

Mobile Extension Planning

DESCRIPTION



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INTRODUCTION

This document describes the architecture and features of Mobile Extension (ME), which is an MX-ONE™ service that rely on mobile extension services in the (PLMN) mobile network.

1.1

SCOPE

Mobile Extension is an application that lets ordinary mobile phones in the PLMN, or terminals in the PSTN or private networks, be treated as ordinary PBX extensions, having access to most of the features of the MX-ONE PBX, like a local phone book, internal short numbers, access to the PBX operator, as well as services, like automatic call back, service class restrictions, call information logging, and so on. For further information, see the description for *MOBILE AND FIXED REMOTE EXTENSION, RE*.

If there is SIP trunk connectivity to the PLMN, then the mobile/remote extension shall be deployed using SIP extension and SIP trunk. For details on this configuration, see the operational directions for *MOBILE AND REMOTE EXTENSION OVER SIP*.

Note the following limitations when mixing different connection types to the PLMN: If a Mobile extension user is using SIP trunk, no alternative routing via ISDN, H.323, DASS, DPNSS or CAS trunk is supported. If a Mobile extension user is using ISDN, H.323, DASS, DPNSS or CAS trunk, no alternative routing via SIP trunk is supported.

In the MX-ONE a fixed remote extension mainly differs from a mobile remote extension by the licenses. In the MX-ONE a mobile extension can have alternate answering positions. Fixed and mobile are properties of the public network and apart from the licensing these extensions are just seen as remote extensions.

The ME service in the PBX cooperates with ME services in the mobile network, either in the Mobile Switching Center (MSC), Home Location Register (HLR), and Visitor Location Register (VLR) or in the custom services of an Intelligent Network (IN) based system. In the MX-ONE mobile networks this is handled by the Network ME Service (N-MES) and Mobile Extension IN Support (MEINS) respectively.

The PLMN network must detect calls to or from the ME clients and route them through the PBX. These calls will be charged in a uniform way in the mobile network, as the PBX handles the routing, the number translations, and the main charging. Support in the mobile network is not mandatory. Mobile extension routing can also be handled by the client side.

Mobile Extension realizes the OnePhone concept, where each employee just needs one extension for all telephony communications inside or outside of the PBX premises. One phone, one number, one mailbox.

Abroad the mobile phone will work as a normal mobile phone.

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SYSTEM OVERVIEW

The picture in 1 A small scale ME Network on page 4 shows the Mobile Extension user in a GSM network. Here the PBXes are assumed to be MX-ONE systems with Media GW connections to the public network where the involved signaling is carried over ISDN PRI.

With Media GW Classic the signaling can be carried over ISDN PRI, H.323, SIP, DASS, DPNSS, or CAS (MFC-R2, DP, DTME).

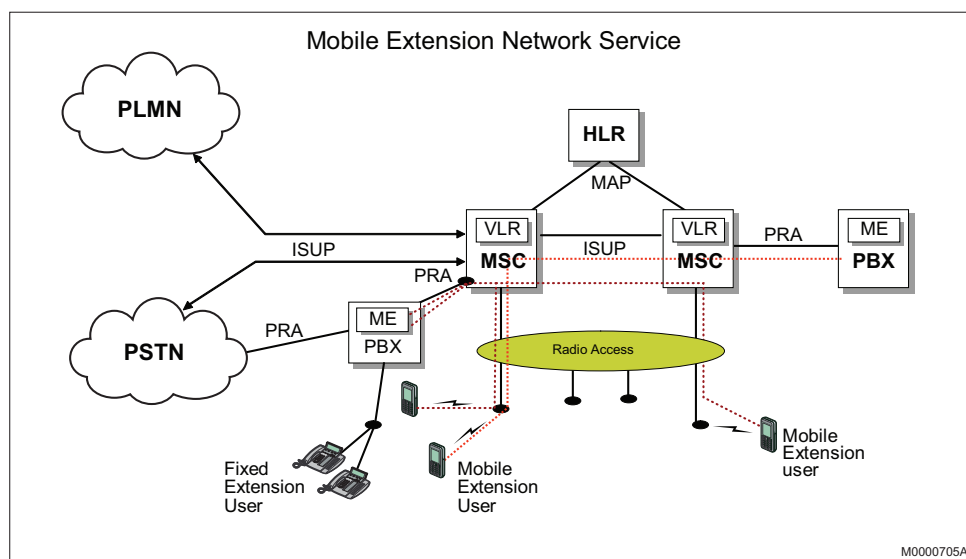


Figure 1: A small scale ME Network

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DEPLOYMENT

Deployment of Mobile Extension requires:

- A Direct-In Dialing (DID) number plan, which is agreed upon with the mobile operator, and which follows the ITU-T E.164 recommendation.
- Direct access lines (ISDN, PRA, 30B+D).

