREQ generated by the network.

5.3.18 INFO

Designated Sender

The mobile terminal subscription.

Designated Addressee

The network.

Criteria for Generating the Packet

The terminal has received INFOREQ.

The Network's Normal Action when Receiving a Packet

The network updates the register.

Length of the Packet

The length may vary between 44 and 46 bytes.

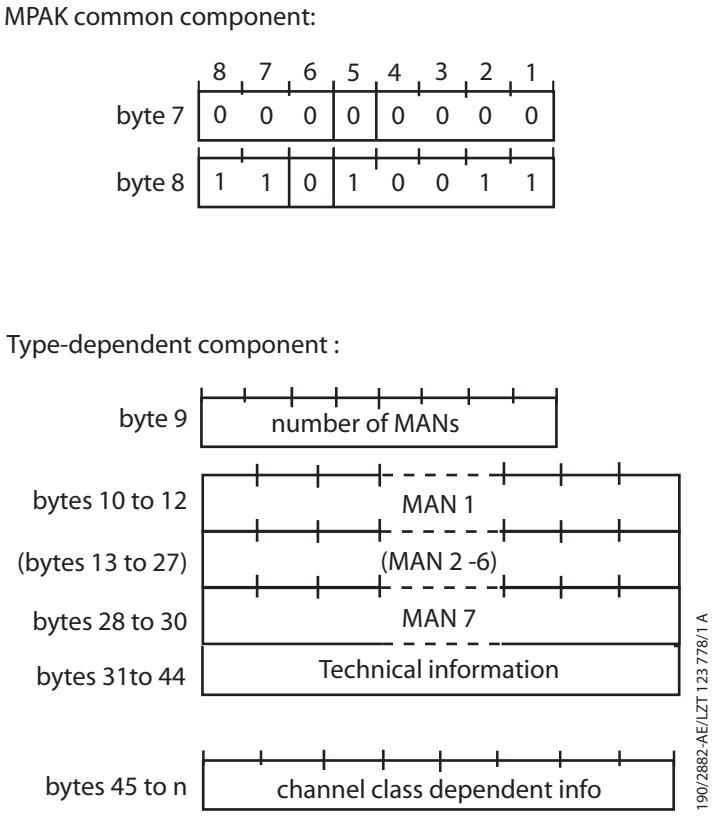

Figure 185 INFO generated by the terminal.

Technical Information

14 bytes.

This field states whether the mobile terminal is equipped with technical media for generating and presenting different traffic types. The field also describes the characteristics of the radio station. The information to be stated in this field must be provided when opening the subscription.

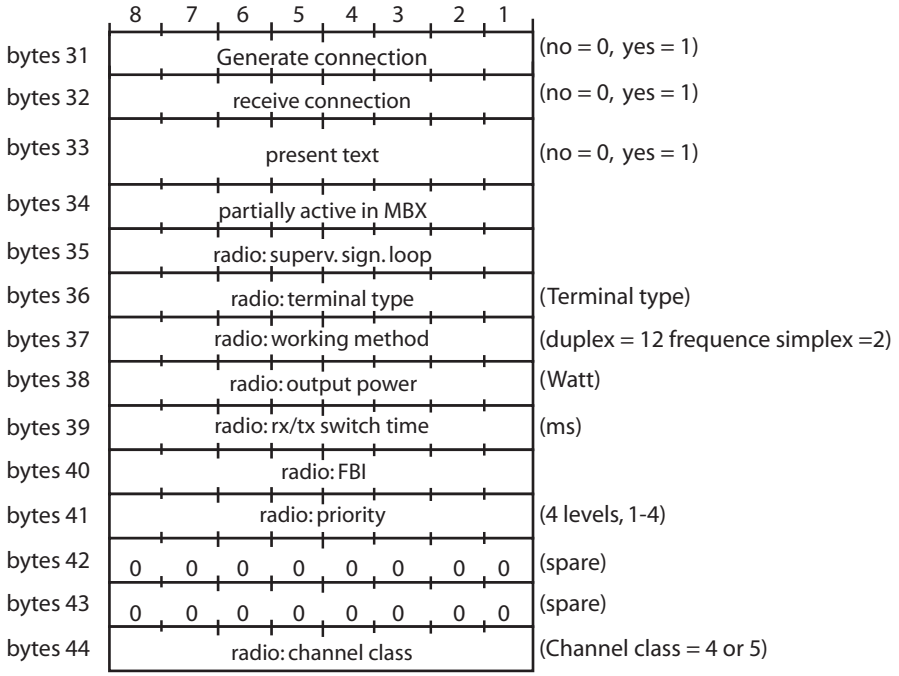

Figure 186 Data representation for technical information.

Channel Class Dependent Information

0-2 bytes.
This field states which radio channels the relevant mobile equipment can use. There are 2 possible channel classes that may be used: channel class 4 or 5.

Channel class 4:	Full band station with independent channels for receiving and transmitting channels.
Channel class 5:	Full band station with fixed duplex spacing. The duplex spacing is given as the channel difference.

Channel Class 4

No channel class-dependent information is required.

Channel Class 5

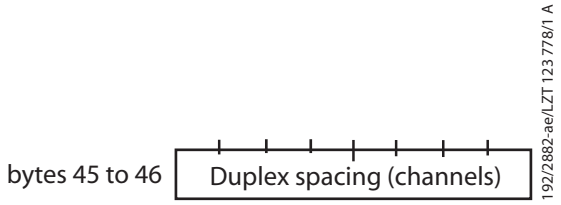

Figure 187 Data representation for channel class 5.

Note: The radio output power parameter (byte 8) indicates the maximum output power of the mobile terminal.

5.3.19 TIME (Time Information)

Designated Sender

The network.

Designated Addressee

The terminal subscription or group.

Criteria for Generating the Packet

When traffic load permits, the network sends the time information to the mobile terminals.

The PC's Normal Action when Receiving a Packet

The time information may only be used as a calendar clock function in the user application.

Note: Do not confuse the TIME packet with the time information given in the time field of other packets. The time information embedded in the PSUBCOM packets gives the time when the network first received the packet - not the time for retransmission.

Length of the Packet

11 bytes.

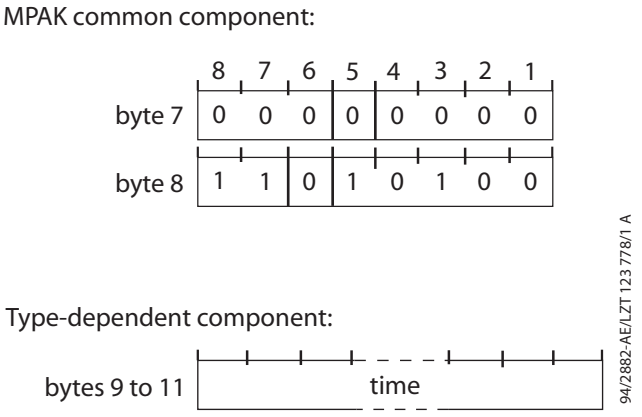

Figure 188 TIME generated by the network.

5.3.20 AREALIST

Designated Sender

The network.

Designated Addressee

The mobile terminal subscription.

Raised Flags

MAILBOX_F

This packet can be placed in the network mailbox if the addressee cannot be reached even if MAILBOX is not included in the subscription.

Criteria for Generating the Packet

Changes in the subscriber information concerning the operational areas have taken place or the mobile terminal has sent BORN.

The PC's Normal Action when Receiving a Packet

The terminal should forward the area list information to the data link layer.

Length of the Packet

17 bytes.

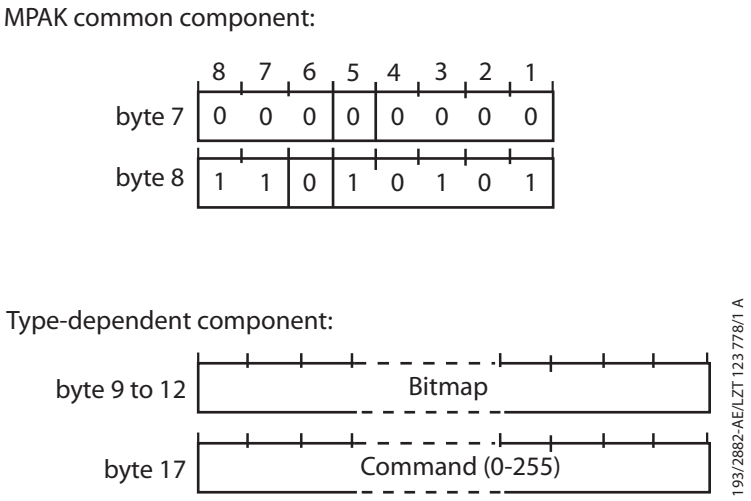

Figure 189 AREALIST generated by the network.

Bitmap

Bitmap representing the area IDs. The bitmap will be transferred to the Data Link Layer. Each bit position (0-63) of the bitmap represents the numerical value (0-63) of an area ID. For example, the bit in position 60 corresponds to the area ID 111100 (binary representation). The area ID is received by the Physical Layer and then used by the roaming algorithm in the Data Link Layer.

0=invalid area ID.

1=valid area ID.

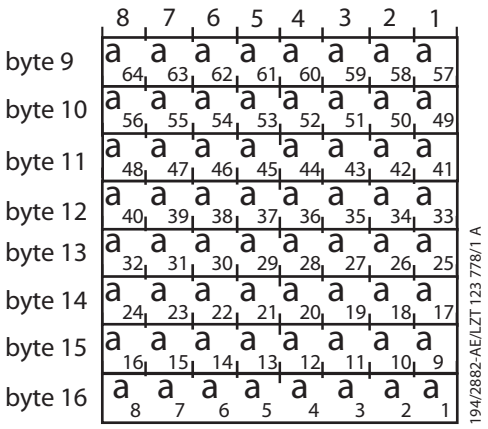

Figure 190 Data representation of the BITMAP field.

Command

Mobile performance in areas which are indicated as *not valid* in the bitmap. The command should also be transferred to the data link layer.

0=invalid area IDs must not be used by the terminal.

1=not valid area IDs may be used, but traffic may be charged a different fee.

Note: If both the *Bitmap* and the *Command* is set to zero (0), this means that the mobile terminal is not allowed to operate any traffic area and roam into any base station. This case should be notified to the user who should contact the network operator or a service centre.

Note: When changing local network, the terminal shall reset its AREALIST to allow all valid area IDs (that is, all bits in the bitmap are set to 1).

5.3.21 ESNREQ (Electronic Serial Number Requested)

Designated Sender

The network.

Designated Addressee

The mobile terminal subscription.

Criteria for Generating the Packet

The network requests a check of the electronic serial number.

The PC's Normal Action when Receiving a Packet

The terminal sends ESNINFO.

Length of the Packet

8 bytes.

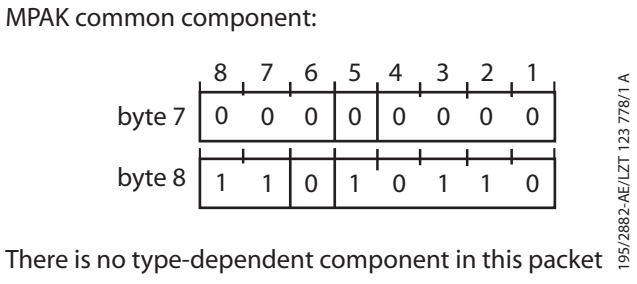

Figure 191 ESNREQ generated by the network.

5.3.22 ESNINFO

Designated Sender

The mobile terminal subscription.

Designated Addressee

The network.

Criteria for Generating the Packet

The terminal has received ESNREQ.

