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Foreword

This Global System for Mobile communications Technical Specification (GTS) has been produced by the Special Mobile Group (SMG) Technical Committee (TC) of the European Telecommunications Standards Institute (ETSI).

This GSM Technical Specification (GTS) presents a study which proves the feasibility of ISDN-based DECT/GSM interworking to support roaming of users of cordless DECT terminals between public GSM networks and private DECT networks via an ISDN-based interface.

GTS are produced by TC-SMG to enable the GSM Phase 2+ specifications to become publicly available, prior to submission for the formal ETSI standards approval procedure to become European Telecommunications Standards (ETS). This ensures the earliest possible access to GSM Phase 2+ specifications for all Manufacturers, Network operators and implementors of the Global System for Mobile communications.

The contents of this GTS are subject to continuing work within TC-SMG and may change following formal TC-SMG approval. Should TC-SMG modify the contents of this GTS it will then be republished by ETSI with an identifying change of release date and an increase in version number as follows:

Version 5.x.y

where:

- y the third digit is incremented when editorial only changes have been incorporated in the specification;
- x the second digit is incremented for all other types of changes, i.e. technical enhancements, corrections, updates, etc.

The specification from which this GTS has been derived was originally based on CEPT documentation, hence the presentation of this GTS may not be entirely in accordance with the ETSI rules.

Reference is made within this GTS to GSM-TSs (note).

NOTE: TC-SMG has produced documents which give the technical specifications for the implementation of the digital cellular telecommunications system. Historically, these documents have been identified as GSM Technical Specifications (GSM-TSs). These TSs may have subsequently become I-ETTs (Phase 1), or ETSs/ETSI Technical Reports (ETRs) (Phase 2). TC-SMG has also produced ETSI GSM TSs which give the technical specifications for the implementation of Phase 2+ enhancements of the digital cellular telecommunications system. These version 5.x.x GSM Technical Specifications may be referred to as GTTs.

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1 Scope

This GSM technical specification provides a study which proves the feasibility of ISDN-based DECT/GSM interworking to support roaming of users of cordless DECT terminals between public GSM networks and private DECT networks via an ISDN-based interface. The study is aiming at teleservice speech and supplementary services. Data, fax and other teleservices are out of scope. In order to limit the amount of work for subsequent specifications to what is achievable within a reasonable timeframe, this feasibility study considers very complex functionality, e.g. inter-network handover, to be out of scope. Commercial viability and demand has to be considered by GSM MoU.

2 References

This GSM technical specification incorporates by dated and undated reference, provisions from other publications. These references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this GSM technical specification only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

- [1] TCR-TR 013 (1993): "Network Aspects (NA); Network Support of cordless terminal mobility".
- [2] ETS 300 466: "Radio Equipment and Systems (RES); Digital European Cordless Telecommunications / Global System for Mobile Communications (DECT/GSM) interworking profile; Functional capabilities and information flows".
- [3] prETS 300 787: "Radio Equipment and Systems (RES); Digital European Cordless Telecommunications (DECT): DECT access to GSM via ISDN, Service Description (Stage 1)".
- [4] prETS 300 788: "Radio Equipment and Systems (RES); Digital European Cordless Telecommunications (DECT): DECT access to GSM via ISDN, Functional Capabilities and information flows (Stage 2)".
- [5] DTR/BTC-01007: "Business Telecommunications (BTC); Mobility Interworking between Private and Public Networks".
- [6] ETS 300 189: "Private Telecommunication Network (PTN); Addressing".
- [7] ETS 300 499: "Radio Equipment and Systems (RES); Digital European Cordless Telecommunications / Global System for Mobile Communications (DECT/GSM) interworking profile; Mobile services Switching Centre (MSC) - Fixed Part (FP) Interconnection".
- [8] ETS 300 370: "Radio Equipment and Systems (RES); Digital European Cordless Telecommunications / Global System for Mobile Communications (DECT/GSM) interworking profile; Access and mapping (Protocol / procedure description for 3,1 kHz speech service)".
- [9] ETS 300 415: "Business Telecommunications (BTC); Private Integrated Services Network (PISN); Terms and definitions".

3 Definitions

In addition to the definitions given below, definitions as given in GSM, DECT and PISN [9] specifications apply, where appropriate.

DECT equipment: Entity that contains DECT cordless terminal processes and procedures of the DECT air interface.

GSM services: Services which are offered to the subscriber / user by a GSM Service Provider and which are defined by the appropriate GSM specifications.

Private DECT network: A network consisting of DECT equipment and PISN equipment under the authority of a private network operator.

PISN services: Services which are offered to the user by a PISN and which are defined by the appropriate PISN specifications.

4 Abbreviations

In addition to those below, abbreviations used in this GTS are listed in GSM 01.04.