For further details, see the installation instructions for *MOBILE AND FIXED REMOTE EXTENSION, RE* and the operational directions for *MOBILE AND FIXED REMOTE EXTENSION, RE*.

If there is SIP trunk connectivity to the PLMN, there is also an alternative configuration using SIP extension and SIP trunk. For details on this alternative, see the operational directions for *MOBILE AND REMOTE EXTENSION OVER SIP*.

4 SECURITY

Mobile Extension gives the same high security as exists within the MX-ONE system and within the public telephony system.

4.1 LESS SECURE DISA

In the past public extensions have been integrated into the PBX through Direct Inward System Access (DISA) where the user dials a certain number followed by a feature code, an authorization code and possibly an account code. Here the A-number, from the caller, is only used for default accounting. Being a relatively simple way of acquiring PBX access it can be misused (by human negligence, codes written down, and so on).

4.2 ME ACCESS CONTROL

Mobile Extension gives a higher level of security in either of two ways, R1 or R2 access control.

Note: For the SIP based configuration, only R1 access control is supported.

In R1 access control user authentication is done by verifying the A-number against an internal database, the number conversion table in the MX-ONE. The database can hold over 40.000 entries. Every public extension that Mobile Extension users should be able to use must be registered in this table. The table can only be managed by commands from within the MX-ONE. If the A-number verification fails the call attempt is immediately terminated. If the verification passes, the dialed B-number will be analyzed and the call setup process will start.

When the signaling is carried over ISDN the user can dial extra digits, which will be buffered in the MX-ONE. No dial tone will heard until these extra digits have been analyzed.

Fraudulent A-number entry is highly unlikely. The A-number is the number delivered, on the fixed or mobile network, from the public operator. It is normally delivered on a fixed digital trunk directly to the MX-ONE. This number is the identifier that the operators are basing all their charging and interconnect agreements on and is as such subject to very high security within the public domain. Configuration and setup of this data in the mobile world is done in the HLR/VLR, and if IN services are used, data is also set in the IN node. In the fixed telephony world this data is set in the local subscriber exchange and, if IN services are used, data is also set in that node. Access to all these public systems is under very strict control. Transmission in-between the systems are following the ISDN standard for public signaling.

R2 access control can be used when the A-number cannot be received (either not delivered to the MX-ONE, or when calling from a temporary phone, which is not registered as an authorized public Mobile Extension number). In R2 access control the ME user enters the personally registered A-number and the associated PIN code. The "registered A-number" is the number registered in the number conversion table and which is normally used when using the Mobile Extension function. The PIN code is the individual authorization code used in the Authorization Code function, see the description *AUTHORIZATION CODE FOR EXTENSION*. The customer can chose to have the R2 access option activated or not.

For details on R1 and R2 access handling, see the description for *MOBILE AND FIXED REMOTE EXTENSION, RE*, section Facilities.

4.3

SERVICES

The remote extensions have access to most of the services and features that are offered to other extension types in the MX-ONE.

Public terminals do not have the possibility to request inquiry (and thus, parking of the current call) via hook-flash/R-button/earth-button as analog extensions do, so suffix-procedure digits must be entered in order to request an inquiry call.

An application system parameter decides specifically if the End to end DTMF mode for remote extensions is activated automatically or if it is activated by suffix digit. (This suffix digit is also set via an application system parameter).

Refer back and other services (call-back, conference, paging, and so on) can only be requested by using suffix digits. No services request by suffix digit is allowed if End to end DTMF mode is active.

5 ME NETWORK SUPPORT

5.1 ME SYSTEMS

To support a fully working ME service, the mobile network must support a transparent connection between the mobile phone and the home PBX, to which the ME is registered. Also, the network must recognize the ME and charge only the normal fare even if the ME user dials a company internal international destination.