The Network's Normal Action when Receiving a Packet

The network checks the electronic serial number.

Length of the Packet

12 bytes.

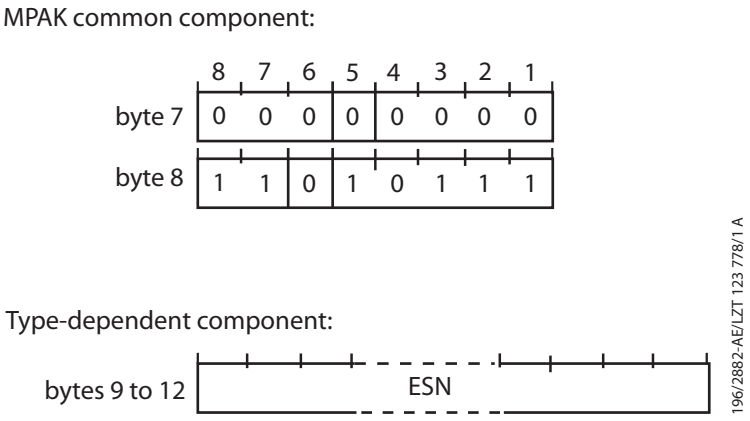

Figure 192 ESNINFO generated by the PC.

5.3.23 MODE (Change of Operating Mode)[1]

Designated Sender

The mobile terminal.

Designated Addressee

The network.

Criteria for Generating the Packet

The user wants to change operating mode between *power saving mode* and *express mode*.

When the radio modem changes operating mode, the packet is sent to the network.

Note 1: The mode change may also be initiated by pressing the MODE key on the M1000.

Note 2: If two consecutive equal MODE changes are given, the radio modem's MASC protocol will send an error message to the PC. This situation may for example occur if the user orders mode change by using the MMODE key on the M1000, and immediately thereafter gives the same order from the PC. See *chapter 3 MASC Protocol Description* for the error message.

The Network's Normal Action when Receiving a Packet

The network registers the operating mode of the mobile terminal (radio modem).

Some applications may require *express mode* to achieve a communication without a delay.

The normal operating mode is *power saving mode*.

1.For a description of the different operating modes, see *chapter 7 Important Mobitex Functions*.

Length of the Packet

9 bytes.

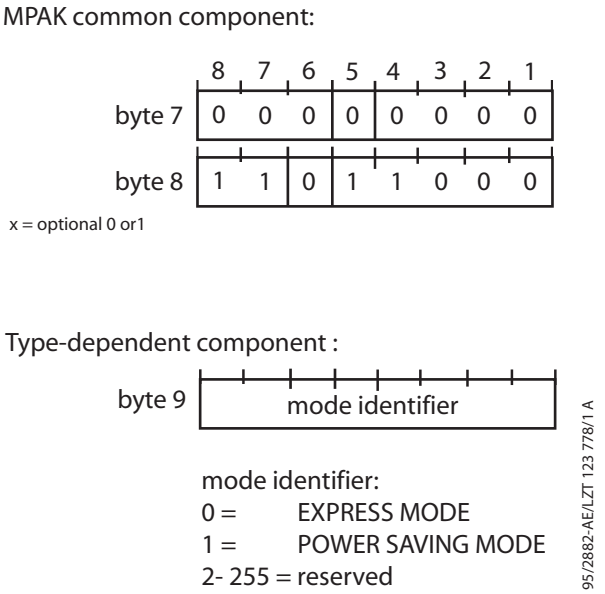

Figure 193 MODE generated by the network.

Note: Using the express mode will mean higher power consumption and shorter battery operating time in radio modems with built in batteries.

5.3.24 LOWPOWER

The MPAK LOWPOWER should be used by portable radio modems if the base radio station supports the extended battery saving protocol. The MPAK LOWPOWER must not be used if the extended battery saving protocol is not supported. The MPAK LOWPOWER replaces the following MPAK packets when a portable radio modem uses the extended battery saving protocol:

- ACTIVE
- BORN
- ESNINFO
- INFO
- MODE
- ROAM

MPAK Common Component

The common component of an MPAK is modified when it is used together with the new MPAK type LOWPOWER. The value in the field packet type in the common component will be set to 31 for the MPAK LOWPOWER. This modified common component must not be used with any other MPAK.

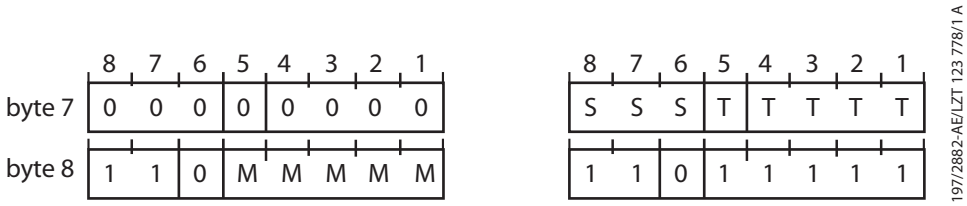

Figure 194 The normal (left) and the modified (right) common component of an MPAK.

MMMMM	The MPAK type (MMMMM=11111 defines the MPAK LOWPOWER).
TTTTT	The subtype of the MPAK type LOWPOWER.
SSS	This field contains information about the new parameter SKIPNUM.

The parameters MODE and SKIPNUM are coded into the field SSS in the figure above. The SKIPNUM and MODE representation is shown below.

SKIPNUM and MODE representation:

SSS	MODE	SKIPNUM
000	Battery Saving Mode	1
001	Battery Saving Mode	2
010	Battery Saving Mode	4
011	Battery Saving Mode	8
100	Battery Saving Mode	16
111	Normal Mobile Mode	Not used
All other combinations	Undefined, spare	

The subtype of the LOWPOWER is coded into the field TTTTT in the figure above.

The coding of the subtypes are shown below. Note that the codes used for the subtypes are identical to the MPAK type codes of the corresponding MPAKs that the subtypes replace.

TTT	Subtype name	Replaced MPAK
00111	Subtype ACTIVE	ACTIVE
00110	Subtype BORN	BORN
10111	Subtype ESNINFO	ESNINFO
10011	Subtype INFO	INFO
11000	Subtype MODE	MODE
01100	Subtype ROAM	ROAM

All other subtype codes are UNDEFINED.

Subtype ACTIVE

The MPAK LOWPOWER, subtype ACTIVE, will be used instead of MPAK ACTIVE provided the base radio station supports the extended battery saving protocol.

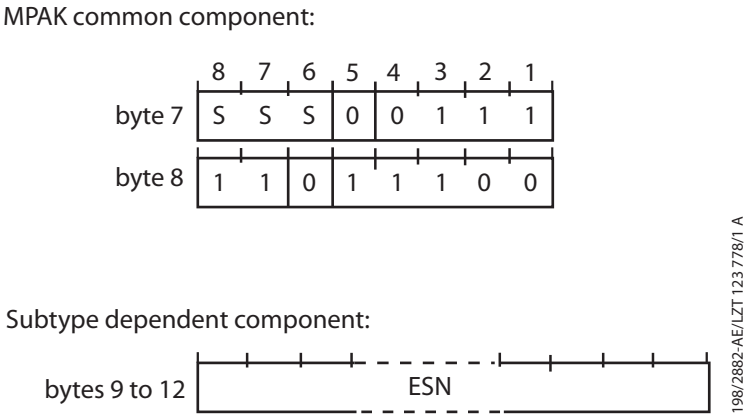

Figure 195 The MPAK LOWPOWER, subtype ACTIVE. Note that the subtype dependent component is identical to the type dependent component of MPAK ACTIVE.

Subtype BORN

The MPAK LOWPOWER, subtype BORN, will be used instead of MPAK BORN provided the base radio station supports the extended battery saving protocol.

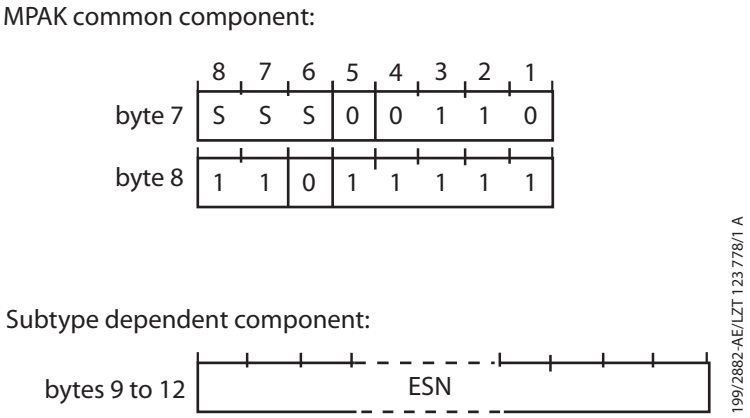

Figure 196 The MPAK LOWPOWER, subtype BORN. Note that the subtype dependent component is identical to the type dependent component of MPAK BORN.

Subtype ESNINFO

The MPAK LOWPOWER, subtype ESNINFO, will be used instead of MPAK ESNINFO provided the base radio station supports the extended battery saving protocol.

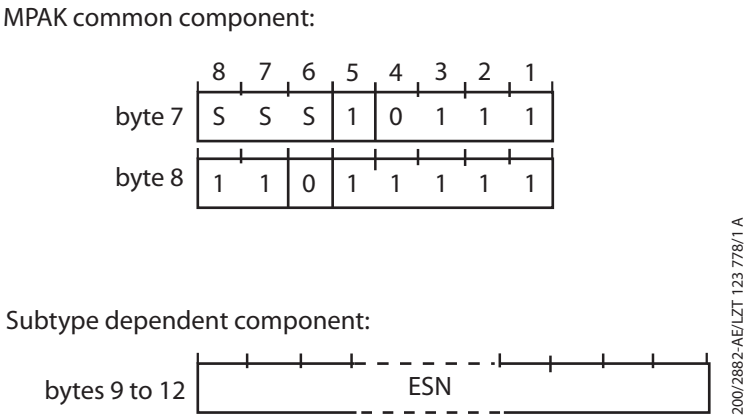

Figure 197 The MPAK LOWPOWER, subtype ESNINFO. Note that the subtype dependent component is identical to the type dependent component of MPAK ESNINFO.

Subtype INFO

The MPAK LOWPOWER, subtype INFO, will be used instead of MPAK INFO provided the base radio station supports the extended battery saving protocol.

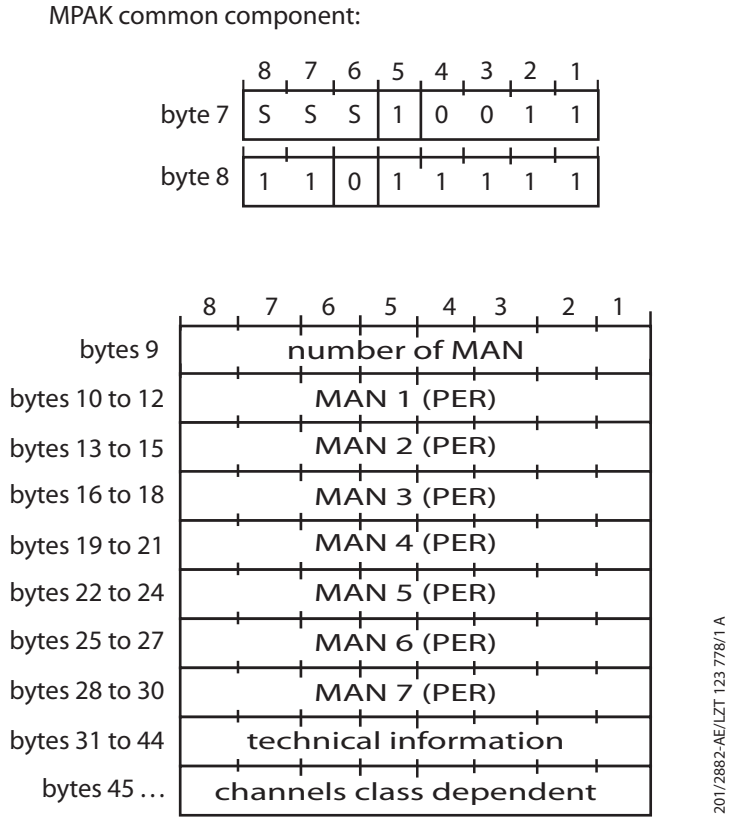

Figure 198 The MPAK LOWPOWER, subtype INFO. Note that the subtype dependent component is identical to the type dependent component of MPAK INFO.

