

Air Interface Description MX-ONE Fixed Part and Air Interface Requirements for Portables

INTERWORKING DESCRIPTION



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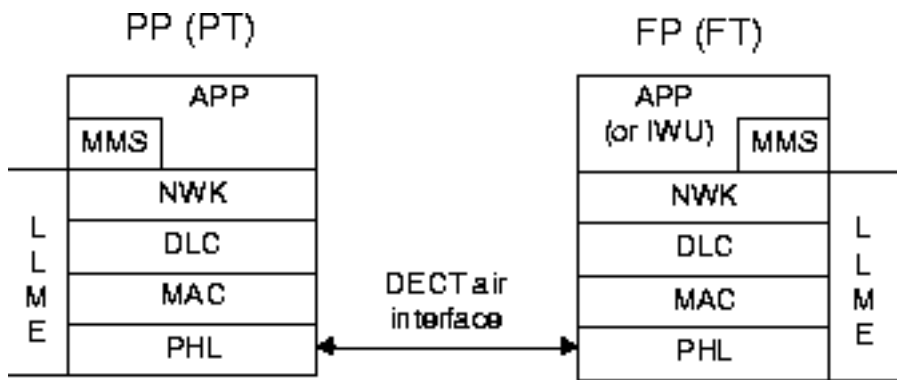
1 GENERAL

1.1 SCOPE

This document specifies the air interface of the MX-ONE DECT Fixed Part, and defines the air interface requirements for the portables to be used with it.

1.2 OVERVIEW

DECT systems can be decomposed into a Portable Part (PP) and a Fixed Part (FP), yielding the architecture, which is shown in the following figure. These two system parts interact with each other via the DECT air interface.



In the DECT standard, the functions in the Portable Part (PP) are named Portable radio Termination (PT), and the functions in the Fixed Part (FP) are named Fixed radio Termination (FT).

The Portable Part and the Fixed Part use DECT messages and procedures to interact via the air interface. These messages and procedures are defined in the DECT CI Base Standard (see [1]..[8]).

Not all of the procedures described in the DECT CI Base Standard are actually required in any particular application. Since the DECT CI Base Standard does not specify which procedures are required in each particular application, profiles are required in order to achieve interoperability of DECT equipment.

1.3 GENERIC ACCESS PROFILE (GAP)

A profile defines a selection of messages and procedures from the DECT CI base standard, and gives an unambiguous description of the CI for specified service(s) and application(s).

The objective of the GAP (see [9]) is to ensure the inter-operability of DECT equipment, which is capable of 3.1 kHz telephony applications, in such a way that any DECT Portable Part is inter-operable with any DECT Fixed Part.

The GAP consists of the minimum mandatory requirements which allow a speech connection to be established, maintained, and released between a Portable Part (with the appropriate access rights) and a Fixed Part, irrespective of whether the Fixed Part provides residential (R), business (B), or public (P) access services.

1.4 CTM ACCESS PROFILE (CAP)

The CAP can be considered as an extension of the GAP mandatory base. It originally has been written for public CTM systems, but it can be applied for large business systems as well.

The objective of CAP (see [10]) is to ensure inter-operability of CAP Portable Parts and CAP Fixed Parts. It allows users of DECT Portable Parts to be mobile within and between networks. One of the most significant features is the external (or inter-system) handover.

1.5 SHORT MESSAGE SERVICE (SMS)

The Short Message Service (SMS) provides a means of transferring GSM like SMS messages over the Low Rate Messaging Service (LRMS).

1.6 MX-ONE PROPRIETARY ADDITIONS

Mitel has defined for the MX-ONE a number of proprietary additions to the DECT air interface. These additions are described in detail in this document.

2 AIR INTERFACE SPECIFICATION

2.1 DEFINITIONS

2.1.1 ITEM REFERENCES

The item references in the tables in this section have the following meanings:

| | |
|-----------------|---|
| GAP-X.nn | The item with number X.nn in the Generic Access Profile (GAP) (see [9]). |
| CAP-X.nn | The item with number X.nn in the CTM Access Profile (CAP) (see [10]). |
| SMS-X.nn | The item with number X.nn in the Low Rate Messaging Service (LRMS) including Short Message Service (SMS) (see [11]). |
| MD-X.nn | The item with number X.nn, which is an MX-ONE proprietary additions to the DECT air interface, and is described in this document. |

2.1.2 SYMBOLS

The symbols used in the status in standard columns in the tables in this section have the following meanings:

| | |
|--------------------------------------|--|
| M | Mandatory. (In case of procedures, an M in the status column means mandatory if the corresponding feature is supported.) |
| O | Optional. |
| O_G / M_C | Optional according to GAP but mandatory according to CAP. |
| - | Not applicable or out of scope. |

The symbols used in the other columns in the tables in this document have the following meanings:

| | |
|----------|--|
| Y | Yes, implemented in MX-ONE Fixed Part, or requirement for MX-ONE portables. |
| N | No, not implemented in MX-ONE Fixed Part, or no requirement for MX-ONE4 portables. |
| W | Wish for MX-ONE portables, but not a hard requirement. |
| - | Not applicable or out of scope. |

2.1.3 FEATURE CODES

In the conditional expressions in the tables in this section feature codes are used. A feature code has to be read as true if the corresponding end-user feature is to be supported, otherwise the feature code must be read as false.

The following feature codes are defined:

| | |
|------------------|--|
| CLIP | The ability of the MX-ONE to send the calling party number (A-number) to the portable as functional information. (So not by means of the feature DISPLAY.) |
| DISPLAY | The ability of an MX-ONE to control the display of a portable. |
| EXTENSION | The ability of a portable to display the extension number related to its subscription on the MX-ONE. |
| HOOK_CTL | The ability of the MX-ONE to remotely control the on-hook / off-hook function of the portable. |
| MWI | The ability of the MX-ONE to send an indication to the portable that messages are waiting as functional information. (So not by means of the feature DISPLAY.) |
| SMS_MO | The ability of sending GSM like SMS messages from the portable to the MX-ONE. |
| SMS_MT | The ability of sending GSM like SMS messages from the MX-ONE to the portable. |
| TIME_DATE | The ability of sending current time and current date information from the MX-ONE to the portable. |

2.2 MAC LAYER

| Item No. | Feature / procedure | Ref. | Status in standard | | Impl. in MX-ONE | Requirement on MX-ONE portables |
|----------|---|----------|--------------------|----|-----------------|---------------------------------|
| | | | FT (B) | PT | | |
| GAP-M.1 | General | [9] 5.2 | M | M | Y | Y |
| | General | [9] 10.1 | M | M | Y | Y |
| GAP-M.2 | Continuous broadcast | [9] 5.2 | M | M | Y | Y |
| | Downlink broadcast | [9] 10.2 | M | M | Y | Y |
| GAP-M.3 | Paging broadcast | [9] 5.2 | M | M | Y | Y |
| | Paging broadcast | [9] 10.3 | M | M | Y | Y |
| GAP-M.4 | Basic connections | [9] 5.2 | M | M | Y | Y |
| | Set-up of basic connection, basic bearer set-up (A-field) | [9] 10.4 | M | M | Y | Y |
| | Connection/bearer release | [9] 10.5 | M | M | Y | Y |
| GAP-M.5 | Cs higher layer signalling | [9] 5.2 | M | M | Y | Y |
| | Cs channel data | [9] 10.8 | M | M | Y | Y |
| | Q2 bit setting | [9] 10.9 | M | M | Y | Y |

| Item No. | Feature / procedure | Ref. | Status in standard | | Impl. in MX-ONE | Requirement on MX-ONE portables |
|----------|---|-----------|----------------------------|----|-----------------|---------------------------------|
| | | | FT (B) | PT | | |
| GAP-M.6 | Quality control | [9] 5.2 | M | M | Y | Y |
| | RFPI handshake | [9] 10.10 | M | M | Y | Y |
| | Antenna diversity detection | [9] 10.11 | O | M | Y | Y |
| | Sliding collision detection | [9] 10.12 | M | O | Y | W |
| GAP-M.7 | Encryption activation | [9] 5.2 | O | M | Y | Y |
| | Encryption process – initialisation and synchronisation | [9] 10.13 | M | M | Y | Y |
| | Encryption mode control | [9] 10.14 | M | M | Y | Y |
| | Handover encryption process | [9] 10.15 | M | M | Y | Y |
| GAP-M.8 | Extended frequency allocation | [9] 5.2 | O | M | Y | Y |
| | Extended frequency allocation | [9] 10.16 | O | M | Y | Y |
| GAP-M.9 | Bearer handover, intra-cell | [9] 5.2 | If GAP-M. 11 then O else M | M | Y | Y |
| | Bearer handover request | [9] 10.6 | M | M | Y | Y |
| GAP-M.10 | Bearer handover, inter-cell | [9] 5.2 | O | M | Y | Y |
| | Bearer handover request | [9] 10.6 | M | M | Y | Y |
| GAP-M.11 | Connection handover, intra-cell | [9] 5.2 | If GAP-M. 9 then O else M | M | Y | Y |
| | Connection handover request | [9] 10.7 | M | M | Y | Y |
| GAP-M.12 | Connection handover, inter-cell | [9] 5.2 | O | M | Y | Y |
| | Connection handover request | [9] 10.7 | M | M | Y | Y |
| GAP-M.13 | SARI support | [9] 5.2 | O | M | Y | Y |
| | Downlink broadcast | [9] 10.2 | O | M | Y | Y |