The mobile operator can use two methods to support an ME network:

- MSC, HLR data configuration
- IN supported solution (MSC, HLR, IN)

5.1.1 HLR, MSC SOLUTION

The HLR, VLR, MSC solution is easy to implement (within some weeks) for small scale networks and takes care of the basic network needs:

- To identify a call from the ME user
- To identify a call to the ME user
- To add a routing or service prefix to route the call to the home PBX
- To add the required tariff information for each originating ME user call
- To be transparent to the Calling Party Number (received from the home PBX node) and present it to the ME user
- To prevent access to standard GSM voice services, as all ME user features are provided from the PBX

5.1.2 IN SOLUTION

The IN solution is more suitable for large networks as the service is highly scalable and better supports volume traffic. Charging variations and customized tariff rates are managed efficiently. Certain call types can be given specific treatment. The IN solution easier operates with IN Virtual Private Network (VPN) features. Fallback in error situations is supported.

Specific needs that require IN support:

- To identify and generate charging information for a variety of call types
- To allow ME users to enter public numbers for calls to company internal destinations but still be charged as internal calls
- To enable Zone handling that allows the Operator to differentiate call tariffs depending on where the ME user is located
- To enable Zone handling that prevents the ME user from being invoked when being outside the designated ME Zones
- To add prefixes that allow the PBX to give certain calls specific handling
- To support cost effective service management for volume handling
- To support backup handling when the direct PBX trunk is not available (out of order, all channels busy)

- To support a user controlled turn-on and turn-off feature

5.2 NETWORK ME SERVICE

5.2.1 REQUIRED SETUP

The following activities should be performed:

- Specify the ME user category in the HLR.
- Specify the ME analysis logic in the involved MSCs.
- Specify the ME node prefix, R1.
- Specify the routing path to the PBX.

5.2.2 FUNCTIONS INVOLVED

The HLR or VLR in the mobile network must detect the ME user either as the call originating A-party or the call receiving B-party, when the call has originated in the fixed or mobile networks.

The originating MSC sends R1, the remote extension access number, plus the dialed number to the terminating MSC, which forwards these on the ISDN PRA trunk to the PBX and the ME application. If the call remains in the same MSC it is forwarded directly, with the R1 prefix added, to the PBX. Calls that enter the PBX with an R1 number prefix will be directed to A-number validation.

6

ME CALL SCENARIOS

Mobile extensions are able to make and receive calls as PBX extensions if they are initiated as mobile extensions in the network. Some ME operations in the NMES, MEINS mobile network are shown in the following examples.

The function Original A-number should be active in the MX-ONE. Extended number presentation should be active in the mobile network.

The public emergency number (112) will not be routed through the PBX.

6.1

CALL FROM ME USER TO PBX EXTENSION

The ME user dials an internal extension number and the MEINS or NMES adds the required R1 number in front of the dialed B-number. These numbers, along with the Mobile Subscriber ISDN (MSISDN) A-number, are sent on the DID ISDN trunk to the PBX. The ME application detects that the received A-number belongs to the ME number plan and translates the MSISDN number to the internal PBX number. This number will be presented to the receiving terminal if A-number presentation is enabled.

If the ME user dials the national (with city code) or international number (with "+", country code, and city code) to the PBX extension NMES must detect the number as an internal number in that PBX and just add R1 in front of the number.

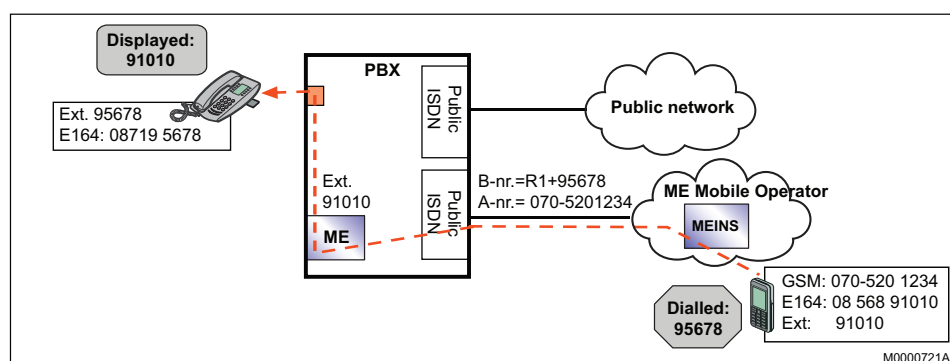


Figure 2: Internal call from an ME user to a PBX extension

This call scenario can also be seen in table form:

Table 1 ME calls PBX extension

B-nr dialed	ME/MS-C -> PBX	Action in PBX	PBX internal	
			B-nr	A-nr
95678	R1 + 95678	Internal call to 95678	95678	91010
08719 95678	R1 + ME-PAC + 08719 95678	Number Conversion (remove 08719) Internal call to 95678	95678	91010
+468719 95678	R1 + ME-PAC + 08719 95678	Number Conversion (remove 08719) Internal call to 95678	95678	91010

ME-PAC = ME Public network Access Code

6.2

CALL FROM PBX EXTENSION TO ME USER

The internal extension number for the ME user is dialed from a PBX extension. The number is modified in ME to the MSISDN number and sent to NMES. The A-number is sent to NMES as the private number of the calling extension. NMES recognizes the call as an ME user call and sends the A-number, as it was received, to the ME terminal.

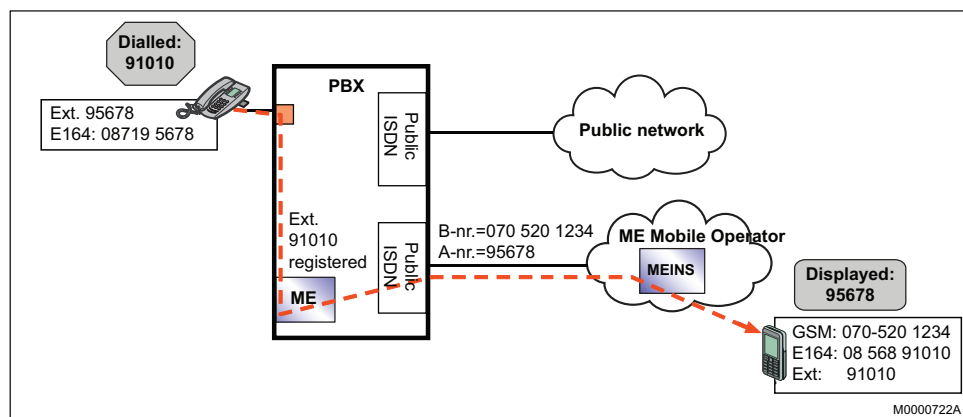


Figure 3: Internal call from a PBX fixed extension to an ME user

In table form this would be:

Table 2 PBX extension calls ME user

B-nr dialed	Action in PBX	PBX -> MSC		PBX -> PSTN	
		B-nr	A-nr	B-nr	A-nr
91010	ME call (91010 is ME number for 070 520 1234)	070 5201234	9567 8		
ME-PAC + 08719 91010	Number Conversion (remove ME-PAC + 08719) ME call (91010 is ME number for 0705201234)	070 5201234	9567 8		
ME-PAC + 070520 1234	Possible to remove but need one extra entry per ME user. This traffic shall be routed via PSTN.			070 5201234	08719 5678

6.3

INTERNAL CALL BETWEEN ME USERS IN SAME PBX NODE

The ME user dials the internal extension number. MEINS adds the R1 prefix in front of the number and sends it to the PBX. The calling MSISDN number is sent along as A-party number to the PBX and the ME application, which will replace it with the corresponding internal number. The received B-number will be looked up in the internal database and will be converted to its registered MSISDN number. The MSISDN B-number and the internal A-number will be transferred to the mobile network. There NMES recognizes the call as an ME call and sends the A-number, as received, to the ME terminal.

After reception of the received A-number in the PBX, the rest of the call is treated as though it was made from an internal PBX phone.