Subtype MODE

The MPAK LOWPOWER, subtype MODE, will be used instead of MPAK MODE provided the base radio station supports the extended battery saving protocol.

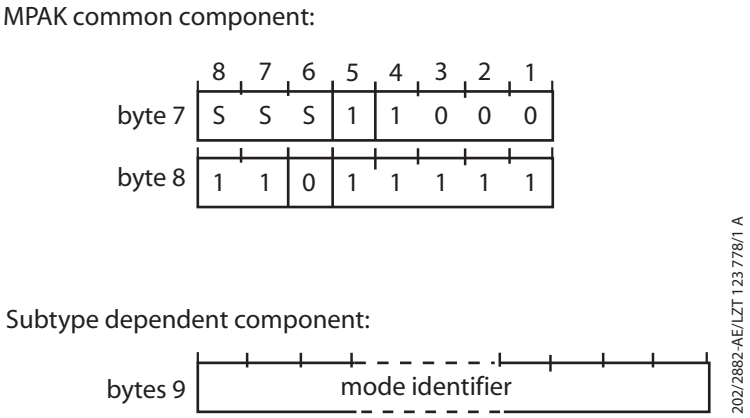

Figure 199 The MPAK LOWPOWER, subtype MODE. Note that the subtype dependent component is identical to the type dependent component of MPAK MODE.

Subtype ROAM

The MPAK LOWPOWER, subtype ROAM, will be used instead of MPAK ROAM provided the base radio station supports the extended battery saving protocol.

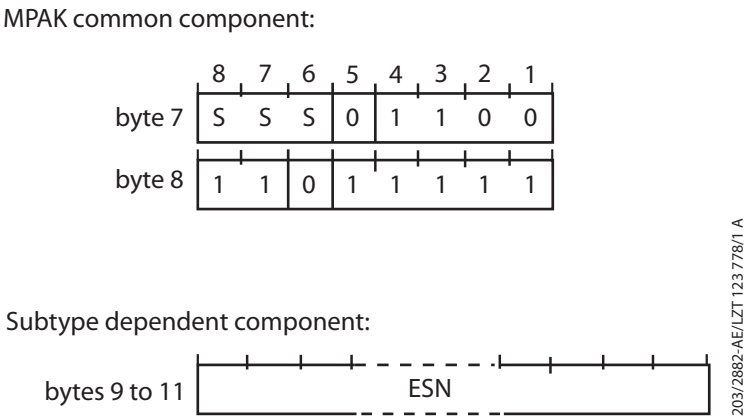

Figure 200 The MPAK LOWPOWER, subtype ROAM. Note that the subtype dependent component is identical to the type dependent component of MPAK ROAM.

5.4 Converted Packets

A few MPAKs will be received and converted by the radio modem before they are sent to the connected PC.

These packets are:

- The network orders the mobile terminal not to send user traffic (DIE).
- The network orders the mobile terminal to resume sending packets (LIVE).

When the radio modem receives one of these orders, an FK-frame indicating the situation - FK01 for DIE and FK02 for LIVE - will be sent to the PC. See description in *chapter 3 MASC Protocol Description.*

6 Mobitex Dialogues

The first part of this chapter describes the different signal flows between the Mobidem and a PC. The second part deals with dialogues between mobile terminals and the Mobitex network.

6.1 Signal Flow Between Radio Modem and PC

6.1.1 General

In order to understand how the MASC interface works and how the frames are exchanged, you must know how different signals flow between the radio modem and the PC.

In this description, the control frames are described separately from the information frames.

Some Rules

A PC connected to the radio modem, must use the same Terminal MAN number (TMAN) as the radio modem (the PC asks the radio modem for the TMAN).

The radio modem communicates with the Mobitex network according to the network layer.

In order to get the Mobitex network layer in the radio modem, and the PC, to interact in an error-free way, the following point has to be considered.

6.1.2 MPAKs

MPAKs are either received from, or transmitted to, the network. The MPAKs received from the network contain information that the mobile terminal is receiving. Transmitted MPAKs are either created by the user application or by the radio modem. MPAKs created by the radio modem are used for radio communication purposes only, and will not be described in this manual.

MPAKs Received from the Network

MPAKs received from the network containing orders to the radio modem to stop, or to resume, transmitting user traffic, will be handled entirely within the radio modem. The connected PC will, however, be notified by an FK-frame. See *chapter 3 MASC Protocol Description.*

Other packets used for radio modem control will be handled entirely within the radio modem. No information will be sent to the PC.

All other correctly received MPAKs will, after normal handling in the radio modem, be sent to the PC.

A packet received by the PC must never be returned to the radio modem without modification of the packet's common components.

MPAKs to Transmit to the Network

If the MPAK passes the checks in the radio modem, it will be sent to the Mobitex network. If the MPAK fails to pass the checks, it will be returned to the PC in an R-frame.

For the LOGINREQ MPAK the following rule holds:

If the personal subscription already exists in the FLEXLIST, then the radio modem will notify the PC by an FK-frame.

Connection Between the Radio Modem and the PC

The radio modem and the PC are supposed to each have a list of group MANs (GROUPLIST) and a list of personal subscriptions (FLEXLIST). In order to make the lists in the radio modem coincide with the lists in the PC, the following should be considered:

When the link layer connection is established (by exchange of INIT frames), the PC must send a MANREQ (FP-frame) to request the MAN from the radio modem.

By way of a reply, the radio modem sends the Terminal MAN (FP-frame). This reply is sent immediately, or, if another frame is currently being transmitted by the radio modem, immediately after the transmission is completed. After that, the radio modem will send the MASC_DEVICE information (FQ-frame).
The radio modem will subsequently send:

- GROUPLIST to set the list of group MANs in the PC.
- FLEXLIST to set the flexlist in the PC.

Example of Start Sequence

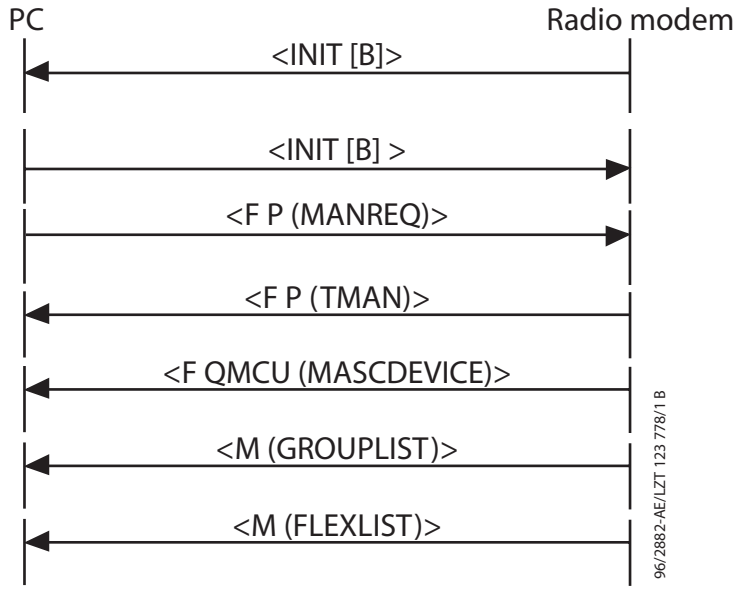

Figure 201 Start sequence.

The flow control frames are neither included in the *Example of start sequence* above, nor in the *Example of start sequence when the radio modem starts with MPAKs stored in the reception buffer* below.

Radio Modems that Can Operate Stand-Alone

The following two examples apply to radio modems that may operate as stand-alone units, that is, receive messages from the network without being connected to a PC.

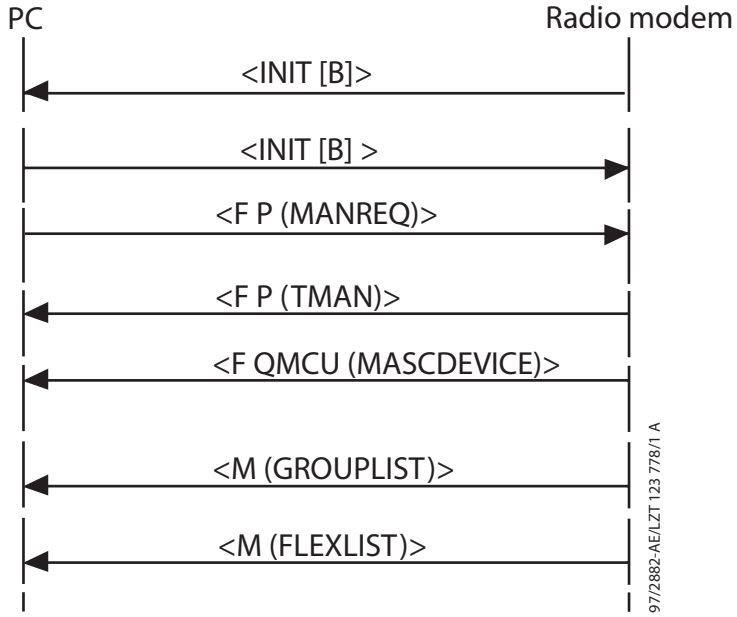

Figure 202 Example of start sequence when the radio modem starts with no MPAKs in the reception buffer.

Sending of the F P-frame (MANREQ) from the PC may be postponed until queued MPAKs have been transferred from the radio modem to the PC. The PC needs the MAN only to transmit MPAKs.

Note: The number of packets may be different from the examples given. Other packets that have been queued may be inserted between the packets listed. However, the packets listed will appear sooner or later, in the specified order.

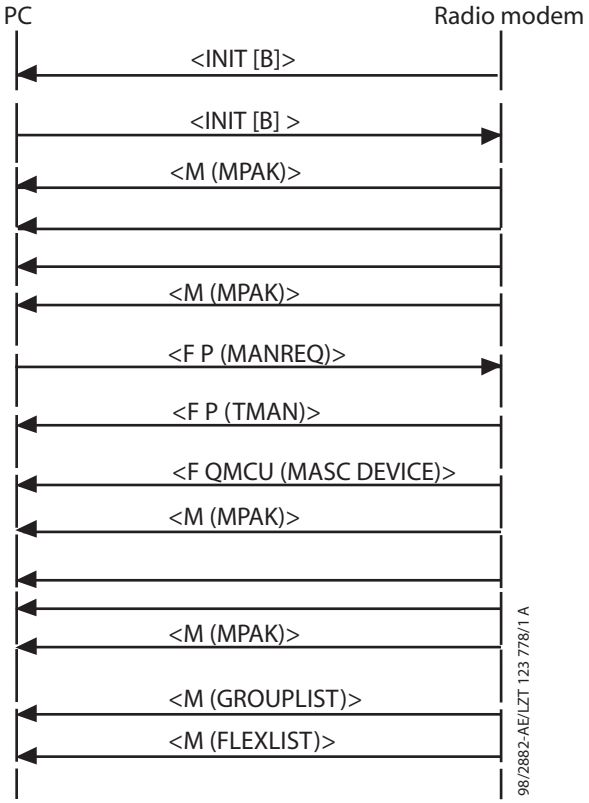

Figure 203 Example of start sequence when the radio modem starts with MPAKs stored in the reception buffer.