| Item No. | Feature / procedure | Ref. | Status in standard | | Impl. in MX-ONE | Requirement on MX-ONE portables |
|----------|---|-------------|---|---|-----------------|---------------------------------|
| | | | FT (B) | PT | | |
| GAP-M.14 | Encryption deactivation | [9] 5.2 | If GAP-N. 28 or GAP-N. 29 then M else - | If GAP-N. 28 or GAP-N. 29 then M else - | N | N |
| | Encryption mode control | [9] 10.14 | M | M | N | N |
| CAP-M.1 | TARI support | [10] 6.2 | O | O | N | N |
| | Non-continues broadcast | [10] 11.3 | M | M | N | N |
| CAP-M.2 | RFP status | [10] 6.2 | O | M | Y | Y |
| | RFP status | [10] 11.4 | M | M | Y | Y |
| CAP-M.3 | Extended Fixed Part capabilities | [10] 6.2 | O | M | Y | Y |
| | Extended Fixed Part capabilities | [10] 11.5 | M | M | Y | Y |
| CAP-M.4 | Prolonged preamble diversity in RFP | [10] 6.2 | O | - | Y | - |
| | Prolonged preamble diversity in RFP and prolonged preamble transmission in PP | [10] 11.6.1 | M | - | Y | - |
| CAP-M.5 | Prolonged preamble diversity in PP | [10] 6.2 | - | O | - | N |
| | Prolonged preamble diversity in PP and prolonged preamble transmission in RFP | [10] 11.6.2 | - | M | - | N |
| CAP-M.6 | Prolonged preamble transmission in RFP | [10] 6.2 | O | - | 1) | - |
| | Prolonged preamble diversity in PP and prolonged preamble transmission in RFP | [10] 11.6.2 | M | - | 1) | - |
| CAP-M.7 | Prolonged preamble transmission in PP | [10] 6.2 | - | M | - | Y |
| | Prolonged preamble diversity in RFP and prolonged preamble transmission in PP | [10] 11.6.1 | - | M | - | Y |

1) N in case CORE RFP is used, Y in case BS330 or BS340 RFP is used.

2.3

DLC LAYER

| Item No. | Feature / procedure | Ref. | Status in standard | | Impl. in MX-ONE | Requirement on MX-ONE portables |
|----------|--|---------|---|----|-----------------|---------------------------------|
| | | | FT (B) | PT | | |
| GAP-D.1 | LAPC class A service and Lc | [9] 5.1 | M | M | Y | Y |
| | Class A link establishment | [9] 9.1 | M | M | Y | Y |
| | Class A acknowledge information transfer | [9] 9.2 | M | M | Y | Y |
| | Class A link release | [9] 9.3 | M | M | Y | Y |
| | Class A link re-establishment | [9] 9.4 | M | M | Y | Y |
| GAP-D.2 | Cs channel fragmentation and recombination | [9] 5.1 | M | M | Y | Y |
| | Cs channel fragmentation and recombination | [9] 9.5 | M | M | Y | Y |
| GAP-D.3 | Broadcast Lb service | [9] 5.1 | M | M | Y | Y |
| | Normal broadcast | [9] 9.6 | M | M | Y | Y |
| GAP-D.4 | Intra-cell voluntary connection handover | [9] 5.1 | If GAP-M. 9 then O else M | M | N | Y |
| | Class A basic connection handover | [9] 9.7 | M | M | N | Y |
| GAP-D.5 | Inter-cell voluntary connection handover | [9] 5.1 | O | M | N | Y |
| | Class A basic connection handover | [9] 9.7 | M | M | N | Y |
| GAP-D.6 | Encryption activation | [9] 5.1 | If GAP-N. 17 or GAP-N. 27 then M else - | M | N | Y |
| | Encryption switching | [9] 9.8 | M | M | N | Y |
| GAP-D.7 | LU1 TRUP class 0/min_delay | [9] 5.1 | M | M | Y | Y |
| | U-plane class 0/min delay | [9] 9.9 | M | M | Y | Y |
| GAP-D.8 | FU1 | [9] 5.1 | M | M | Y | Y |

| Item No. | Feature / procedure | Ref. | Status in standard | | Impl. in MX-ONE | Requirement on MX-ONE portables |
|----------|--|-------------|---|---|-----------------|-----------------------------------|
| | | | FT (B) | PT | | |
| | FU1 frame operation | [9] 9.10 | M | M | Y | Y |
| GAP-D.9 | Encryption deactivation | [9] 5.1 | If GAP-N. 28 or GAP-N. 29 then M else - | If GAP-N. 28 or GAP-N. 29 then M else - | N | N |
| | Encryption switching | [9] 9.11 | M | M | N | N |
| SMS-D.1 | Class B service and Lc 1) | [11] 7.3.10 | O | O | N | If SMS_MT or SMS_MO then W else N |
| | Class B link establishment | [11] 7.7.1 | M | M | N | If SMS_MT or SMS_MO then W else N |
| | Class B multiple frame operation | [11] 7.7.2 | M | M | N | If SMS_MT or SMS_MO then W else N |
| | Class B link release | [11] 7.7.3 | M | M | N | If SMS_MT or SMS_MO then W else N |
| | Class B link suspension and resumption | [11] 7.7.4 | M | M | N | If SMS_MT or SMS_MO then W else N |

| Item No. | Feature / procedure | Ref. | Status in standard | | Impl. in MX-ONE | Requirement on MX-ONE portables |
|----------|-------------------------------|---------------|--------------------|----|-----------------|-----------------------------------|
| | | | FT (B) | PT | | |
| | Class B link re-establishment | [11] 7.7.5 | M | M | N | If SMS_MT or SMS_MO then W else N |

1) For future use.

2.4 NWK LAYER

| Item No. | Feature / procedure | Ref. | Status in standard | | Impl. in MX-ONE | Requirement on MX-ONE portables |
|----------|----------------------------|----------|--------------------|----|-----------------|---------------------------------|
| | | | FT (B) | PT | | |
| GAP-N.1 | Outgoing call | [9] 4.1 | M | M | Y | Y |
| | Outgoing call request | [9] 8.2 | M | M | Y | Y |
| | Overlap sending | [9] 8.3 | O | M | N | Y |
| | Outgoing call proceeding | [9] 8.4 | O | M | N | Y |
| | Outgoing call confirmation | [9] 8.5 | O | M | N | Y |
| | Outgoing call connection | [9] 8.6 | M | M | Y | Y |
| | Sending keypad information | [9] 8.10 | M | M | Y | Y |
| GAP-N.2 | Off hook | [9] 4.1 | M | M | Y | Y |
| | Outgoing call request | [9] 8.2 | M | M | Y | Y |
| | Outgoing call connection | [9] 8.15 | M | M | Y | Y |
| GAP-N.3 | On hook (full release) | [9] 4.1 | M | M | Y | Y |
| | Normal call release | [9] 8.7 | M | M | Y | Y |
| | Abnormal call release | [9] 8.8 | M | M | Y | Y |
| GAP-N.4 | Dialled digits (basic) | [9] 4.1 | M | M | Y | Y |
| | Sending keypad information | [9] 8.10 | M | M | Y | Y |

| Item No. | Feature / procedure | Ref. | Status in standard | | Impl. in MX-ONE | Requirement on MX-ONE portables |
|----------|---|----------|---------------------------------|----|-----------------|---------------------------------|
| | | | FT (B) | PT | | |
| GAP-N.5 | Register recall | [9] 4.1 | O | M | Y | Y |
| | Sending keypad information | [9] 8.10 | M | M | Y | Y |
| GAP-N.6 | Go to DTMF signalling (defined tone length) | [9] 4.1 | O | M | Y | Y |
| | Sending keypad information | [9] 8.10 | M | M | Y | Y |
| GAP-N.7 | Pause (dialling pause) | [9] 4.1 | O | M | N | Y |
| | Sending keypad information | [9] 8.10 | M | M | N | Y |
| GAP-N.8 | Incoming call | [9] 4.1 | M | M | Y | Y |
| | Incoming call request | [9] 8.12 | M | M | Y | Y |
| | Incoming call confirmation | [9] 8.13 | M | M | Y | Y |
| | PT alerting | [9] 8.14 | M | M | Y | Y |
| | Incoming call connection | [9] 8.15 | M | M | Y | Y |
| GAP-N.9 | Authentication of PP | [9] 4.1 | O | M | Y | Y |
| | Authentication of PT | [9] 8.24 | M | M | Y | Y |
| GAP-N.10 | Authentication of user | [9] 4.1 | O | M | N | Y |
| | Authentication of user | [9] 8.25 | M | M | N | Y |
| GAP-N.11 | Location registration | [9] 4.1 | O _G / M _C | M | Y | Y |
| | Location registration | [9] 8.28 | M | M | Y | Y |
| | Location update | [9] 8.29 | O | M | Y | Y |
| GAP-N.12 | On air key allocation | [9] 4.1 | O | M | Y | Y |
| | Key allocation | [9] 8.32 | M | M | Y | Y |
| GAP-N.13 | Identification of PP | [9] 4.1 | O | M | Y | Y |
| | Indication of PT | [9] 8.22 | M | M | Y | Y |
| GAP-N.14 | Service class indication/assignment | [9] 4.1 | O | M | Y | Y |
| | Obtaining access rights | [9] 8.30 | M | M | Y | Y |