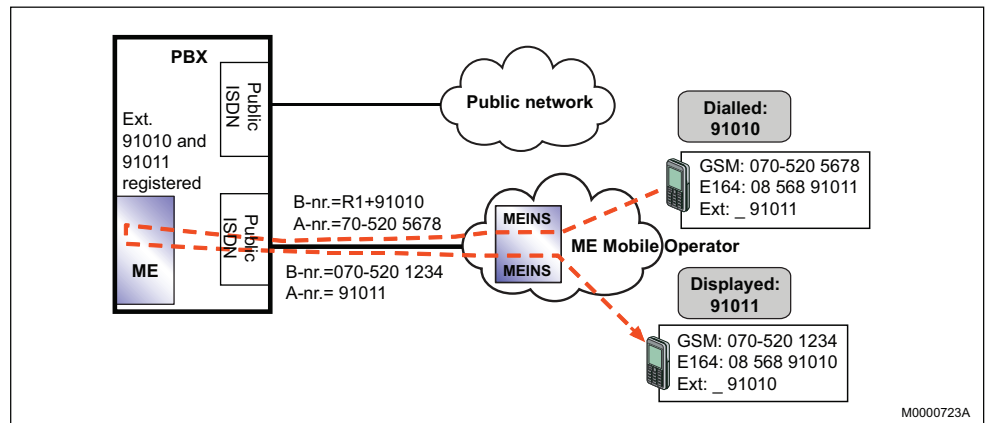


Figure 4: Internal call from an ME extension to an ME extension in the same ME node

In table form this can be seen in the following way:

Table 3 ME user calls ME user

B-nr dialed	ME/MSC -> PBX	Action in PBX	PBX -> MSC	
			B-nr	A-nr
91010	R1 + 91010	ME call (91010 is ME number for 0705201234)	070 520 1234	91011
08719 91010	R1 + ME-PAC + 08719 91010	Number Conversion (remove ME-PAC + 08719) ME call	070 520 1234	91011
+468719 91010	R1 + ME-PAC + 08719 91010	Number Conversion (remove ME-PAC + 08719) ME call	070 520 1234	91011
070 520 1234	R1 + ME-PAC + 070 5201234	Number conversion (translate ME-PAC + 0705201234 in 91010)	070 520 1234	91011
+4670 520 1234	R1 + ME-PAC + 070 5201234	Number conversion (translate ME-PAC + 0705201234 in 91010)	070 520 1234	91011

In the second and third cases above the PSTN access code to the PBX has to be removed.

For the fourth and fifth call cases one entry per ME user need to be added into the number conversion table.

When the mobile extension is called the sent A-number is the internal number. The public access code to the PBX can be added.

6.4

PRIVATE NETWORK CALL FROM ME USER

The ME user dials a company location code (for example, 830) plus an internal extension number. MAINS adds the R1 prefix and sends the complete number to the PBX. The A-party MSISDN number is sent to the PBX, where the ME application will replace it with the internal number prefixed with the callers location code. The B-number, stripped of the R1 DID number, will be transferred on the internal private network to the extension in the terminating PBX.

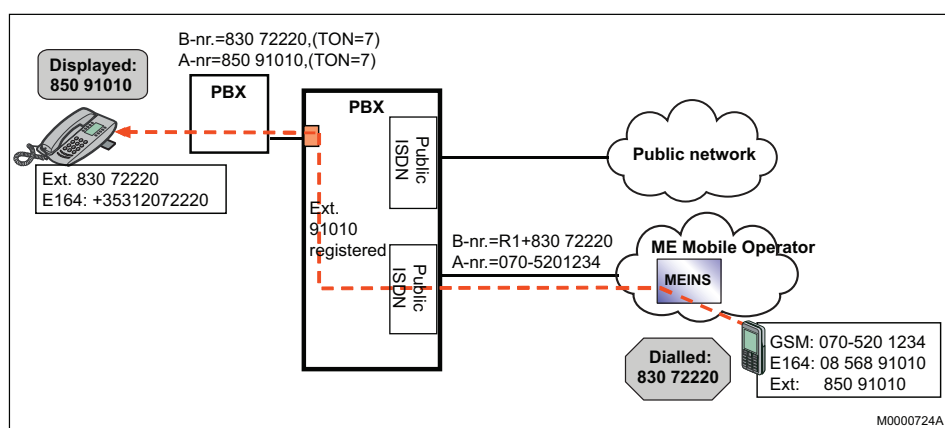


Figure 5: Private network call from an ME user

6.5

PRIVATE NETWORK CALL TO ME USER

The PBX fixed extension user dials a company location code (for example, 850) plus the internal number for the ME user. This number is converted in the PBX ME application to the registered MSISDN number, which is sent to NMES in the mobile network. The A-number is sent to NMES as the private number of the calling extension. NMES recognizes this call as an ME user call and sends the A-number, as received, to the ME terminal.