The MPAKs may be sent from the radio modem in any order after the establishment of the connection.

6.1.3 Flow of Control Frames

The control frames are used to ensure that the transmission of the information frame was successful.

This section describes how the control frames are used.

Actions to be Taken After Sending an Information Frame

If the information frame is acknowledged by an ACK frame, it has been accurately received. The value of the ACK frame's sequ field is saved as the last received sequence number.

If the information frame was not accurately received and must be repeated, the NACK frame is sent.

ACK and NACK frames are sent by the unit that receives the information frame.

The RACK frame will be sent if no reply has been received within 10 seconds of the information frame being sent.

The RACK frame is sent by the unit which sent the information frame.

If there is no reply to the RACK frame, a new RACK frame will be sent every 10 seconds. If no ACK has been received within 30 seconds, the higher level layer must be notified. The repetition of RACK will continue until interrupted by the application or by a received ACK.

The sequence number of an ACK received as a reply to a RACK will be compared with the last sequ number saved.

If these numbers are equal, the last information frame was received correctly, but the ACK was lost. This case is the only case in which the information frame will not be repeated.

An ACK with a sequence number value equal to - (minus sign) means that the information frame must be repeated.

If transmission of an INIT frame starts the handling of an error with RACK, the INIT frame must be repeated, regardless of the value of the sequ field in the ACK frame following RACK.

Note: The sequence number mentioned in this section belongs to the ACK frame. Do not confuse this sequence number with the sequence number of an M, N or R frame.

The table below summarizes the actions to be taken when receiving an ACK frame as a reply to a RACK.

		Sequence number of the last ACK received before the RACK		
		-	0	1
Sequence number of the last ACK received before the RACK	0	R	R	X
	1	R	X	R
No ACK was received before the RACK		R	R	R

Action: R = repeat the information frame
X = do not repeat the information frame
- = minus sign

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Figure 204 Actions to be taken when receiving an ACK frame.

Examples

In the following examples, the direction of the different frames may be interchanged.

Establish Connection

When the application is started, initialization is performed to set up the communication parameters. The first ACK sent should be <ACK0>. The initialization procedure is also performed whenever the connection has been broken.

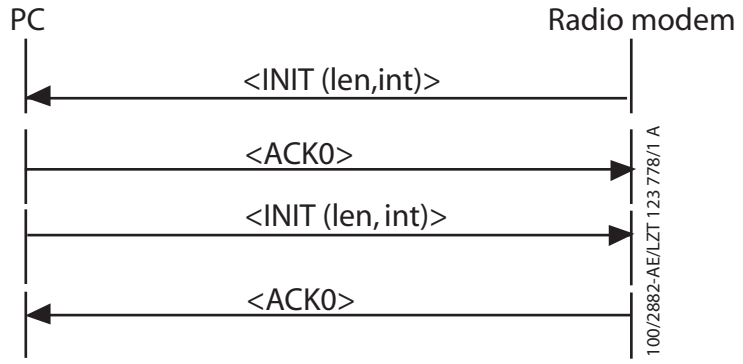

Figure 205 Initialization.

Information Frame with ACK

This is the normal status, with an acknowledgement sent as a reply to the information frame. The latest ACK sent by the PC was <ACK0>.

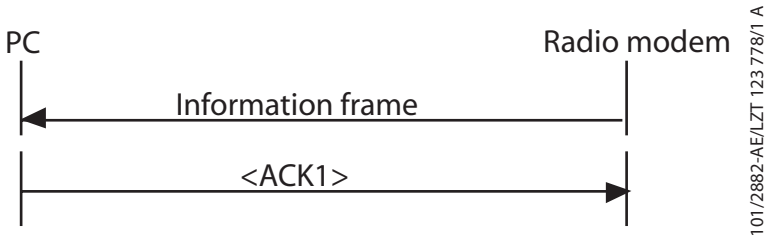

Figure 206 Direction of the information frame and the ACK frame.

Disturbed Information Frame

This is an example of how errors are handled in the protocol when a character in an information frame is disturbed when being sent over the communication link. The latest ACK sent by the PC was <ACK1>.

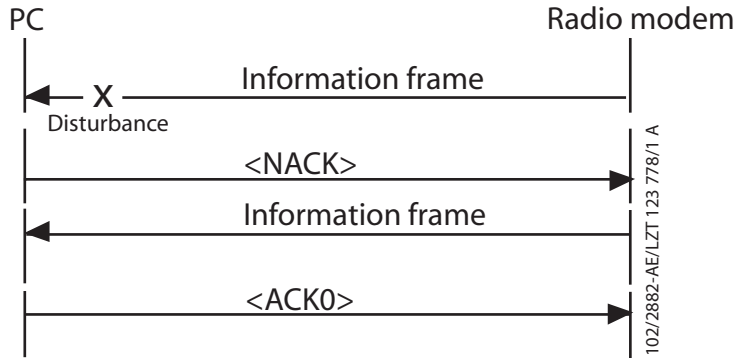

Figure 207 .Disturbance.

Lost Information Frame

This is an example of how errors are handled in the protocol when an information frame is lost. The latest ACK sent by the PC was <ACK1>.

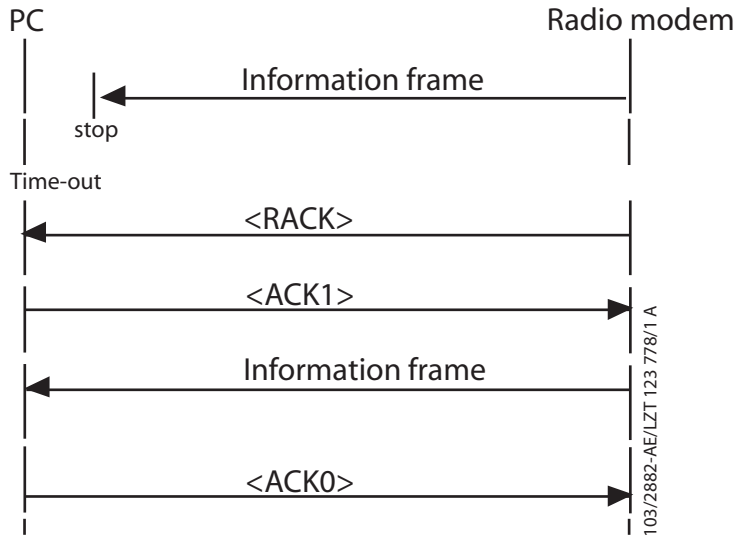

Figure 208 Retransmission procedure, information frame lost.

If the information frame does not reach the PC, RACK is sent and the ACK that is repeated will have an old sequence number (compared to the latest ACK received), indicating that the information frame was not received. The lost information frame must be retransmitted.

Information Frame with Lost ACK

This is an example of how errors are handled in the protocol when an acknowledgement is lost. The latest ACK sent by the PC was <ACK1>.

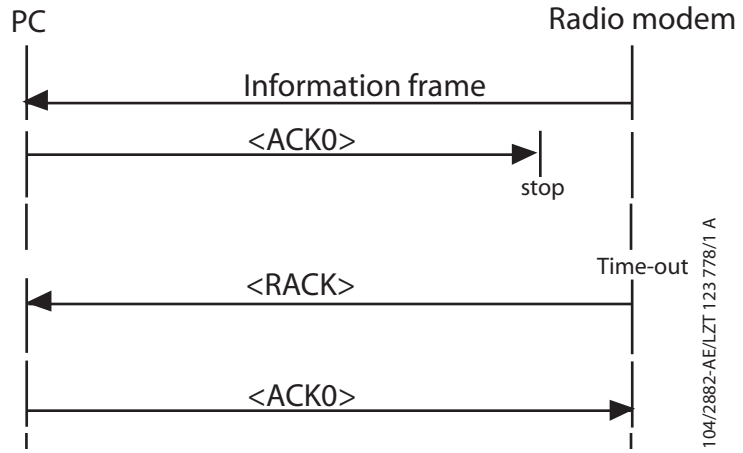

Figure 209 Retransmission procedure, ACK lost.

If the ACK0 does not reach the radio modem, RACK is sent and the repeated ACK will have a new sequence number (compared to the latest ACK received), indicating that the information frame was received correctly.

Check Communication Link, Link is OK

To check the communication link between the radio modem and the PC, the application may send a SENS frame as soon as there is no other traffic in process between the units.

The time between two SENS frames must be at least 10 seconds.

The SACK frame must be sent within 10 seconds of the SENS frame being received.

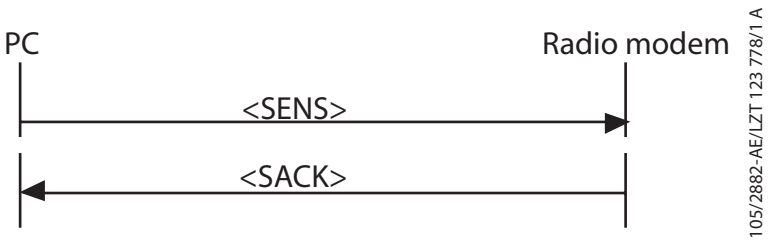

Figure 210 Check communication procedure, link ok.

Check Communication Link, Link is broken

If the link is broken, no SACK will be sent from the radio modem. If two SENS frames have been sent without receiving a reply, the unit which sent SENS must restart the link by sending an INIT frame.

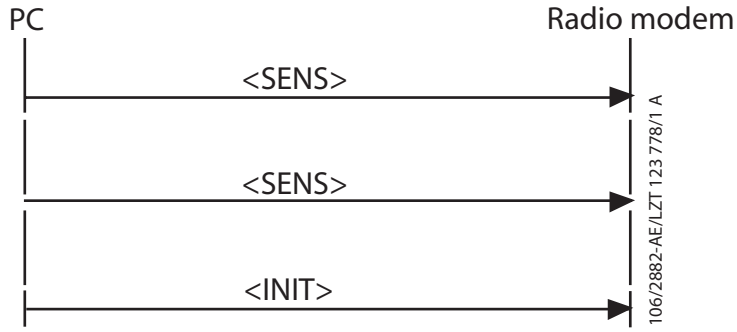

Figure 211 Check communication link, link broken.

6.1.4 Flow of Information Frames

This section describes how the information frames cooperate. All commands and replies that are used in the protocol are mentioned here. The description does not include any control frames, since these are covered in the previous section.

The frame structure is described in the Protocol Description chapter.

Start-Up

When the link layer is established, the PC should always check the MAN, in order to ensure that the correct MAN number is used. This will also make the radio modem send GROUPLIST and FLEXLIST to the PC. Other queued MPAKs may come out before GROUPLIST and FLEXLIST and must be taken care of.

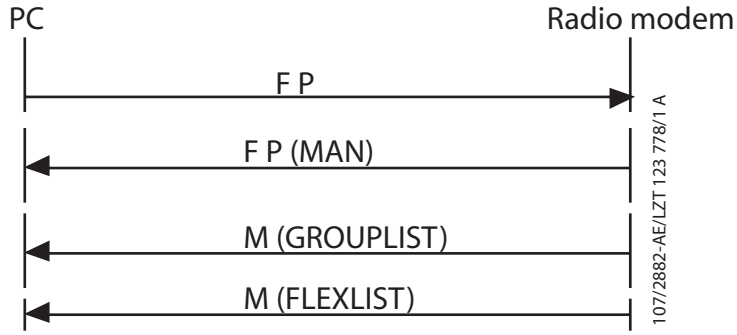

Figure 212 Example of packets sent at start-up.