| Item No. | Feature / procedure | Ref. | Status in standard | | Impl. in MX-ONE | Requirement on MX-ONE portables |
|----------|---|----------|--------------------|----|-----------------|---------------------------------|
| | | | FT (B) | PT | | |
| | Authentication of PT | [9] 8.24 | M | M | Y | Y |
| GAP-N.15 | Alerting | [9] 4.1 | M | M | Y | Y |
| | PT alerting | [9] 8.14 | M | M | Y | Y |
| GAP-N.16 | ZAP | [9] 4.1 | O | M | N | Y |
| | Obtaining access rights | [9] 8.30 | M | M | N | Y |
| | Incrementing ZAP value | [9] 8.26 | M | M | N | Y |
| | Authentication of FT | [9] 8.23 | M | M | N | Y |
| GAP-N.17 | Encryption activation FT initiated | [9] 4.1 | O | M | Y | Y |
| | Cipher switching initiated by FT | [9] 8.33 | M | M | Y | Y |
| | Storing the DCK | [9] 8.27 | M | M | Y | Y |
| GAP-N.18 | Subscription registration procedure on-air 1) | [9] 4.1 | M | M | Y | Y |
| | Obtaining access rights | [9] 8.30 | M | M | Y | Y |
| GAP-N.19 | Link control | [9] 4.1 | M | M | Y | Y |
| | Indirect FT initiated link establishment | [9] 8.35 | M | M | Y | Y |
| | Direct PT initiated link establishment | [9] 8.36 | M | M | Y | Y |
| | Link release normal | [9] 8.37 | M | M | Y | Y |
| | Link release abnormal | [9] 8.38 | M | M | Y | Y |
| | Link release maintain | [9] 8.39 | M | M | Y | Y |
| GAP-N.20 | Terminate access rights FT initiated | [9] 4.1 | O | M | N | Y |
| | FT terminating access rights | [9] 8.31 | M | M | N | Y |
| | Authentication of FT | [9] 8.23 | M | O | N | Y |
| GAP-N.21 | Partial release | [9] 4.1 | O | O | N | N |
| | Partial release | [9] 8.9 | M | M | N | N |
| GAP-N.22 | Go to DTMF (infinite tone length) | [9] 4.1 | O | O | Y | Y |
| | Go to DTMF (infinite tone length) | [9] 8.10 | M | M | Y | Y |

| Item No. | Feature / procedure | Ref. | Status in standard | | Impl. in MX-ONE | Requirement on MX-ONE portables |
|----------|--------------------------------------|----------|--------------------|----|-----------------|---------------------------------|
| | | | FT (B) | PT | | |
| GAP-N.23 | Go to Pulse | [9] 4.1 | O | O | N | N |
| | Sending keypad information | [9] 8.10 | M | M | N | N |
| GAP-N.24 | Signalling of display characters 3) | [9] 4.1 | O | O | Y | If DISPLAY then Y else N |
| | Display | [9] 8.16 | M | M | Y | If DISPLAY then Y else N |
| | Terminal capability indication | [9] 8.17 | M | M | Y | If DISPLAY then Y else N |
| GAP-N.25 | Display control characters 3) | [9] 4.1 | O | O | Y | If DISPLAY then Y else N |
| | Display | [9] 8.16 | M | M | Y | If DISPLAY then Y else N |
| | Terminal capability indication | [9] 8.17 | M | M | Y | If DISPLAY then Y else N |
| GAP-N.26 | Authentication of FT 2) | [9] 4.1 | O | O | Y | Y |
| | Authentication of FT | [9] 8.23 | M | M | Y | Y |
| GAP-N.27 | Encryption activation PT initiated | [9] 4.1 | O | O | N | N |
| | Cipher-switching initiated by FT | [9] 8.34 | M | M | N | N |
| | Storing the DCK | [9] 8.27 | M | M | N | N |
| GAP-N.28 | Encryption deactivation FT initiated | [9] 4.1 | O | O | N | N |
| | Cipher-switching initiated by FT | [9] 8.33 | M | M | N | N |
| GAP-N.29 | Encryption deactivation PT initiated | [9] 4.1 | O | O | N | N |
| | Cipher-switching initiated by PT | [9] 8.34 | M | M | N | N |

| Item No. | Feature / procedure | Ref. | Status in standard | | Impl. in MX-ONE | Requirement on MX-ONE portables |
|----------|---|--------------|----------------------------|---------------------------------|-----------------|---------------------------------|
| | | | FT (B) | PT | | |
| GAP-N.30 | Calling Line Identification Presentation (CLIP) | [9] 4.1 | O | O _G / M _C | Y | If CLIP then Y else N |
| | Incoming call request | [9] 8.12 | M | M | Y | If CLIP then Y else N |
| GAP-N.31 | Internal call | [9] 4.1 | O | O | N | N |
| | Internal call set-up | [9] 8.18 | M | M | N | N |
| | Internal call keypad | [9] 8.19 | O | M | N | N |
| GAP-N.32 | Service call | [9] 4.1 | O | O | N | N |
| | Service call set-up | [9] 8.20 | M | M | N | N |
| | Service call keypad | [9] 8.21 | O | M | N | N |
| GAP-N.33 | Enhanced U-plane connection | [9] 4.1 | O | O | N | N |
| | Enhanced FT initiated U-plane connection | [9] 8.21 | M | M | N | N |
| CAP-N.1 | DECT external handover | [10] 5.1 | O | M | Y | Y |
| | Handover candidate indication | [10] 9.1.1.1 | M | M | Y | Y |
| | Handover candidate retrieval | [10] 9.1.1.2 | O | M | N | N |
| | Target FP selection | [10] 9.1.2 | - | M | - | Y |
| | Handover reference indication | [10] 9.1.3.1 | C1) | M | Y | Y |
| | Handover reference retrieval | [10] 9.1.3.2 | C2) | M | N | N |
| | External handover call set-up | [10] 9.1.4 | M | M | Y | Y |
| | Ciphering procedure PT initiated | [10] 9.1.5.1 | If GAP-N. 27 then M else O | O | N | N |

| Item No. | Feature / procedure | Ref. | Status in standard | | Impl. in MX-ONE | Requirement on MX-ONE portables |
|----------|--|--------------|----------------------------|----|-----------------|---------------------------------|
| | | | FT (B) | PT | | |
| | Ciphering procedure FT initiated | [10] 9.1.5.2 | If GAP-N. 17 then M else O | M | Y | Y |
| | U-plane handling | [10] 9.1.6 | M | M | Y | Y |
| CAP-N.2 | Emergency call | [10] 5.1 | O | M | N | N |
| | Emergency call set-up | [10] 9.2 | O | M | N | N |
| CAP-N.3 | Display management | [10] 5.1 | O | M | Y | If DISPLAY then Y else N |
| | Display | [10] 9.3 | M | M | | If DISPLAY then Y else N |
| | Terminal capability indication | [10] 9.4 | M | M | | If DISPLAY then Y else N |
| CAP-N.4 | Message Waiting Indication (MWI) | [10] 5.1 | O | M | Y | If MWI then Y else N |
| | Message Waiting Indication (MWI) | [10] 9.7 | M | M | Y | If MWI then Y else N |
| CAP-N.5 | Detach | [10] 5.1 | O | M | Y | Y |
| | Detach | [10] 9.5 | M | M | Y | Y |
| CAP-N.6 | Periodic location registration 4) | [10] 5.1 | O | M | N | W |
| | Enhanced location registration | [10] 9.6 | M | M | N | W |
| CAP-N.7 | On-air modification of user parameters | [10] 5.1 | O | M | N | N |
| | On-air modification of user parameters | [10] 9.8 | M | M | N | N |
| | FT authentication | [9] 8.23 | M | M | N | N |