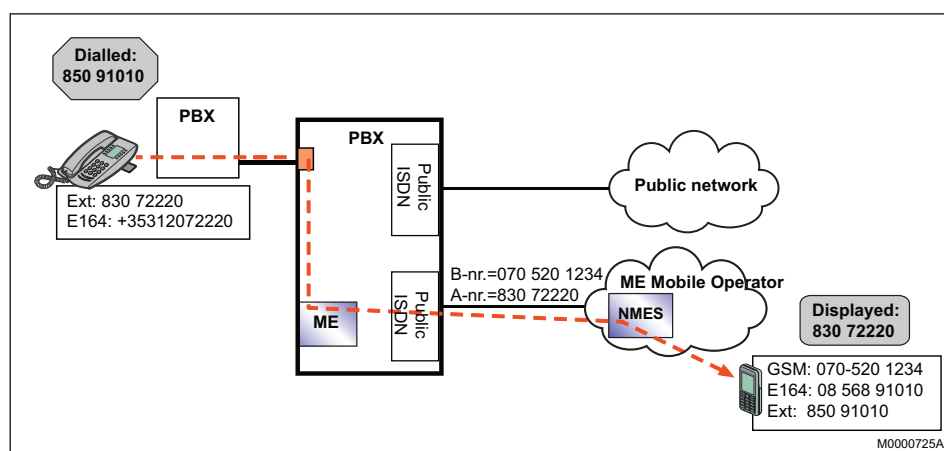


Figure 6: Private network call to an ME user

6.6

CALL FROM ME USER TO PSTN

The ME user dials a public national number either with the normal outgoing public access code, for example 00, or with the international prefix with plus, “+”, and country code, followed by the national number. MEINS will analyze the number to select a valid charging rate. An international number to a national destination is converted to the national form. The access code is removed and replaced with R1 plus the unique ME-PAC code.

ME in the MX-ONE identifies the call as a PSTN call and replaces the R1 and ME-PAC prefixes with an ME PSTN Call Indicator (ME-PCI). The ME-PCI code is placed in front of the dialed number and the call is routed back to NMES. The ME-PCI is used to route the call back to the Mobile Direct Access (MDA) trunk in order to get correct accounting. NMES detects the call as an ME user call, applies charging and call statistics, and then removes the prefix and forwards the call to the public network.

The A-number is the MSISDN number, which is sent to the PBX. In the ME application it is replaced by the registered internal number. This private number is then sent on as the calling party number when the call is transferred to NMES and then to the PSTN.

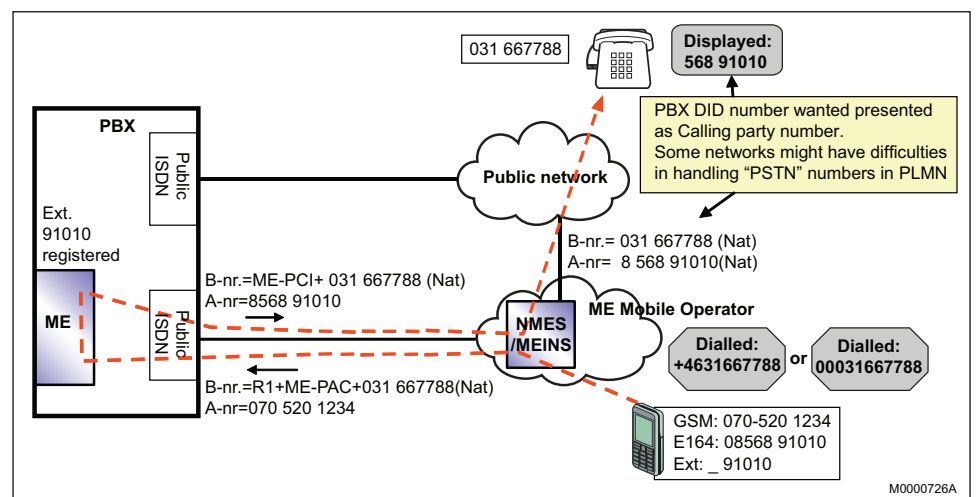


Figure 7: Outgoing national call from ME user to PSTN

In table form, with the B-party as a public mobile phone, an ME call could be seen as follows:

Table 4 ME user calls PLMN extension

B-nr dialed	ME/MSC -> PBX	Action in PBX	PBX -> PSTN	
			B-nr	A-nr
070 345 777	R1 + ME-PAC + 070 345 777	ME-PAC is access code to the PSTN 070 345 777 is sent to PSTN	070 345 777	08568 91010
+4670 345 777	R1 + ME-PAC + 070 345 777	070 345 777 is sent to PSTN	070 345 777	08568 91010
0800xxxx	R1 + ME-PAC + 0800xxxx	0800xxxx is sent to PSTN	0800xxxx	08568 91010

6.7

CALL FROM PSTN TO ME USER

A PSTN user dials the E.164 PBX DID number to an ME user. The call is setup in the public network to the PBX home node using the PSTN direct trunk (PRA). The ME application in the PBX identifies the call as an ME call and translates the number to the ME user MSISDN number, which is sent to the mobile network through the MDA trunk. In the PBX the A-number is completed with the Public network Access Code, PAC (for example, 00), and the complete number will be presented on the ME terminal.

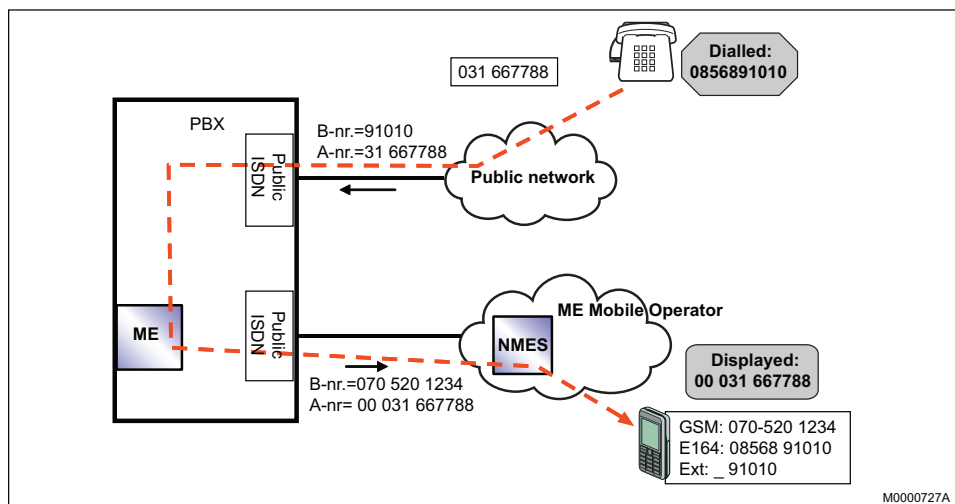


Figure 8: Incoming national call from PSTN to an ME user

6.8

ME USER CALL TO PBX OPERATOR

The ME user dials the attendant code, for example 009. MEINS will prefix with R1 and send the complete number to the PBX. In the PBX the ME application sets up the call to the company attendant.

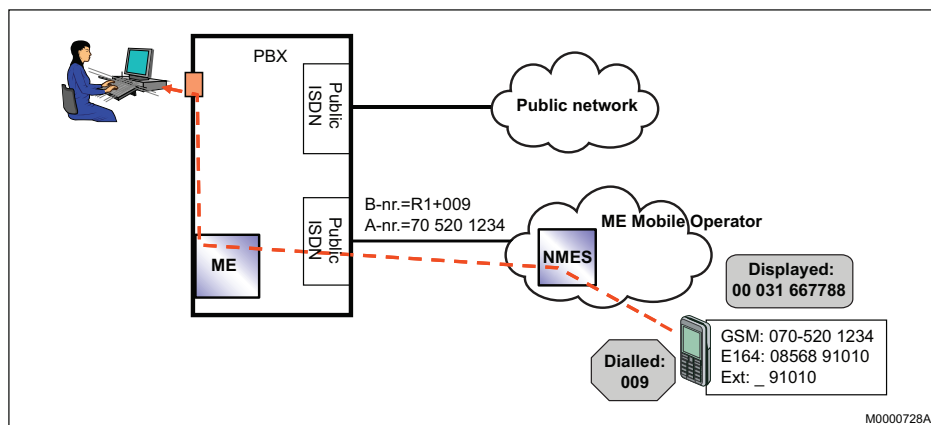


Figure 9: Attendant call from ME user

6.9

CALL FROM ME USER TO PSTN WHEN MSC-PBX TRUNK IS BUSY

The system should be dimensioned so that blocked or busy situations are unlikely to occur. When they do occur there are safety mechanisms that will take care of them.