Send MPAK

The M-frame from the PC is a request to send an MPAK to the Mobitex network. If the MPAK is erroneous, it is returned by the R-frame. An erroneous MPAK must be corrected before it is retransmitted to the radio modem.

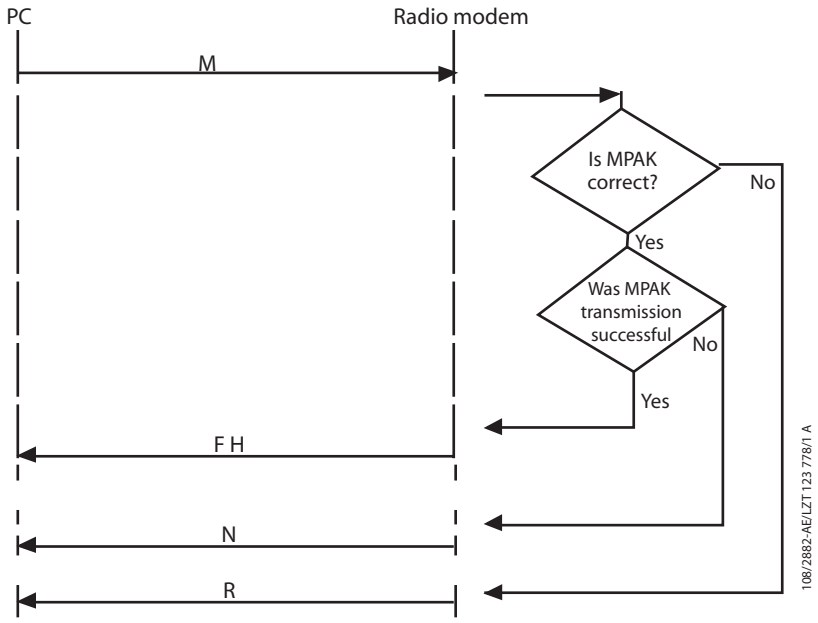

Figure 213 Sending MPAK, different scenarios.

If transmission of the MPAK to the network fails, the MPAK is returned to the PC by an N-frame.

To prevent the radio modem's buffer from becoming full, each MPAK sent from the PC should be acknowledged by an FH-frame before the next one is sent.

Receive MPAK

The M-frame from the radio modem includes the incoming MPAK from the Mobitex network.

Figure 214 Direction of the M frame.

Cancel Previous Transmission of MPAK

The M-frame from the PC is a request to transmit an MPAK to the Mobitex network.

The FI-frame is used to retrieve the last MPAK sent, if it has not already been transmitted to the Mobitex network.

It is not possible to recall more than one MPAK even if there is a queue of MPAKs waiting to be transmitted to the Mobitex network.

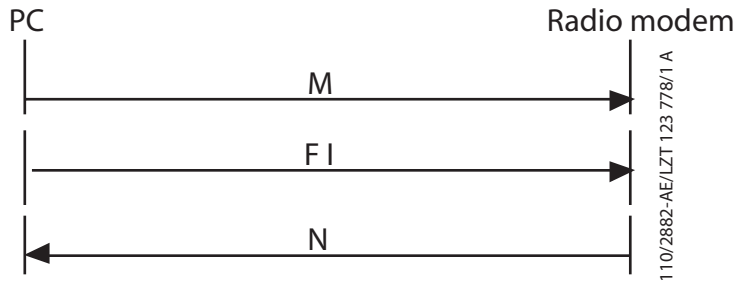

Figure 215 Cancel transmission of MPAK.

Information About Full Transmission Buffer

The M-frame from the PC is a request to send an MPAK to the Mobitex network.

If the transmission buffer becomes full when the radio modem is receiving an MPAK, the PC will be notified by an FK-frame.

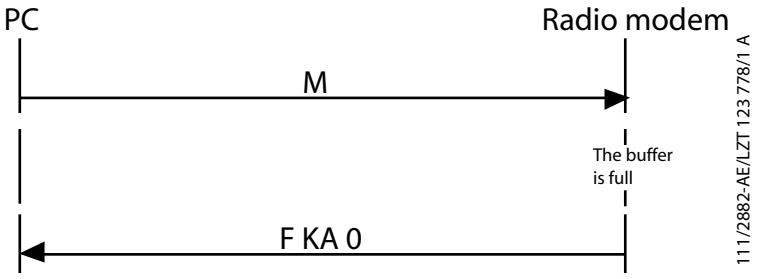

Figure 216 Buffer full.

Transmission Buffer Full, Still Trying to Send MPAK

An M-frame from the PC is a request to send an MPAK to the Mobitex network.

If the transmission buffer is full and the radio modem receives a new request to send an MPAK, the MPAK will be returned by an N-frame.

If there is no sequence number in the M-frame, then the error code is sent in an FK-frame.

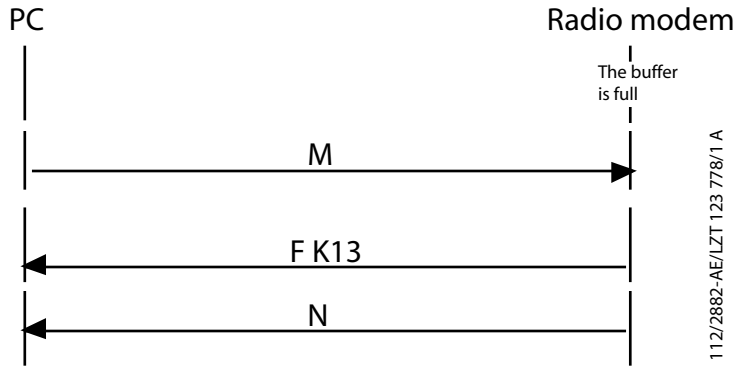

Figure 217 Buffer full, still trying.

If there is a sequence number, then the error code is included in the N-frame.

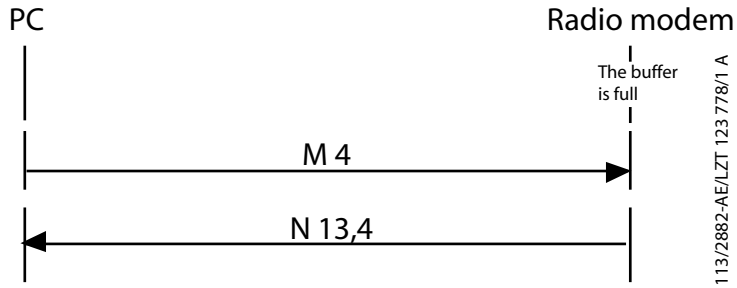

Figure 218 Buffer full, still trying, with sequence number.

Turning Power Off by Command

The FO-frame from the PC is a command to turn off the radio modem. Queued MPAKs that could not be sent to the Mobitex network are returned by N-frames.

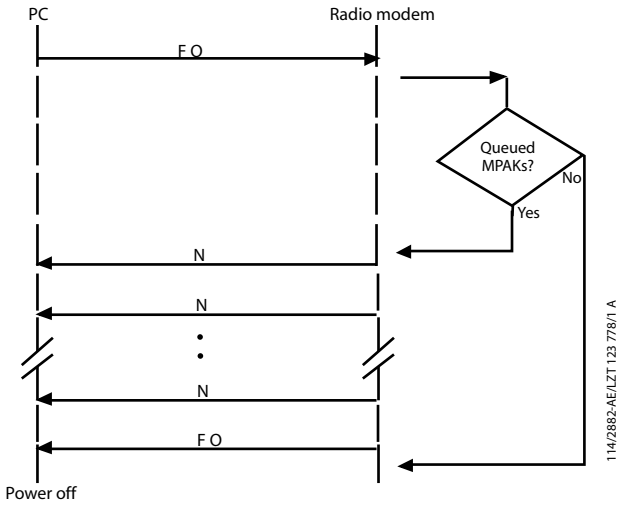

Figure 219 Power off, different scenarios.

Turning Power Off with the ON/OFF Key

Certain types of radio modems may be turned off manually with an ON/OFF key. The procedure is equal to that described above, except that the first FO-frame is replaced by the ON/OFF key being pressed.

6.2 Dialogues, Mobile Terminal to Network

6.2.1 General

A thorough understanding of the dialogues between the mobile terminal and the Mobitex network is necessary when an application is to be developed.

Combinations of dialogues are not described. Instead, typical cases of communication to or from the mobile terminals are presented.

In the following description, the *A-party* is always the calling mobile terminal or subscription (sender), while the *B-party* is the called subscriber (addressee). Depending on the dialogue the network may also be the sender or addressee.

6.2.2 Groups of Dialogues

The following groups of dialogues are used in conjunction with the radio modem (the corresponding packet names are shown in brackets):

PSUBCOM - Packet-Switched Subscriber Communication

- Internal traffic without address list	(TEXT, DATA, STATUS, HPDATA)
- Internal traffic with address list	(as above)
- Internal traffic to groups	(as above)
- External traffic	(EXTPAK)

DTESERV - Data Terminal Service Communication

SUBSCRIPTION STATUS

- Login	(LOGINREQ, LOGINGRA, LOGINREF)
- Logout	(LOGOUT, LOGOUTORD)

MOBILE TERMINAL STATUS

- Activation	(ACTIVE)
- Deactivation	(INACTIVE)

MOBILE TERMINAL INFORMATION

- Updating groups	(GROUPLIST)
- Updating area IDs	(AREALIST)
- Time information	(TIME)

6.2.3 Internal Traffic Without Address List

The dialogues are identical for all packet-switched internal traffic without an address list. The TEXT packet in the following dialogues may be replaced by DATA, STATUS or HPDATA, without any other changes in the dialogue.

The common factor for all dialogues in internal traffic is that the original packet (“TEXT”1) is generated by the A-party according to the criteria and the structure described in *chapter 5 MPAK Protocol Description - Packet Formats*. Any exceptions to this rule are stated for the respective dialogues.

The B-party is Active and Reachable by the Network

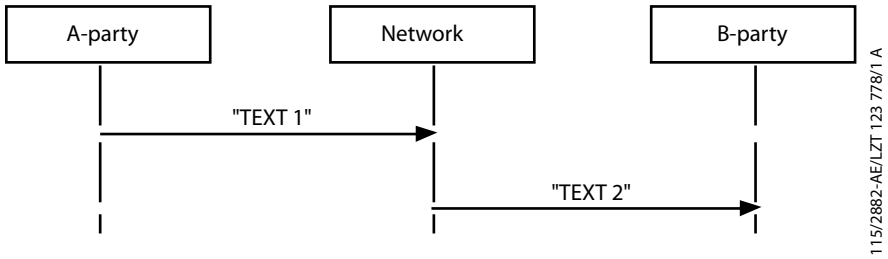

Figure 220 Successful transmission.

All fields of “TEXT”1 and “TEXT”2, except the time field, are identical.

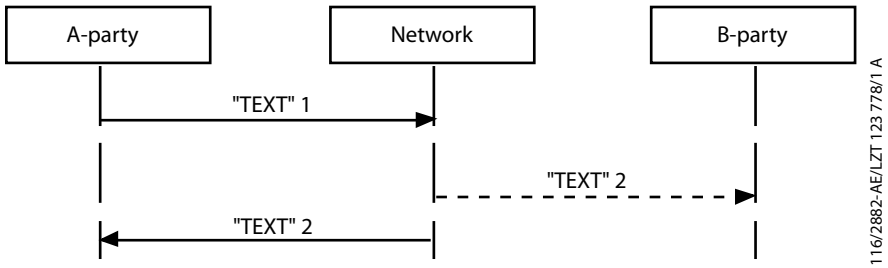

Figure 221 Unsuccessful transmission.