| Item No. | Feature / procedure | Ref. | Status in standard | | Impl. in MX-ONE | Requirement on MX-ONE portables |
|----------|----------------------------------|---------------|--------------------|----|-----------------|---------------------------------|
| | | | FT (B) | PT | | |
| SMS-N.1 | Outgoing message call | [11] 7.3.9 | M | M | Y | If SMS_MO then Y else N |
| | Outgoing message call request | [11] 7.6.2 | M | M | Y | If SMS_MO then Y else N |
| | Outgoing message call connect | [11] 7.6.3 | M | M | Y | If SMS_MO then Y else N |
| | Message transfer | [11] 7.6.4 | M | M | Y | If SMS_MO then Y else N |
| | Normal call release | [9] 8.7 | M | M | Y | If SMS_MO then Y else N |
| | Abnormal call release | [9] 8.8 | M | M | Y | If SMS_MO then Y else N |
| | Partial call release | [9] 8.9 | O | O | N | N |
| SMS-N.2 | Incoming message call | [11] 7.3.9 | M | M | Y | If SMS_MT then Y else N |
| | Incoming message call request | [11] 7.6.5 | M | M | Y | If SMS_MT then Y else N |
| | Incoming message call connection | [11] 7.6.6 | M | M | Y | If SMS_MT then Y else N |
| | Message transfer | [11] 7.6.7 | M | M | Y | If SMS_MT then Y else N |

| Item No. | Feature / procedure | Ref. | Status in standard | | Impl. in MX-ONE | Requirement on MX-ONE portables |
|----------|---|---------|--------------------|----|-----------------|---------------------------------|
| | | | FT (B) | PT | | |
| | Normal call release | [9] 8.7 | M | M | Y | If SMS_MT then Y else N |
| | Abnormal call release | [9] 8.8 | M | M | | If SMS_MT then Y else N |
| | Partial release | [9] 8.9 | O | O | N | N |
| | Terminal capability indication | | M | M | Y | If SMS_MT then Y else N |
| MD-N.1 | Idle display management 3) | 3.1 | - | - | Y | If DISPLAY then Y else N |
| | Idle display management | 3.1.1 | - | - | Y | If DISPLAY then Y else N |
| MD-N.2 | Proprietary info call independent | 3.2 | - | - | Y | If TIME_DATE then Y else N |
| | Proprietary info call independent request | 3.2.1 | - | - | Y | If TIME_DATE then Y else N |
| | Proprietary info call independent confirm | 3.2.2 | - | - | Y | If TIME_DATE then Y else N |
| MD-N.3 | Remote off-hook 4) | 3.3 | - | - | N | If HOOK_CTL the Y else N |
| | Remote off-hook request | 3.3.1 | - | - | N | If HOOK_CTL the Y else N |

| Item No. | Feature / procedure | Ref. | Status in standard | | Impl. in MX-ONE | Requirement on MX-ONE portables |
|----------|----------------------------|----------|--------------------|----|-----------------|---------------------------------|
| | | | FT (B) | PT | | |
| | Incoming call confirmation | [9] 8.13 | - | - | N | If HOOK_C TL the Y else N |
| | PT alerting | [9] 8.14 | - | - | N | If HOOK_C TL the Y else N |
| | Incoming call connection | [9] 8.15 | - | - | N | If HOOK_C TL the Y else N |
| MD-N.4 | Remote on-hook 4) | 3.4 | - | - | N | If HOOK_C TL the Y else N |
| | Normal call release | 3.4.1 | - | - | N | If HOOK_C TL the Y else N |

- C1)** If procedure [10] 9.1.3.2 is supported then O else M.
- C2)** If procedure [10] 9.1.3.1 is supported then O else M.
- 1)** The MX-ONE allows multiple portables to start subscription procedure on-air at the same time.
 - 2)** This feature is an integral part of the on air key allocation procedure therefore mandatory to implement.
 - 3)** Currently the MX-ONE is only able to utilise the display of portables that have indicated there display size is 2 lines of 12 characters and being able to use character set Latin-1.
 - 4)** For future use.

2.5

MMS LAYER

| Item No. | Feature / procedure | Ref. | Status in standard | | Impl. in MX-ONE | Requirement on MX-ONE portables |
|----------|---------------------------|---------------|--------------------|----|-----------------|---------------------------------|
| | | | FT (B) | PT | | |
| SMS-S.1 | Outgoing message transfer | [11] 7.3.8 | M | M | Y | If SMS_MO then Y else N |
| | Message send procedure | [11] 7.4.1 | M | M | Y | If SMS_MO then Y else N |
| SMS-S.2 | Incoming message transfer | [11] 7.3.8 | M | M | Y | If SMS_MT then Y else N |
| | Message send procedure | [11] 7.4.1 | M | M | Y | If SMS_MT then Y else N |

2.6

APP LAYER

| Item No. | Feature / procedure | Ref. | Status in standard | | Impl. in MX-ONE | Requirement on MX-ONE portables |
|----------|--|----------|---|----|-----------------|---------------------------------|
| | | | FT (B) | PT | | |
| GAP-A.1 | AC to bitstring mapping | [9] 4.2 | If GAP-N. 9 or GAP-N. 10 or GAP-N. 12 or GAP N.26 then M else - | M | Y | Y |
| | AC to bitstring mapping | [9] 14.1 | M | M | Y | Y |
| GAP-A.2 | Multiple subscription registration in a PP | [9] 4.2 | - | M | - | Y |

| Item No. | Feature / procedure | Ref. | Status in standard | | Impl. in MX-ONE | Requirement on MX-ONE portables |
|----------|--------------------------------------|------------|--------------------|----|-----------------|---------------------------------------|
| | | | FT (B) | PT | | |
| | Subscription control | [9] 14.2 | - | M | - | Y |
| GAP-A.3 | Manual entry of the PARK | [9] 4.2 | - | O | - | Y |
| | Manual entry of the PARK | [9] 14.3 | - | M | - | Y |
| SMS-A.1 | Incoming message storage | [11] 7.3.7 | - | M | - | If SMS_MT then Y else N |
| | Incoming message storage | [11] 7.4.1 | - | M | - | If SMS_MT then Y else N |
| SMS-A.2 | Message interworking | [11] 7.3.7 | M | M | Y | If SMS_MO or SMS_MT then Y else N |
| | Message encapsulation | [11] 7.4.2 | M | M | Y | If SMS_MO or SMS_MT then Y else N |
| | General interworking requirements | [11] 7.4.3 | M | M | Y | If SMS_MO or SMS_MT then Y else N |
| | Message/primitive interworking | [11] 7.4.4 | M | M | Y | If SMS_MO or SMS_MT then Y else N |
| MD-A.1 | Proprietary registration information | 4.1 | - | - | Y | If DISPLAY or EXTENSION then Y else N |

| Item No. | Feature / procedure | Ref. | Status in standard | | Impl. in MX-ONE | Requirement on MX-ONE portables |
|----------|---|-------|--------------------|----|-----------------|---------------------------------|
| | | | FT (B) | PT | | |
| | Language | 4.1.1 | - | - | Y | If DISPLAY then Y else N |
| | Extension number | 4.1.2 | - | - | Y | If EXTENSION then Y else N |
| MD-A.2 | Time/date | 4.2 | - | - | Y | If TIME_DATE then Y else N |
| | Time/date request | 4.2.1 | - | - | Y | If TIME_DATE then Y else N |
| | Time/date confirm | 4.2.2 | - | - | Y | If TIME_DATE then Y else N |
| | Reject in case of valid proprietary message | 4.2.3 | - | - | Y | If TIME_DATE then Y else N |
| | Reject in case of invalid proprietary message | 4.2.4 | - | - | Y | If TIME_DATE then Y else N |
| MD-A.3 | Forced roaming in case of busy Fixed Part | 4.3 | - | - | - | Y |
| | Forced roaming in case of busy Fixed Part | 4.3.1 | - | - | - | Y |
| MD-A.4 | DCA | 4.4 | - | - | Y | W |
| | Double dummy bearer on RFP | 4.4.1 | - | - | Y | - |
| | Page scanning | 4.4.2 | - | - | Y | W |
| | Measuring channel quality and RSSI | 4.4.3 | - | - | Y | W |
| | Portable DCA | 4.4.4 | - | - | - | W |

| Item No. | Feature / procedure | Ref. | Status in standard | | Impl. in MX-ONE | Requirement on MX-ONE portables |
|----------|---------------------|-------|--------------------|----|-----------------|---------------------------------|
| | | | FT (B) | PT | | |
| | RFP DCA | 4.4.5 | - | - | Y | - |

3

PROPRIETARY NWK LAYER FEATURES

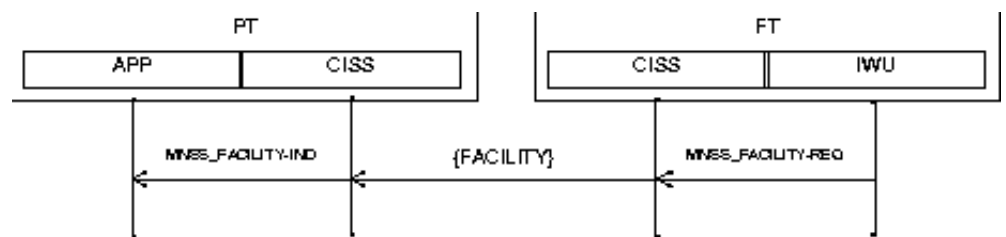
3.1

IDLE DISPLAY MANAGMENT

This service provides for the transfer of idle display information from FP to PP (uni-directional). This service can be invoked by the FP at any time, independent whether calls exist.