At start, MEINS treats the call as an ME call to the PSTN and routes the call to the PBX in the ordinary way. At detection of no channels available, when the trunk is either busy or blocked, MEINS deletes all prefixed codes and the MSISDN calling party number is fetched. The call is then sent to the PSTN as an ordinary GSM call to the PSTN.

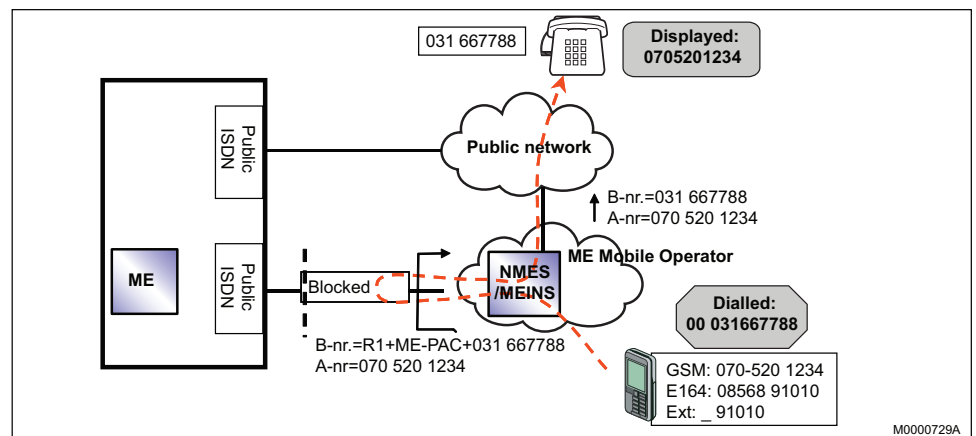


Figure 10: Outgoing call from ME user to PSTN when MSC-PBX/ME trunk is blocked or busy

6.10

ME FUNCTION CALL AFTER DIAL TONE

If the ME user dials the R1 access code the entered R1 code plus the callers A-number will be sent on to the PBX. After the A-number analysis the ME caller will receive a special tone or an RVA message and can continue, for example, by using the star, *, and hash mark, #, characters to activate functions in the PBX. In this way these characters will be sent as DTMF tones for further analysis in the PBX.

If the ME user would try to use the * or # characters directly the mobile system would see them as function codes for that system, which would prevent them from being sent on to the PBX.

7

NUMBER ANALYSIS

7.1

IN NETWORK

Here follows some examples on how different ME calls are treated in the public networks. Two R1 numbers are defined, R1n for national numbers and R1i for international numbers. The customer can define three different prefix options. A line prefix, like 00, for calls to the public network, a service prefix, to be used before all internal calls, and no prefix. With the no prefix option the used number plan must exclude the special numbers used in the external network, like 112 for emergency, 133 for mobile phone answer, and so on.

Here in 5 Number conversion in network on page 16 just the line prefix option is given, for clarity.

Table 5 Number conversion in network

Ex.	Entered digits	R1n	R1i	LP	B-number sent to PBX Format "unknown"
1	45466	45678	87654	00	45678 45466
2	45678	45678	87654	00	45678 45678
3	00 060145466	45678	87654	00	45678 00 060145466
4	45466	45678	87654		45678 45466
5	060145466	45678	87654		45678 060145466
6	+4660145466	45678	87654	00	87654 4660145466
7	00004755443322	45678	87654	00	87654 4755443322

In example 2 the ME user dials the R1 number to get a dial tone. The entered digits will be sent to the PBX without modification. The PBX has to handle these digits in its number analysis.

For the last two examples the network detects that the calls are international and therefore adds the international R1 prefix.

7.2

IN PBX

Number analysis in the MX-ONE is a major task on its own. For further information, see the operational directions for *NUMBERING*.