If the B-party’s ACK signal from B to the network is destroyed, the “TEXT2” will be returned to the A-party, even if it has reached its destination. The traffic state of the returned packet will be NO_TRANSFER.

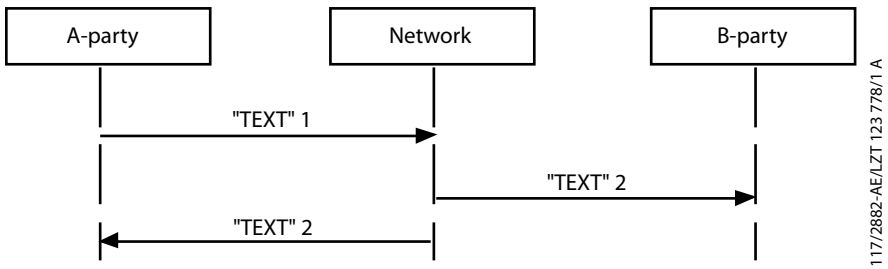

Figure 222 Successful transmission, POSACK active.

If the POSACK_F flag in “TEXT1” is raised, an identical copy of the message will be created by the network when the B-party has acknowledged the message. The copy is returned to the original sender.

The B-party Cannot be Reached at the Moment

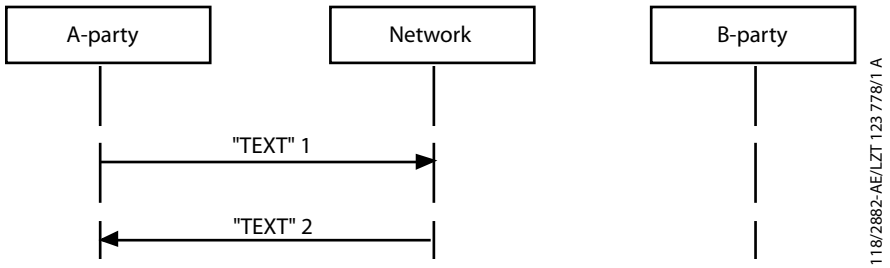

Figure 223 Unsuccessful transmission, no mailbox

"TEXT"1 has been generated with the subscriber flag MAILBOX_F=0, which indicates that the packet must not be stored in the network mailbox.

- "TEXT"2 is returned with the traffic state = NO_TRANSFER (state 3)

or

- "TEXT2" is returned with the traffic state = CONGEST (state 5)

Note: This dialogue also occurs when MAILBOX_F = 1 and the packet cannot be stored in the mailbox. A packet cannot be stored in the mailbox unless the B-party has mailbox service included in his subscription.

If "TEXT"1 has subscriber flag MAILBOX_F = 1, the packet may be stored in the mailbox.

A copy of "TEXT"1 is stored in the network mailbox. "TEXT"2 has the traffic state = IN_MAIL (state 2).

Packets stored in the mailbox are sent to the addressee when the mobile terminal has sent an ACTIVE MPAK. See the note above concerning subscribers who do not subscribe to the mailbox service.

When the packets with POSACK_F = 1 are delivered after having been put in the mailbox, a copy of the original message is sent to the original sender with the traffic state = FROM_MAIL (state 1).

The Network has Not Switched the Packet

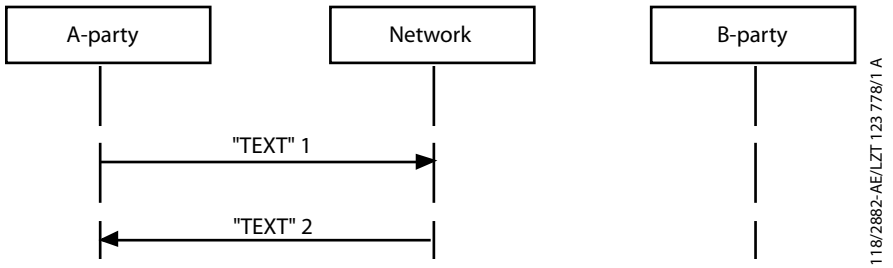

Figure 224 Unsuccessful transmission.

1. Transfer not possible because:

- The B-party does not exist.
  "TEXT"2 is returned with the traffic state = ERROR (state 6).
- The A-party subscription does not permit transfer.
  "TEXT"2 is returned with the traffic state = ILLEGAL (state 4).
- The B-party subscription does not permit transfer.
  "TEXT"2 is returned with the traffic state = ILLEGAL (state 4).

2. The network is overloaded.
   "TEXT"2 is returned with the traffic state = CONGEST (state 5).

3. The packet cannot be switched due to a technical problem in the network.
   "TEXT"2 is returned with the traffic state = ERROR (state 6).

6.2.4 Internal Traffic With Address List

The dialogues are identical for all internal traffic sent with an address list. The "TEXT" packet in the following dialogues may be replaced by "DATA", "STATUS" or "HPDATA", without any changes occurring in the dialogue.

The common factor for all dialogues in internal traffic is that the original packet ("TEXT"1) is generated by the A-party according to the criteria and the structure described in the MPAKs and the Packet Formats chapters. Any exceptions to this rule are stated for the respective dialogues.

The network will promptly convert "TEXT"1 to the number of packets stated in the address list. Each one of these packets will be identical except for the addressee information

.

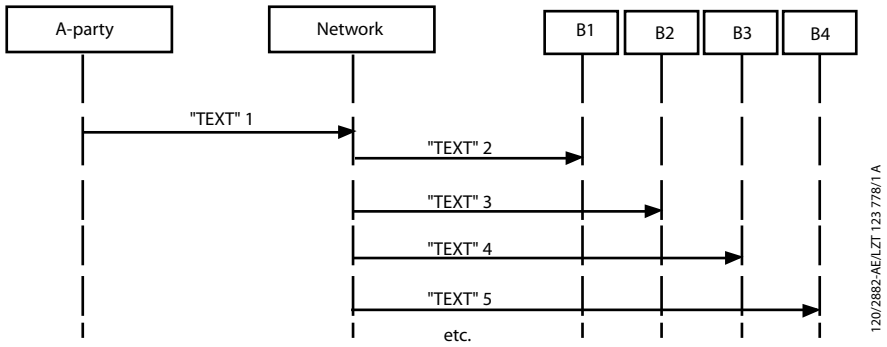

Figure 225 Successful transmission, with sendlist.

“TEXT”2 - “TEXT”5, etc., are each allocated an address from the address list in “TEXT”1.

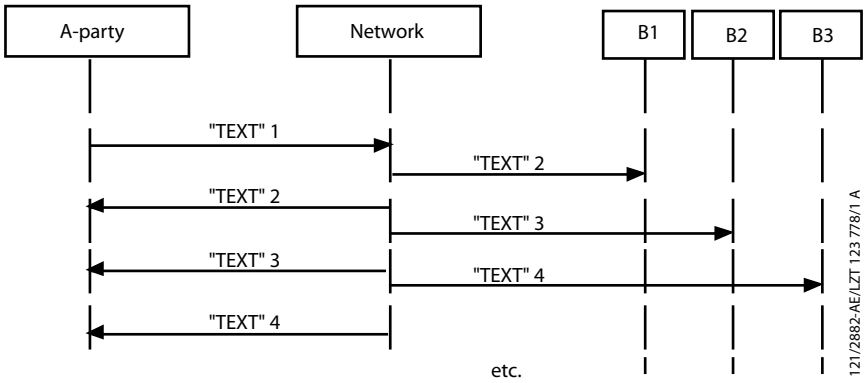

Figure 226 Successful transmission, sendlist and POSACK activated

If both the POSACK_F flag and the SENDLIST_F flag are raised, a positive acknowledgement is received for each addressee.

One or More B-Parties is Currently Not Reachable

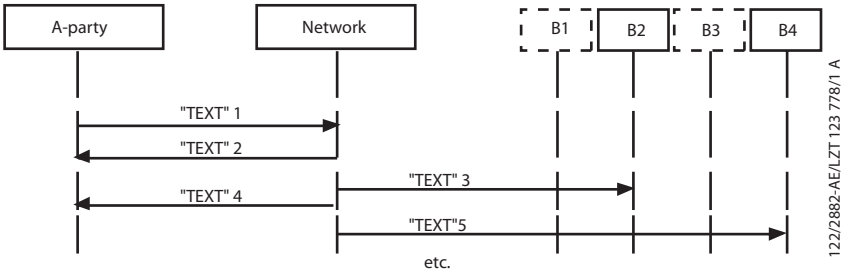

Figure 227 Partially successful transmission, sendlist active.

“TEXT”2 - “TEXT”5, etc., in the dialogue do not contain address lists.

1. “TEXT”1 contains an address list and has the subscription flag MAILBOX_F = 0, that is, the packet must not be stored in the mailbox.

   “TEXT”2 and “TEXT”4 in this example have the traffic state = NO_TRANSFER (state 3).

Note: This dialogue above also occurs when MAILBOX_F = 1 and the packet cannot be stored in the mailbox. A packet cannot be stored in the mailbox unless the B-party has a mailbox service included in his subscription. If the mailbox is full, the packet will also be returned.

2. “TEXT”1 contains an address list and has the subscription flag MAILBOX_F = 1, that is, the packet may be stored in the mailbox.

   “TEXT”2 and “TEXT”4 now have the traffic state = IN_MAIL (state 2).

   If the B-party’s subscription does not include the mailbox service, the packet is returned as an item 1 above.

The Network has Not Switched the Packet

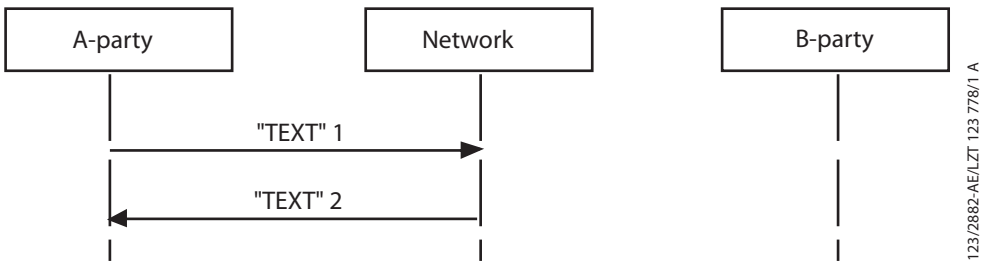

Figure 228 Unsuccessful transmission.

1. “TEXT”2 is returned before the packet was copied.
   “TEXT”2 contains the address list.

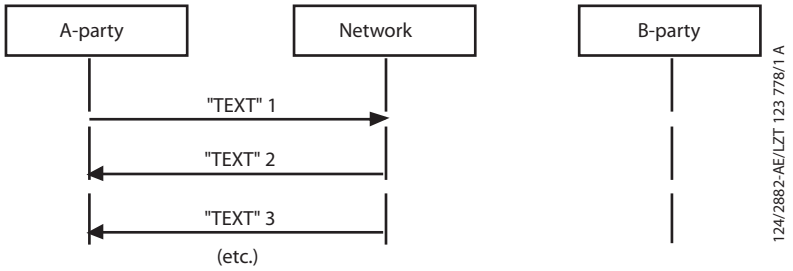

Figure 229 Unsuccessful transmission.

2. “TEXT”2, etc., are returned after the packet was copied by the network. The returned packets contain no address list.