This service is based on the CLSS procedure (see [5] section 10.4.2.3). It utilizes the <<MULTI-DISPLAY>> information element in the {FACILITY} message in order to transparently transfer idle display information from FP to PP.

The following message sequence chart provides an overview of the idle display management procedures. The CISS entities of the NWK layer are used to provide the idle display management service.



3.1.1

IDLE DISPLAY MANAGEMENT PROCEDURE

The FP shall send an idle display information by transmitting a {FACILITY} message.

The {FACILITY} message shall contain a <<MULTI-DISPLAY>> information element, which carries the idle display information. In addition, the {FACILITY} message shall contain a <<FACILITY>> information element. The dummy TI (Transaction Identifier) value 6 shall be used, indicating connectionless.

In order to transmit a {FACILITY} message, the CISS entity shall use the message routing service, which is offered by the NWK layer's link control entity.

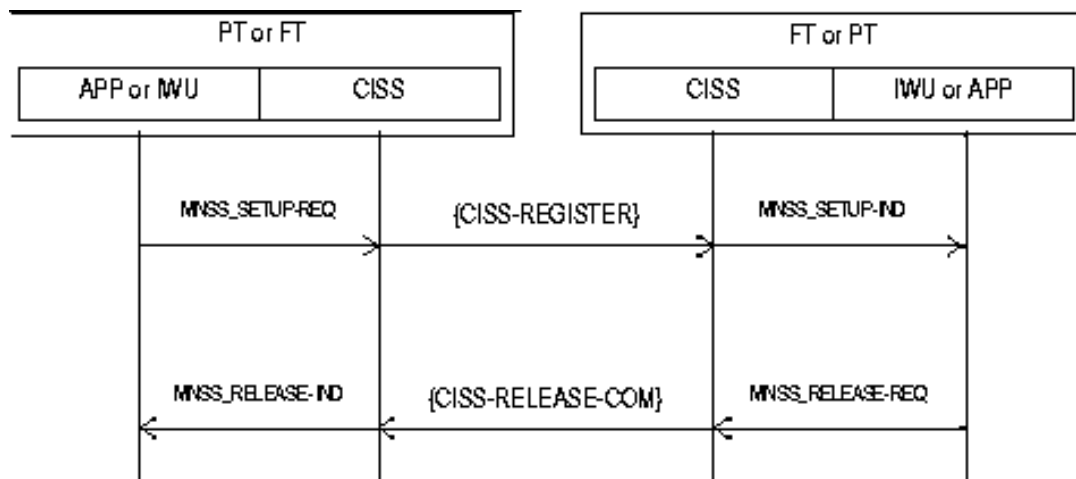
The <<MULTI-DISPLAY>> information element can contain DECT standard characters and DECT control characters, as specified for feature CAP-N.3 (see [10]).

3.2

PROPRIETARY-INFO CALL INDEPENDENT SERVICE

This service utilises the <<ESCAPE-TO-PROPRIETARY>> information element in CISS messages in order to transparently transfer proprietary information between PP and FP.

The following message sequence chart provides an overview of the proprietary-info call independent procedures. The CISS entities of the NWK layer are used to provide the proprietary-info call independent service.



3.2.1

PROPRIETARY-INFO CALL INDEPENDENT REQUEST PROCEDURE

On request of an APP or IWU entity, the underlying CISS entity shall start a proprietary-info call independent request procedure by transmitting a {CISS-REGISTER} message.

The {CISS-REGISTER} message shall contain an <<ESCAPE-TO-PROPRIETARY>> information element which is formatted according to the following table:

| Fields within the information element | Octet | Value 8765 4321 | Comment |
|---------------------------------------|--------|------------------------|---|
| <NWK-ELEMENT-IDENTIFIER> | 1 | 0111 1011 | Element type <<ESCAPE-TO-PROPRIETARY>> (see [5] clause 7.7.45). |
| <LENGTH-OF-CONTENTS> | 2 | | The number of octets in the contents (i.e. octets 3 to n). |
| <DISCRIMINATOR-TYPE> | 3 | 1000 0001 | EMC (0x81). |
| <DISCRIMINATOR> | 4 5 | 0000 0000 0000 0111 | EMC (0x0007). |
| <PROPRIETARY-CONTENTS> | 6 to n | | Contains the APP layer information. |

The EMC (Equipment Manufacturer Code) in this information element shall contain the first EMC, indicating an <<ESCAPE-TO-PROPRIETARY>> information element. This way, a receiving CISS entity (which resides in Mitel equipment) is able to discriminate which <<ESCAPE-TO-PROPRIETARY>> information elements it has to examine.

If a CISS entity receives an information element containing an EMC that is not the Mitel EMC, then the information element shall be discarded, and the message shall be ignored.

3.2.2

PROPRIETARY-INFO CALL INDEPENDENT CONFIRM PROCEDURE

On completion of the requested service, the peer CISS entity shall respond with a {CISS-RELEASE-COM} message.

The {CISS-RELEASE-COM} message shall contain an <<ESCAPE-TO-PROPRIETARY>> information element which is formatted according to the following table:

| Fields within the information element | Octet | Value 8765 4321 | Comment |
|---------------------------------------|--------|-----------------|---|
| <NWK-ELEMENT-IDENTIFIER> | 1 | 0111 1011 | Element type <<ESCAPE-TO-PROPRIETARY>> (see [5] clause 7.7.45). |
| <LENGTH-OF-CONTENTS> | 2 | | The number of octets in the contents (i.e. octets 3 to n). |
| <DISCRIMINATOR-TYPE> | 3 | 1000 0001 | EMC (0x81). |
| <DISCRIMINATOR> | 4 5 | | The same EMC as received in the {CISS-REGISTER} message. Usually this will be EMC (0x0007). |
| <PROPRIETARY-CONTENTS> | 6 to n | | Contains the APP layer information, if any. |

3.3 REMOTE OFF-HOOK

The remote off-hook service enables the FP to set-up a call to the PP, which will respond with going off-hook without user intervention.

3.3.1 REMOTE OFF-HOOK REQUEST PROCEDURE

The remote off-hook request procedure is identical to the standard GAP incoming call request procedure, as described in [9] clause 8.12, with ring pattern 4. A portable not supporting hook control by the Fixed Part will start ringing instead of going off-hook, in which case the user can go off-hook manually.

3.4 REMOTE ON-HOOK

The remote on-hook service enables the Fixed Part to terminate a call to the portable, which will respond with going on-hook without user intervention. In contrast to the normal GAP on-hook (full release) service, as described in [9] clause 4.1, the user interface of the portable will respond as if the user has initiated the on-hook.

3.4.1 REMOTE ON-HOOK REQUEST PROCEDURE

The remote on-hook request procedure is identical to the standard GAP normal call release procedure, as described in [9] clause 8.7, where there is an information element <<Test-Hook-Control>> with the value on-hook included in the {CC-RELEASE-MESSAGE}.

4 PROPRIETARY APP LAYER FEATURES

4.1 PROPRIETARY REGISTRATION INFORMATION

The application feature proprietary registration information exchanges information between the portable and the Fixed Part upon registration of the portable.

4.1.1 LANGUAGE

For exchange of the language selected by the end-user, an information element of type <<IWU-TO-IWU>> information element can be added to the NWK layer {LOCATE-REQUEST} and {ACCESS-RIGHTS-REQUEST} messages. The format of this information element is described in the following table:

| Fields within the information element | Octet | Value 8765 4321 | Comment |
|---|-------|------------------------|--|
| <NWK-ELEMENT-IDENTIFIER> | 1 | 0111 0111 | Element type <<IWU-TO-IWU>> (see [5] clause 7.7.23). |
| <LENGTH-OF- CONTENTS> | 2 | | The number of octets in the contents (i.e. octets 3 to n). |
| <1>, <S/R> and <PROTOCOL-DISCRIMINATOR> | 3 | 1100 0000 | User specific. |
| <DISCRIMINATOR-TYPE> | 4 | 1000 0001 | EMC. |
| <DISCRIMINATOR> | 5 6 | 0000 0000 0000 0111 | EMC (0x0007). |
| <MESSAGE-TYPE> | 7 | 1000 0001 | Configuration info (0x81). |
| <0> and <APP- ELEMENT-IDENTIFIER> | 8 | 0000 0010 | Language information element (0x2). |
| <LENGTH-OF-CONTENTS-2> | 9 | 0000 0001 | The number of octets in the rest of the contents (i.e. octets 10 to n). |
| <LANGUAGE-CODE> | 10 | | Language code (English = 0x00, Dutch = 0x01, German = 0x02, French = 0x03, Swedish = 0x04, Finnish = 0x05, Spanish = 0x06, Danish = 0x07, Italian = 0x08, Norwegian = 0x09, Portuguese = 0x0A, Greek = 0x0B, Turkish = 0x0c) |