The returned packets will have the traffic state = ILLEGAL (state 4), CONGEST (state 5) or ERROR (state 6) depending on the reason for the return.

6.2.5 Internal Traffic to Groups

The dialogues for traffic to groups are similar to those for traffic to other subscriptions. However, since traffic to groups may involve a considerable number of subscriptions, the A-party will not be notified if any of the B-parties are not reachable.

6.2.6 External Traffic

External traffic means traffic with different telecommunications networks external to Mobitex.

Dialogues between a mobile terminal and these networks must be specified by the operator of the external network.

6.2.7 Login

For all login dialogues, the original packet (LOGINREQ) is generated by the A-party.

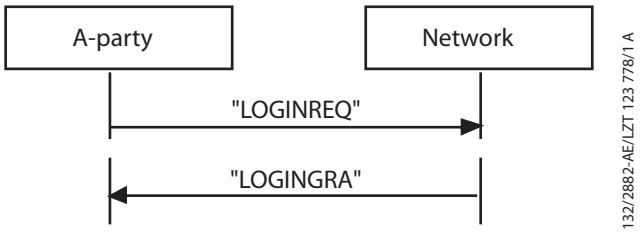

Figure 230 Login granted.

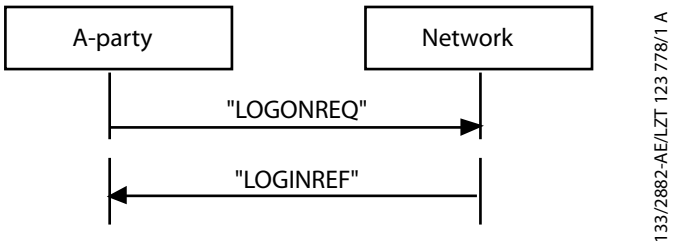

Figure 231 Login refused.

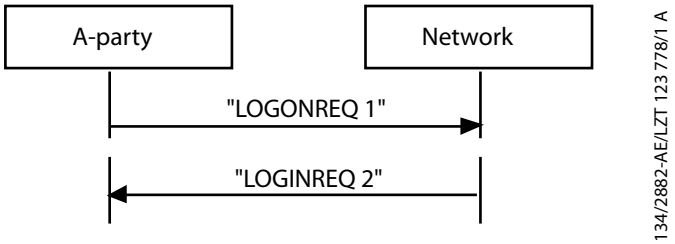

Figure 232 Login has failed.

1. “LOGINREQ”2 is returned with the traffic state = ILLEGAL.
   Login is denied. An incorrect subscription number may have been entered.

2. “LOGINREQ”2 is returned with the traffic state = CONGEST
   The network is overloaded.

3. “LOGINREQ”2 is returned with the traffic state = ERROR
   Technical error.

6.2.8 Logout

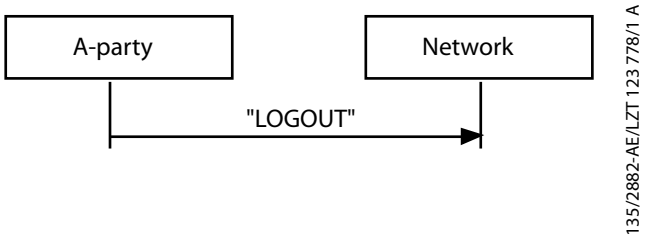

Figure 233 Subscription initiates logout.

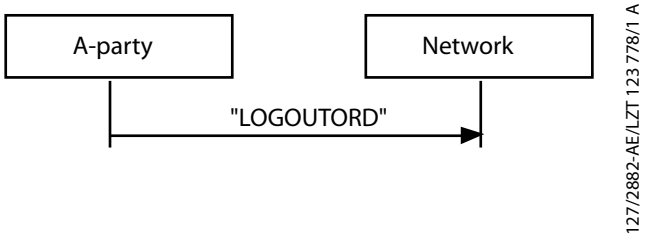

Figure 234 Network initiates logout.

If a personal subscription is logged in on mobile terminal A while still registered as logged in on mobile terminal B, the network will send LOGOUTORD to mobile terminal B.

6.2.9 Activation

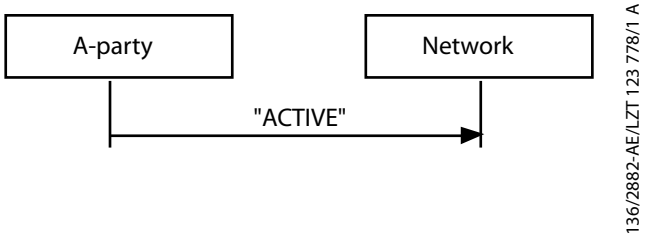

Figure 235 Approved activation, mailbox is empty.

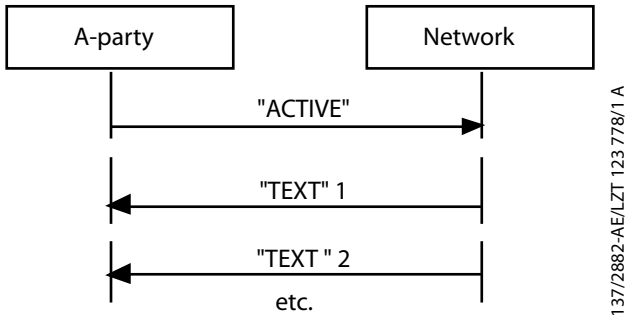

Figure 236 Approved activation, messages in mailbox.

The messages (MPAKs) in the mailbox may be addressed to the mobile terminal, the personal subscription or both.

Messages are stored in the mailbox while the mobile terminal is inactive. Packets sent from the mailbox are delayed with respect to each other to prevent overloading of the mobile terminal.

6.2.10 Deactivation

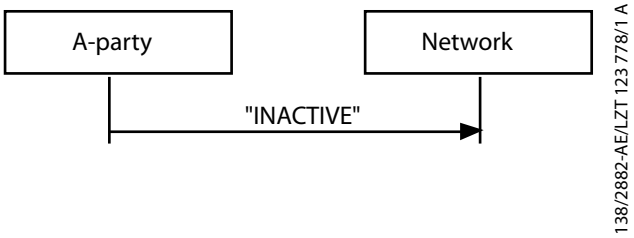

Figure 237 Deactivation.

6.2.11 Inhibit User Traffic

In some situations the network needs to force a mobile terminal not to send user traffic.

In these situations the network generates a DIE packet.

This packet will be converted to an FK-frame (F K01) by the radio modem. The FK-frame is transferred to the PC.

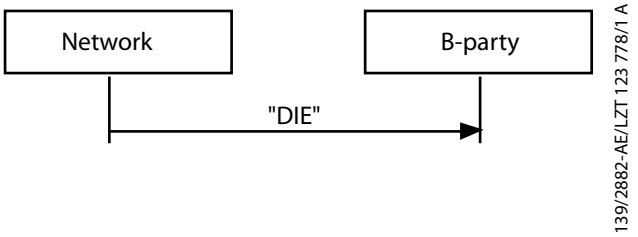

Figure 238 The mobile terminal must not send user traffic.

6.2.12 Resume User Traffic

When a mobile terminal can, after having been inhibited, resume user traffic, a LIVE packet will be sent from the network.
This packet will be converted to an FK-frame (F K02) by the radio modem. The FK-frame is transferred to the PC.

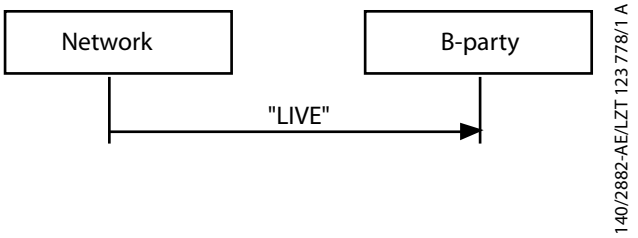

Figure 239 The mobile terminal may send user traffic again.

DIE and LIVE are stored in the mailbox if the B-party is not active.

6.2.13 Updating Grouplist

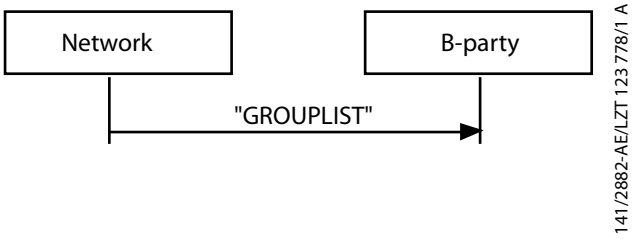

Figure 240 Update of grouplist.

GROUPLIST is stored in the mailbox if the B-party is not active.

6.2.14 Mode Information

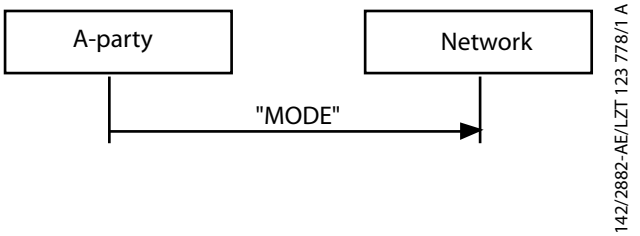

Figure 241 The radio modem informs the network about changed mode.

6.2.15 Time Information

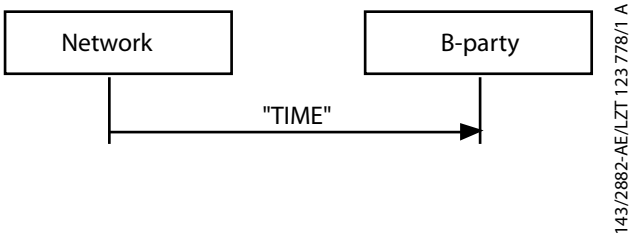

Figure 242 Time information sent.

The TIME packet is sent with regular intervals when no other traffic is loading the network.

The time information stated is the time of the day when the packet is sent from the network.

The information in the TIME packet may be used to check the internal time piece in the PC.

Note: Do not confuse the TIME packet with the time information given in other packets. The time information embedded in data transferring packets states the time when the network first received the packet - not the time for retransmission.

See also *chapter 5.1.2 Time*

7 Important Mobitex Functions

This chapter describes a few important Mobitex functions that are not described elsewhere in this manual.

7.1 Subscribers and Subscriptions

In order to enable the transfer of messages between different users of the Mobitex network, every user must be a subscriber, or must make use of an established subscription.

A subscription to Mobitex can either be a terminal subscription, a personal subscription or a group subscription.

Each subscription has its own subscription number, also called the MAN number or just MAN.

7.1.1 Mobile Terminal Subscription

A mobile terminal subscription is always linked to a certain mobile terminal, that is, a radio modem. Mobile terminals communicate with the network by radio links to the base radio stations. The MAN number for a mobile terminal subscription is stored in the radio modem. This number is also called the TMAN.

7.1.2 Personal Subscriptions

A personal subscription is linked to a person and not to any particular terminal. It can be activated from any terminal defined for personal subscriptions, either fixed or mobile. This is useful for subscribers who often use different terminals, for example in different vehicles or in rental cars.

When a personal subscription logs in, the services defined for it are made available to the user. However, the technical limitations of the terminal being used can limit the services.

A login message always includes a password and notifies the network that a personal subscription has been logged in at that particular physical terminal. The network regards the subscription as having been transferred to this terminal until the user either sends a logout message or is logged in at another terminal. A personal subscription can only be logged in to one terminal at a time.

A mobile terminal can have up to seven personal subscriptions logged in simultaneously. The subscription numbers for the personal subscriptions logged in via a terminal are stored in the terminal’s Flexlist.