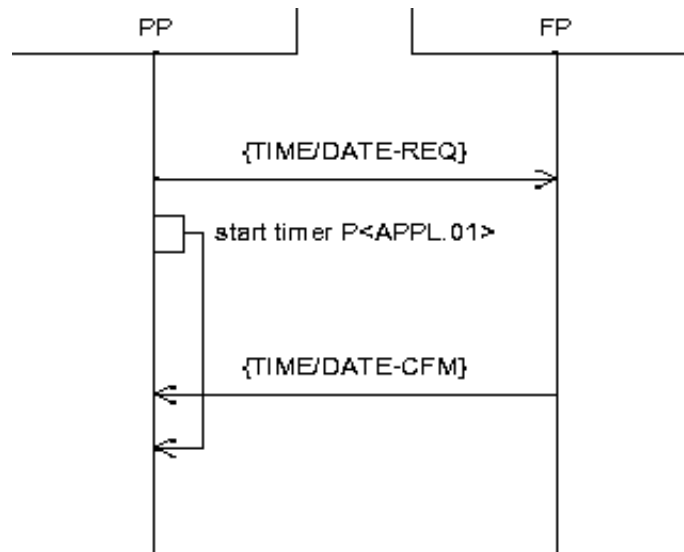
4.1.2 EXTENSION NUMBER

The extension number associated with the portable can be derived from the IPUI. When a portable is subscribed to the MX-ONE, it gets an IPUI of type T assigned. The extension number is BCD coded into the lower 44 bits of the IPUI, as suggested in [6] section 6.2.4.

4.2

TIME / DATE

The following message sequence chart provides an overview of the time-date procedures.



4.2.1

TIME / DATE REQUEST PROCEDURE

On request, the portable shall start a time-date request procedure by transmitting a {TIME/DATE-REQ} message and starting timer P<APPL.01>.

The {TIME-DATE-REQ} message is sent by the NWK layer proprietary-info call independent request procedure as a NWK layer {CISS-REGISTER} message containing the following information element:

| Fields within the information element | Octet | Value 8765 4321 | Comment |
|---------------------------------------|-------|------------------------|---|
| <NWK-ELEMENT-IDENTIFIER> | 1 | 0111 1011 | Element type <<ESCAPE-TO-PROPRIETARY>> (see [5] clause 7.7.45). |
| <LENGTH-OF-CONTENTS> | 2 | | The number of octets in the contents (i.e. octets 3 to n). |
| <DISCRIMINATOR-TYPE> | 3 | 1000 0001 | EMC (0x81). |
| <DISCRIMINATOR> | 4 5 | 0000 0000 0000 0111 | EMC (0x0007). |
| <PRIMITIVE> | 6 | 0000 0011 | Time / date request (0x01). |
| <LENGTH-OF-CONTENTS-2> | 7 | 0000 0000 | The number of octets in the rest of the contents (i.e. 0). |

Note: The {TIME/DATE-REQ} message does not contain APP-layer information elements.

Management of timer P<APPL.01>:

- Start when a {TIME/DATE-REQ} message is sent;
- Stop when a {TIME/DATE-CFM} or {REJECT} message is received;

- On expiry the portable shall report failure to the user of the time/date service. In addition, it shall request the proprietary-info call independent service to release the CISS transaction, in which case the NWK layer sends a {CISS-RELEASE-COM} message without APP layer information.

4.2.2

TIME / DATE CONFIRM PROCEDURE

The Fixed Part shall respond with a {TIME/DATE-CFM} message.

The {TIME/DATE-CFM} message is sent by the NWK layer proprietary-info call independent confirm procedure as a {CCSS-RELEASE-COM} message containing the following information element:

| Fields within the information element | Octet | Value 8765 4321 | Comment |
|---------------------------------------|-------|------------------------|--|
| <NWK-ELEMENT-IDENTIFIER> | 1 | 0111 1011 | Element type <<ESCAPE-TO-PROPRIETARY>> (see [5] clause 7.7.45). |
| <LENGTH-OF-CONTENTS> | 2 | | The number of octets in the contents (i.e. octets 3 to n). |
| <DISCRIMINATOR-TYPE> | 3 | 1000 0001 | EMC (0x81). |
| <DISCRIMINATOR> | 4 5 | 0000 0000 0000 0111 | EMC (0x0007). |
| <PRIMITIVE> | 6 | 0000 0010 | Time / date confirm (0x02). |
| <LENGTH-OF-CONTENTS-2> | 7 | 0001 0010 | The number of octets in the rest of the contents (i.e. octets 8 to 17). |
| <APP-ELEMENT-IDENTIFIER> | 8 | 0010 0011 | Element time <<TIME-DATE>>(see [5] clause 7.7.50). |
| <LENGTH-OF-CONTENTS-3> | 9 | 0001 0000 | The number of octets in the rest of the contents (i.e. octets 10 to 17). |
| <CODING> and <INTERPRE-TA-TION> | 10 | 1100 0000 | Both current time and current date (see [5] clause 7.7.50). |
| <YEAR> | 11 | | The year coded as two digits in two semi octets(see [5] clause 7.7.50). |
| <MONTH> | 12 | | The month coded as two digits in two semi octets (see [5] clause 7.7.50). |
| <DAY> | 13 | | The day coded as two digits in two semi octets (see [5] clause 7.7.50). |
| <HOUR> | 14 | | The hour coded as two digits in two semi octets (see [5] clause 7.7.50). |
| <MINUTE> | 15 | | The minute coded as two digits in two semi octets (see [5] clause 7.7.50). |
| <SECOND> | 16 | | The second coded as two digits in two semi octets (see [5] clause 7.7.50). |
| <TIME-ZONE> | 17 | 0000 0000 | Not used, always has value 0x00. |

Note: The {TIME/DATE-CFM} message contains a <<TIME-DATE>> APP layer information element, which is similar to the corresponding NWK layer information element.

On receipt of the {TIME/DATE-CFM} message, the portable shall stop timer P<APPL.01> and offer the time-date information to the user of the time-date service.

4.2.3

REJECT PROCEDURE FOR A VALID PROPRIETARY MESSAGE

This procedure is applicable if the Fixed Part receives a valid {TIME/DATE-REQ} message, but is not able to provide the time and date.

A {REJECT} message is sent by the NWK layer proprietary-info call independent confirm procedure as a {CCSS-RELEASE-COM} message containing the following information element:

| Fields within the information element | Octet | Value 8765 4321 | Comment |
|---------------------------------------|-------|------------------------|---|
| <NWK-ELEMENT-IDENTIFIER> | 1 | 0111 1011 | Element type <<ESCAPE-TO-PROPRIETARY>> (see [5] clause 7.7.45). |
| <LENGTH-OF-CONTENTS> | 2 | | The number of octets in the contents (i.e. octets 3 to n). |
| <DISCRIMINATOR-TYPE> | 3 | 1000 0001 | EMC (0x81). |
| <DISCRIMINATOR> | 4 5 | 0000 0000 0000 0111 | EMC (0x0007). |
| <PRIMITIVE> | 6 | 0000 0011 | Reject (0x03). |
| <LENGTH-OF-CONTENTS-2> | 7 | 0000 0011 | The number of octets in the rest of the contents (i.e. octets 8 to 10). |
| <APP-ELEMENT-IDENTIFIER> | 8 | 0110 0000 | Element type <<REJECT-REASON>> (see [5] clause 7.7.34). |
| <LENGTH-OF-CONTENTS-3> | 9 | 0000 0001 | The number of octets in the rest of the contents (i.e. octets 10 only). |
| <REJECT-REASON> | 10 | | Reject reason (see [5] clause 7.7.34). |

Note: The {REJECT} message contains a <<REJECT-REASON>> APP layer information element, which is similar to the corresponding NWK layer information element, indicating the reason of release.

On receipt of the {REJECT} message, the portable shall stop timer P<APPL.01>, and offer the reject reason to the user of the time / date service.

4.2.4

REJECT PROCEDURE FOR AN INVALID PROPRIETARY MESSAGE

This procedure is applicable if an invalid proprietary message is received.