7.1.3 Group Subscriptions

A group subscription is comprised by a number of mobile terminal subscriptions. Any mobile terminal subscription can be a member of up to 15 different group subscriptions. All mobile terminals will belong to the All-Terminals Group.

The member of a group will be addressed via the subscription number of the group. The subscription numbers for group subscriptions are stored in a Grouplist.

A group subscription can only receive messages.

7.2 Extended Battery Saving Protocol

7.2.1 Protocol Revision

To make it possible for portable radio modems to determine whether the network supports the extended battery saving protocol or not, the <FRI> and <SVP3> radio link layer frames are modified. When the field REVISION INFO is set to 1 or higher the base radio station supports the extended battery saving protocol, if set to 0 the extended battery saving protocol is not supported. The extended battery saving protocol must only be used by a portable radio modem when it has received a <FRI> or <SVP3> frame with the REVISION INFO field set to 1 or higher.

7.2.2 Extended Stand-By Mode

A portable radio modem in battery saving mode may reduce battery consumption by monitoring every <SVP6> period. A new parameter SKIPNUM is introduced. This new parameter is used by the radio modem to inform the Mobitex network about which <SVP6> frames the radio modem is monitoring.

The SKIPNUM parameter means that the portable radio modem will only listen to every SKIPNUMth <SVP6>, and hence every SKIPNUMth <SVP3> and <SVP4> and <SVP5> (note that <SVP4> and <SVP5> are only sent when needed). Legal values of SKIPNUM are 1, 2, 4, 8 and 16.
It is necessary for the portable radio modem to inform the base radio station about the MODE and SKIPNUM parameter settings whenever it roams in to a new radio station or changes the parameter setting. For this purpose the MPAK LOWPOWER will be used.

A portable radio modem will use the new DTSERV MPAK LOWPOWER and the appropriate subtype to roam into a base radio station supporting the Extended Stand-by Mode (see *7.2.1 Protocol Revision* above). This way the base radio station will be informed about the MODE and SKIPNUM settings.

7.2.3 Deep Sleep Inhibit

In order to enable faster responses following an up- or down-link radio transmission, portable radio modems shall listen to all low power protocol sweep signals a number of SKIP_TRANS<SVP6> signals following an up- or down-link transmission. This should be done independently of chosen SKIPNUM. That is, portable radio modems should fall back to SKIPNUM 1 a certain number of sweep signals following a packet transaction without reporting the change of SKIPNUM to the radio base station. After reception of SKIP_TRANS<SVP6> signals, it will resume to its chosen SKIPNUM, again without reporting the SKIPNUM change to the radio base station. The field SKIP_TRANS is broadcasted in the <SVP6> sweep signal.

Note: The portable radio modems shall also follow the rules for TRANSACTION_TIME.

7.2.4 Sorting of the MANs Broadcasted in <SVP5> and <SVP6> Frames

The MANs in the <SVP5> and <SVP6> sweep signals are sorted alternately in descending or ascending order provided that the new functionality is supported by the radio base station[1]. A radio modem may determine the sorting order by comparing the first and second MAN transmitted in the list. During reception of the <SVP5> or <SVP6> signal, the radio modem may enter stand-by mode when it determines that neither its own MAN nor any MAN in the radio modem's group list is included in the sweep signal.

If the radio modem enters stand-by mode during reception of an <SVP5> signal, it must be back in reception mode in time to receive the following <SVP6> signal.

7.2.5 Possibility for Quicker Return to Stand-By Mode for Portable Radio Modems

A new field, ADDRESSED, and a new flag, G7, will be added to the <SVP6> primary block. The field ADDRESSED will also ba added to the <SVP5> primary block. The ADDRESSED field consists of 31 bits, representing 31 flags, f0-f30. These flags may be used by the radio modem to determine if it will monitor the following MAN list of the sweep signal or return to stand-by mode. Flag fn is set if any of the MANs in the list satisfies the following condition:

MAN modulo 31 = n.

If the G7 flag (<SVP6> frame only) or the flag (fn) corresponding to the terminal MAN or any of the MANs included in the grouplist is set, the radio modem will continue in operational mode and check its own MAN and the MANs included in its group list against the list of MANs included in the sweep frame. If none of the G7 flag and the flags (fn) corresponding to the terminal MAN and the MANs in the terminal grouplist except group 7 are set, then the terminal may enter stand-by mode immediately.

1.Radio base stations not supporting the new functionality do not sort the MANs in any particular order.

If the radio modem enters stand-by mode during reception of an <SVP5> signal, it must be back in reception mode in time to receive the following <SVP6> signal.

7.2.6 Multiple <ACK> and <ATD> Frames

When the radio link is poor between the base radio station and a radio modem, the base radio station may send multiple <ACK> and <ATD> frames in order to increase the probability of successfully completing an up-link traffic session.

Multiple <ACK> Frames

The first <ACK> frame that the radio modem receives will be used to end the up-link traffic session. Any subsequent <ACK> frames shall be ignored, the up-link traffic session is already ended.

Multiple <ATD> Frames

When the radio modem receives an <ATD> frame after having sent an <ABD> frame it will respond with an <MRM> frame. If the radio modem receives a second <ATD> frame the <MRM> frame will be repeated.

7.2.7 <SBF_ACK> Frame

A new, shorter frame, the <SBF_ACK> frame is introduced to improve the radio base station's ability to correctly receive and acknowledge frames from the radio modem under poor radio conditions. Two new <SBF_ACK> frames should be sent instead of one <ACK> frame (however to conserve battery the radio modem may choose to send only one <SBF_ACK> frame if the signal strength is considered sufficient).

Note: The <SBF_ACK> frame must not be used if the extended battery saving protocol is not supported.

7.2.8 Roaming Criteria

The criteria for evaluating other base radio stations and when to roam into another base radio station are not defined in this document. However, the parameters GOODBASE and BADBASE should not be used, since the radio modems in paging-like applications may work at lower signal levels than specified in these parameters.

When roaming into a base radio station, the radio modem will determine the base radio station's radio protocol revision by monitoring the radio channel for a <FRI> or <SVP3> frame and checking REVISION INFO.

If REVISION INFO is set to 0, the base radio station does not support the extended battery saving protocol and the portable radio modem will act accordingly.

If REVISION INFO is 1 or higher, the SKIPNUM value must be sent to the Mobitex network from the radio modem in one of the subtypes of the new DTSERV MPAK LOWPOWER. If the radio modem operates in battery saving mode, the radio modem will synchronize its channel monitoring with the <SVP6> frames transmitted.

The use of the new SKIPNUM parameter implies that a criterion for leaving CURRENT BASE must be modified. If the radio modem has lost consecutive <SVP6> frames within the time $T_{LeaveCurrentBase}$ (Defined below), it should stay in the operating state to re-synchronizing within 60 seconds, it should begin quick channel monitoring (roaming).

$T_{LeaveCurrentBase}$ = SKIPNUM * EVALUATE_CURRENT

where

EVALUATE_CURRENT is a parameter sent in the <SVP6> frame.

7.2.9 Synchronization with the Network for Portable Radio Modems

The network periodically transmits <SVP6> frames on system channels where the battery saving protocol is used.

To synchronize the radio modem to monitor the correct <SVP6> signals transmitted by the base radio station, the base radio station labels each <SVP6> frame with a number, SVP6NUM, increasing from 0 to 15, then restarting from 0 again.

A portable radio modem will monitor the <SVP6> signal when the following expression is true:

((MAN div 4) - SVP6NUM) mod SKIPNUM = 0

MAN div 4 in the expression above means that the two least significant bits in the MAN are truncated. *MAN* is the terminal MAN.

When roaming into a base station, or if an unexpected SVP6NUM is received when the radio modem monitors a <SVP6> signal, the radio modem shall re-synchronize its channel monitoring. If the radio modem fails to synchronize, the radio modem will determine the base radio station’s radio protocol revision by monitoring the radio channel for a <FRI> or <SVP3> frame. If the REVISION INFO is 1 or higher, the radio modem shall retry to synchronize its channel monitoring.

Radio modems using this protocol cyclically toggle between the stand-by state and the operating state. This toggling is synchronized by the <SVP6> frames and the SKIPNUM parameter.

The <SVP6> frame contains the parameter CYCLE-TIME and TIME-TO-NEXT.

The value of these two parameters and the SKIPNUM parameter defines the next time the radio modem should enter the operating state.

To ensure that the portable radio modems receive <SVP3> and <SVP5> frames the <SVP3> and <SVP5> periodicity must be an odd number. When needed <SVP4> and <SVP 5> frames will be sent before the <SVP 6> frame.

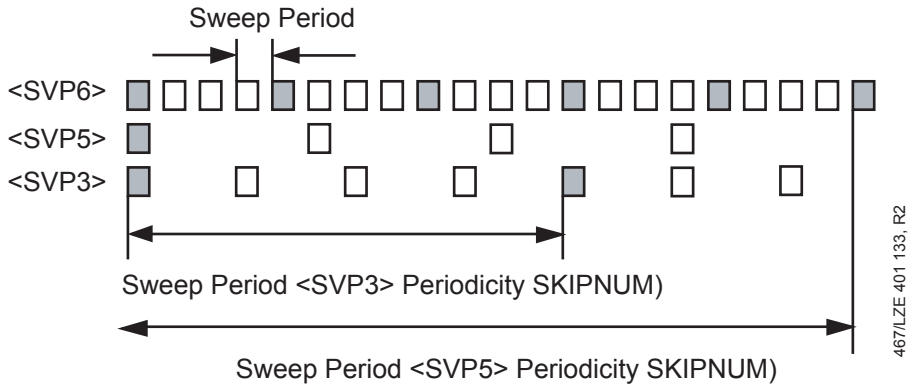

Figure 243

7.2.10 Radio Modem Response to a <SVP5> Frame

If the base radio station supports the new functionality the radio modem shall respond with an MPAK LOWPOWER, subtype ACTIVE. If the base radio station does not support the new functionality the radio modem will respond with an MPAK ACTIVE.

8 Glossary

The list below describes some terms used in this manual.

CCITT	The International Telegraph and Telephone Consultative Committee: an advisory committee established to recommend world-wide standards.
MAN, (MAN number)	Mobitex Subscription Number, also called Mobitex Access Number. Every subscriber connected to a Mobitex system is assigned a MAN number. The mobile terminal's MAN number is stored in the radio modem. In this manual "MAN number" means the same thing as "phone number".
MASC	Mobitex Asynchronous Communication, a protocol used for communication between a radio modem and its connected PC.
Mobile terminal	A radio modem connected to a data terminal or a PC. The equipment does not necessarily have to be really mobile.
Modem	An electronic device that permits digital equipment to use analog media for data communication.
MPAK	Mobitex Packet, digital information to be transmitted by a radio modem. The packet includes addressee and sender information as well as certain control signals.
Network ID	The Network Identity is unique to each Mobitex network. A radio modem user may subscribe to up to four different networks.
OSI (OSI-RM or ISO/ OSI)	Open Systems Interface Reference Model. Standardised procedures for enabling computers to communicate with each other.
PC	Personal Computer. In this manual the term PC is used for any data terminal unit that the user has connected to the radio modem. It corresponds to a data terminal equipment (DTE) according to CCITT V.24.
Protocol	A set of rules governing the operation of functional units of a communication system. The protocol must be followed if communication is to be achieved.
Radio modem (RM)	A modem for wireless communication. In this manual a radio modem is equivalent of a Mobidem. It corresponds to a data circuit terminating equipment (DCE) according to CCITT V.24.

Radio protocol	Protocol used for transferring data over a radio channel. The radio protocol makes error-free data transfer possible.