The {REJECT} message is sent by the NWK layer proprietary-info call independent confirm procedure as a {CCSS-RELEASE-COM} message containing the following information element:

| Fields within the information element | Octet | Value 8765 4321 | Comment |
|---------------------------------------|-------|------------------------|--|
| <NWK-ELEMENT-IDENTIFIER> | 1 | 0111 1011 | Element type <<ESCAPE-TO-PROPRIETARY>> (see [5] clause 7.7.22). |
| <LENGTH-OF- CONTENTS> | 2 | | The number of octets in the contents (i.e. octets 3 to n). |
| <DISCRIMINATOR-TYPE> | 3 | 1000 0001 | EMC (0x81). |
| <DISCRIMINATOR> | 4 5 | 0000 0000 0000 0111 | EMC (0x0007). |
| <PRIMITIVE> | 6 | 0000 0011 | Reject (0x03). |
| <LENGTH-OF- CONTENTS-2> | 7 | 0000 0010 | The number of octets in the rest of the contents (i.e. octets 8 to 9). |
| <APP-ELEMENT- IDENTIFIER> | 8 | 0110 0000 | Element type <<RELEASE-REASON>> (see [5] clause 7.6.7). |
| <RELEASE-REASON> | 9 | 0000 0101 | Incompatible service (0x05). |

Note: The {REJECT} message contains a <<RELEASE-REASON>> APP layer information element, which is similar to the corresponding NWK layer information element, indicating the reason of release.

4.3

FORCED ROAMING IN CASE OF BUSY FIXED PART

Fixed Parts in the MX-ONE have only a limited number of speech channels available. So single Fixed Parts easily get filled up with calls, in which case portables registered on that Fixed Part are neither able to place outgoing calls nor able to answer incoming calls.

The application feature forced roaming in case of busy Fixed Part, will make a portable roam to another Fixed Part in case the Fixed Part is busy:

- the portable is paged for an incoming call,
- or the portable wants to place an outgoing call.

The portable considers a Fixed Part to be busy if:

- the Fixed Part busy flag is set,
- the RFP busy flag is set on all the RFPs the portable can see on that Fixed Part.

4.3.1

FORCED ROAMING IN CASE OF BUSY FIXED PART PROCEDURE

If a Fixed Part is completely filled up with calls, all RFPs connected to that Fixed Part will indicate Fixed Part busy using the GAP-M.2 continues broadcast procedure. If an RFP is completely filled up with calls, the RFP will indicate RFP busy using the GAP-M.2 continues broadcast procedure.

In case:

- a portable is paged for an incoming call ,
- or the portable wants to place an outgoing call

while:

- the Fixed Part is indicating Fixed Part busy,
- or all the RFPs the portable can see on that particular Fixed Part indicate RFP busy

the portable will roam to another Fixed Part using the GAP-N.11 location registration procedure.

Note: In case only some of the RFPs on a Fixed Part indicate RFP busy, the portable will try other RFPs on the same Fixed Part first.

While roaming to another Fixed Part, the portable shall register as soon as possible. It shall not wait until it has received the Fixed Part busy information.

If during location registration on another Fixed Part, this Fixed Part also appears to be busy, or does not reply, the portable will try to roam to the next Fixed Part. This is continued until the portable is registered on a Fixed Part not indicating Fixed Part busy.

4.4

DCA

This section describes DCA (Dynamic Channel Allocation) and related issues. They are not hard requirements but implementation guidelines.

4.4.1

DOUBLE DUMMY BEARER ON RFP

A portable with one radio receiver is not able to scan other channels on the same time slot position. If the portable contains a radio with a single slow adjustable frequency synthesiser, then also the channels on other frequencies on the neighbouring time slot positions cannot be scanned. These time slots are called blind slots.

An RFP, which is completely idle, will transmit two dummy bearers with at least two time slots separation unless this is not possible because all radio channels are occupied by other RFPs. In this way, always one of the two dummy bearers will be outside the portables blind slot area. When the first two traffic channels are set-up at the RFP the two dummy channels are removed.

4.4.2

PAGE SCANNING

A portable has to listen to the RFP it is locked to for page messages in the P-channel. The P-channel is transmitted in frame 0 of every multiframe. There are two page scan modes:

- Normal duty cycle. The portable listens at least once every multiframe (160 ms);
- Low duty cycle. The portable listens at least once every four multiframes (640 ms). The RFP shall indicate if low duty cycle scanning is allowed. Only if allowed by the RFP, the portable may enter the low duty cycle scanning mode. Otherwise the portable shall use normal duty cycle scanning.

All RFPs on the MX-ONE system support low duty cycle page scanning.

Note: Low duty cycle and normal duty cycle scanning are related to the scanning of information transmitted by RFPs, not to environment scanning.

4.4.3 MEASURING RSSI AND CHANNEL QUALITY

The RSSI and the quality of the standby bearer (in idle locked state) or the traffic bearer (in active locked state) to which a portable is locked, is continuously monitored. The portable also monitors the quality and RSSI of the bearers of alternative RFPs, and the RSSI level on unused channels.

4.4.3.1 *RSSI*

RSSI (Radio Signal Strength Indicator) is an important parameter needed for selecting either the strongest channel or the most quiet channel. The requirements for the RSSI measurements are defined in the DECT standard.

Due to fast fading, averaging of RSSI measurements is required for evaluation of the active channel by the portable. Otherwise a fading dip could trigger an undesired handover. However, for evaluation of alternative RFPs or free channels, averaging is not necessary and consumes too much time.

4.4.3.2 *RQI*

Many DCA decisions require an indication for the quality of ongoing transmissions. The ultimate quality indication would be the BER (Bit Error Rate). Unfortunately, this figure is not available. Therefore the RQI (Received Quality Indication) is introduced.

The RQI is implemented in the portable as a so-called leaky bucket and gives an indication of the number of missed bursts over a certain time span. The leaky bucket implies, that in case of a good reception a certain amount is added to the RQI until the bucket overflows, and in case of a bad reception another amount is subtracted until it is empty. A full bucket (RQI=32) means good quality. An empty bucket (RQI=0) means the signal quality is too bad.

The RQI can be expressed with the following formula:

$$RQI(n) = RQI(n-1) + Q(n)$$

Q(n) is defined according to the following table:

| | Q(n) in case of good reception | Q(n) in case of bad reception |
|---|---------------------------------------|--------------------------------------|
| Own traffic bearer | +1 | -8 |
| Standby bearer (to which the portable is idle locked) | +2 | -8 |
| Scanning of RFP down links | +4 | -8 |

The criteria for good reception are defined in the following table:

| | Criterion for good reception |
|--------------------|--|
| Own traffic bearer | SYNC detected, correct A-field CRC, correct B-field CRC, no sliding collision, RFP reports no sliding collision, RFP reports no signalling error |

| | |
|---|---|
| Standby bearer (to which the portable is idle locked) | SYNC detected, correct A-field CRC, RFP reports no sliding collision, RFP reports no signalling error |
| Scanning of RFP down links | SYNC detected, correct A-field CRC |

Note: Of the own traffic bearer every 10 ms a frame is received. Of the standby bearer only once every 640 ms a frame is received. Therefore the reaction time when the traffic bearer is faster then the reaction time when a standby bearer gets bad.

4.4.4

PORTABLE DCA

4.4.4.1

Environment scanning

All carrier / time slot combinations are monitored for:

- Least interfered channels. This results in a list of channels and their RSSI values. To reduce processor load and allow for smaller RAMs, this list can be limited. This list shall be regularly updated in accordance with the changes in the local environment and due to movement and mobility;
- Valid downlink transmissions. This results in a list of:
 - Fixed Parts,
 - RFPs within each Fixed Part,
 - active channel information for each RFP (RSSI and RQI of active bearers),
 - an indication whether the portable has access right to this RFP,
 - other relevant information about this RFP.

It is important that this list of alternative RFPs is as big as possible. It is desired that the list contains also RFPs which make part of a different Fixed Part then the Fixed Part to which the portable is currently locked.

To be able to determine whether a portable has access right to an RFP, information about the system to which the RFP belongs must be collected. Especially the PARI (Primary Access Right Identity) and SARI (Secondary Access Rights Identity) are important. The PARI can be retrieved from the N-channel, which is transmitted at least in every 14th frame of a multiframe. If the identity information received from another RFP indicates it belongs to another Fixed Part (different PARI), the portable has to listen to the Q-channel on which the SARI is transmitted, and which is transmitted every 8th frame of a multiframe. The portable uses the SARI to determine if the RFP is a possible handover candidate.

The scanning rate with which the portable monitors the environment is a compromise between power consumption and consistency of channel data. The DECT standard requires that all channels are scanned at least once every 30 s. Mitel prefers for their portables a higher scanning rate. There are three options:

- Slow low duty cycle scanning. The portable is in idle locked state using low duty cycle page scanning mode. The portable scans one carrier every four multi-frames. So it takes 6.4 s to scan 10 carriers;
- Slow normal duty cycle scanning. The portable is in active locked state, or the portable is in idle locked state using normal duty cycle page scanning. The portable scans one carrier every multiframe. So it takes 1.6 s to scan 10 carriers;

- Fast scanning. The portable is not locked, or the portable is forced to roam or make a handover. The portable scans one carrier every frame. So it takes 100 ms to scan 10 carriers.

4.4.4.2

Free channel selection

During initial bearer set-up the portable has to choose the least interfered channel. If the RFP concerned does not have other calls yet, the call will usually be set up on the dummy channel instead, which changes into a traffic channel.

It is preferred to keep the dummy channel unchanged, as other portables listen to this channel for their paging information. Only in case of interference the dummy bearer shall be changed, because this forces idle portables which are locked to this dummy bearer to lock on another downlink transmission.

Except for the received channel quality, the following additional information provided by DECT RFPs can be used in order to support the choice of channel:

- Blind full slot information of RFP. This is information about the time slots at which the RFP has active calls or dummy bearers;
- Number of transceivers of RFP;
- Available carriers. Not all 10 carriers are used in every system, sometimes fewer carriers give enough capacity;
- Handover information (bearer or connection handover);
- Bearer information. The RFP transmits information about its bearers, e.g. when a traffic bearer is about to be released within four frames the base station will let the portables know. The RFP will also recommend another channel that the portables can listen to.

4.4.4.3

Forced handover

The portable is forced to make a handover if:

- The signal quality of the traffic channel suddenly becomes unacceptable. E.g. due to interference. The criterion is an RQI value of 0 (empty leaky bucket).

The portable will first try to set-up another channel on the same RFP. If several attempts to set up a new channel on the same RFP fail, the portable will start setting up a channel on the second best RFP. The second best RFP is considered to be:

- The RFP which has the highest RSSI value;
- And has an RQI value greater than 0 (leaky bucket not empty).

For the set-up of the connection to the new RFP, the conditions for free channel selection stated in section 4.4.4.2 apply.

In case of a handover the portable will select the best RFP. It does not have a preference for an RFP connected to the same Fixed Part. This is in contrast to roaming, where the portable has a preference for an RFP connected to the same part, to limit the amount of location registrations on the MX-ONE.

4.4.4.4

Unforced handover

The portable decides to make a handover to another RFP (either within the same Fixed Part or at another Fixed Part) if:

- The RSSI of another RFP becomes 12 dB stronger than the RSSI of the RFP to which the portable is locked;
- And the other RFP has an RQI value greater than 0 (leaky bucket not empty).

For the set-up of the connection to the new RFP, the conditions for free channel selection stated in section 4.4.4.2 apply.

In case of a handover the portable will select the best RFP. It does not have a preference for an RFP connected to the same Fixed Part. This is in contrast to roaming, where the portable has a preference for an RFP connected to the same part, to limit the amount of location registrations on the MX-ONE.

4.4.4.5

Forced roaming

The portable is forced to roam to another RFP if:

- The RQI value gets 0 (empty leaky bucket) for the current RFP.

In case of forced roaming, the portable will first re-scan the environment using fast environment scanning. This results in an up to date list of valid downlink transmissions. This re-scan of the environment is to be completed within 800 ms.

The portable will lock to an RFP on the same Fixed Part if there is one, which matches the following criteria:

- It has the highest RSSI value of the RFPs on that Fixed Part;
- And has an RQI value greater than 0 (leaky bucket not empty).

If no RFP on the same Fixed Part matches these criteria, while the portable has not roamed to this Fixed Part within the last 8 seconds, the portable will roam to an RFP on another Fixed Part. This RFP must match the following criteria:

- It has the highest RSSI value of all RFPs to which the portable has access rights;
- And has an RQI value greater than 0 (leaky bucket not empty).

By roaming only to another Fixed Part when the quality of the all RFPs connected to the current Fixed Part gets too low, the amount of location registrations within the MX-ONE is limited.

4.4.4.6

Voluntary roaming

The portable decides to lock to another RFP on the same Fixed Part when:

- The RSSI of another RFP within the same Fixed Part becomes 12 dB stronger than the RSSI of the current RFP;
- And this RFP has an RQI value greater than 0 (leaky bucket not empty).

The portable decides to roam to another Fixed Part if:

- The RSSI of the current RFP gets below $\text{RSSI}_{\text{threshold}}$;
- And the RSSI of all other RFPs on the same Fixed Part is also below $\text{RSSI}_{\text{threshold}}$;
- And there is an RFP on the other Fixed Part with an RSSI, which is at least 12 dB higher than the RSSI of the current RFP;
- And this RFP has an RQI value greater than 0 (leaky bucket not empty).

A good value for $\text{RSSI}_{\text{threshold}}$ is the sensitivity level of the portable plus 12 dB. However, $\text{RSSI}_{\text{threshold}}$ shall not be less than -80 dB.

By roaming only to another Fixed Part when the quality of the all RFPs connected to the current Fixed Part gets too low, the amount of location registrations within the MX-ONE is limited.

4.4.4.7

Antenna diversity

The purpose of antenna diversity is to be able to cope with multi path effects. The portable requests the RFP to switch antennas, by means of the Q1 bit in the A-field header:

- If the portable receives a frame with an A-CRC error;
- If the portable encounters a SYNC error;
- If the portable encounters a signalling error on MAC level.

In case of interference, the above means that the antennas will be switched continuously during the first four erroneous receptions before a forced handover is initiated.

4.4.5

RFP DCA

4.4.5.1

Environment scanning

The RFP scans the environment for initial bearer set-up or to check whether its existing dummies are still on the least interfered channels. In order to be able to check whether a dummy bearer is still on the least interfered channel, the RFP regularly has to measure interference on the channel used for the dummy bearer and the interference on the other channels in the environment. For this purpose, DECT allows the system to make short breaks in the dummy bearer transmissions (one downlink transmission may be missed in a one second interval). Thus the RFP measures interference both on the channel used for its dummy bearer(s) and on all the other channels during the downlink period. To measure the interference level on active channels, only the received field strength (RSSI) can be used.

The RFP does use CRC errors for quality monitoring of an active link and suggest the portable to select another channel using the Q1 and Q2 bits of the A-field header.

4.4.5.2

Free channel selection

This includes the following two services:

- Requested allocations for initial dummy bearer set-up. DCA provides the least interfered channel by keeping a data base containing the least interfered channels;
- Dummy bearer switch. If DCA detects that the dummy bearer is not on the least interfered channel anymore, it switches the dummy bearer to the least interfered channel. Dummy bearer switching shall not happen too often. Every dummy bearer switch implies that all portables that are locked to this dummy bearer have to switch to another bearer.

4.4.5.3

Antenna diversity

The antenna diversity process in the RFP is responsible for switching the antennas. During active transmissions, the RFP switches the antenna on a frame basis:

- If the RFP receives a frame with an A-CRC error;

- If the RFP receives a frame with an X-CRC;
- If the RFP has a SYNC error while receiving a frame;
- If the RFP detects a fast decay of the RSSI within one frame;

During dummy bearer transmissions, the RFP toggles the antenna to ensure that portables that are locked to that dummy bearer can benefit from the antenna diversity of the RFP.

5

REFERENCES

| | |
|------|--|
| [1] | EN 300 175-1; Digital Enhanced Cordless Telecommunications (DECT); Common Interface (CI); Part 1: Overview; ETSI; Revision V1.4.2; 1999-06 |
| [2] | EN 300 175-2; Digital Enhanced Cordless Telecommunications (DECT); Common Interface (CI); Part 2: Physical layer; ETSI; Revision V1.4.2; 1999-06 |
| [3] | EN 300 175-3; Digital Enhanced Cordless Telecommunications (DECT); Common Interface (CI); Part 3: Medium Access Control (MAC) layer; ETSI; Revision V1.4.2; 1999-06 |
| [4] | EN 300 175-4; Digital Enhanced Cordless Telecommunications (DECT); Common Interface (CI); Part 4: Data Link Control (DLC) layer; ETSI; Revision V1.4.2; 1999-06 |
| [5] | EN 300 175-5; Digital Enhanced Cordless Telecommunications (DECT); Common Interface (CI); Part 5: Network (NWK) layer; ETSI; Revision V1.4.2; 1999-06 |
| [6] | EN 300 175-6; Digital Enhanced Cordless Telecommunications (DECT); Common Interface (CI); Part 6: Identities and addressing ; ETSI; Revision V1.4.2; 1999-06 |
| [7] | EN 300 175-7; Digital Enhanced Cordless Telecommunications (DECT); Common Interface (CI); Part 7: Security features; ETSI; Revision V1.4.2; 1999-06 |
| [8] | EN 300 175-8; Digital Enhanced Cordless Telecommunications (DECT); Common Interface (CI); Part 8: Speech coding and transmission; ETSI; Revision V1.4.2; 1999-06 |
| [9] | EN 300 444; Radio Equipment and Systems (RES); Digital Enhanced Cordless Telecommunications (DECT); Generic Access Profile (GAP); ETSI; Revision V1.3.3; 1999-05 |
| [10] | EN 300 824; Digital Enhanced Cordless Telecommunications (DECT); Cordless Terminal Mobility (CTM); CTM Access Profile (CAP); ETSI; Revision V1.1.2; 1999-09 |
| [11] | Draft EN 300 757; Digital Enhanced Cordless Telecommunications (DECT); Low Rate Messaging Service (LRMS) including Short Message Service (SMS); ETSI; Revision V1.1.2; 2000-09 |