CLIP	Calling Line Identification Presentation
CLIR	Calling Line Identification Restriction
COLP	Called Line Identification Presentation
COLR	Called Line Identification Restriction
DAM	DECT Authentication Module
DECT	Digital European Cordless Telecommunications
GAP	Generic Access Profile
GSM	Global System for Mobile communications
IMSI	International Mobile Subscriber Identity
IPUI	International Portable User Identity
ISDN	Integrated Services Digital Network
MSC	Mobile Switching Centre
NR	No Reply
PABX	Private Automatic Branch Exchange
PCM	Pulse Code Modulation
PISN	Private Integrated Services Network
PINX	Private Integrated Network Exchange
SIM	Subscriber Identity Module

5 Introduction

The sophisticated business user is seen as the most promising group of users.

DECT systems initially serve business users with on-site PBX systems, but those users will also want to roam to GSM systems. GSM operators may want to provide roaming service to business DECT users within islands of coverage, progressing to ubiquitous coverage with full mobility in pedestrian locations. The vast majority of public users will not be for public use only, but will be users from business environment for whom the public roaming is a key benefit of their DECT equipment.

In large business applications, mobility must provide not only full roaming capability within a campus with multiple buildings, but also roaming from public systems to provide call originating and terminating capability within any private business system. Also, typically, the business user will want to use his DECT terminal while attending a meeting at a hotel, having lunch with business associates, etc.

These full levels of mobility require full interworking between public and private systems for user convenience.

Also, in comparison to wired systems, the business user will require speech quality at least as good as known from wired systems, which is a key capability of DECT, and security of the conversation. Therefore, encryption will be a frequently demanded feature.

Dual mode handsets comprising DECT and GSM in one handset allow the service area to be global, and at the same time in-door coverage could be provided at appropriate costs.

The DECT standard defines cordless access to various networks, public and private ISDN and non-ISDN. DECT access to GSM was specified by RES3/SMG3 based on an A-Interface [2]. An additional interface between GSM and DECT systems based on an ISDN-interface would allow attachment of not only public access systems, but in addition of small and big DECT wireless PINXs. ISDN-based interfaces are available in all PINXs. The A-interface as specified for DECT/GSM interworking need not to be changed.

Various scenarios could be supported, such as attachment of DECT equipment to GSM/MSC via PINX equipment which provides DECT Cluster Control Functions ([3], [4]), and DECT equipment attached to a PISN, and the PISN to GSM network. Since ISDN-based interfaces are available in all PINXs, an ISDN-based interface between DECT and GSM systems should be supported.

Based on market requirements and a request from the Strategic Review Committee, a TCR-TR has been produced by ETSI NA (TCR-TR 013) on "Network Support of cordless terminal mobility" [1]. This report provides an outline of technical solutions requiring standards to enable users of cordless terminals to roam between public (ISDN/PSTN, GSM) and private networks. A Joint Management Group has been formed on Cordless Terminal Mobility (JMG CTM) to support cordless terminal mobility in fixed ISDN/PSTN networks, however, excluding GSM.

This report reuses[1] as much as possible, limiting the issue to DECT equipment / private DECT networks and GSM, extending the considered aspects by work done since then in other ETSI STCs, e.g. BTC1 ([5], [6]), or by aspects felt necessary in addition. To decide on the feasibility of the complete scope of the Work Item it is also required to address network aspects which may have to be reviewed by SMG3.

Responsibility of standardization groups are indicated in Section 6 on Scenarios and associated figure (RES on DECT side, SMG on GSM network side, SPS5/ECMA TC32 TG14 for the ISDN-based interface (see also 8.2.3)).

6 Scenarios

6.1 Basic DECT / GSM scenarios

The scenarios described are depicted in the attached figure.

1) DECT equipment attached to GSM/MSC:

As already recognized, DECT systems could be used to complement GSM in traffic "hot spots" requiring increased capacity.

In this scenario, only GSM databases are involved, and no databases at the periphery are required.

1a) DECT equipment attached to GSM/MSC

NOTE: This scenario is included here to give an overall view, but is not further addressed in this document, since it uses the A interface. Reference is made to RES3 standards on "DECT/GSM interworking profile" [2], [7], [8].

1b) DECT equipment attached to GSM/MSC via PINX equipment providing DECT Cluster Control Functions

GSM core services are provided to the users of cordless DECT terminals with GSM subscription, via co-operating GSM and DECT network elements which are interconnected by means of an ISDN interface. In this scenario, the DECT network elements consist of PINX equipment, that is able to control DECT specific mobility and DECT intra-cell and intra-cluster handover. The DECT network elements may or may not be under the authority of a GSM network provider.

NOTE: For this scenario reference is made to the current work within RES3 on ETSS "DECT access to GSM via ISDN" ([3] (stable draft, [4] (fairly stable draft)). Interaction with supplementary services and charging principles are out of their scope. Based on this work, is assumed that feasibility of this scenario is not questioned.

2) DECT equipment attached to PISN, private DECT networks interworking with GSM:

The PISN is to be regarded on a peer-to-peer level as a different network, and as such needs to receive an own mobile network code (recommended in [5]). However, contrary to GSM, the PISN is seen as a single visited area. A single subscription is assumed. Double subscription, however, is possible as specified by DECT-GAP. DECT algorithms are used for encryption of the DECT air interface.

In this scenario both GSM / private DECT network databases are involved.

Roaming of users of cordless DECT terminals between private DECT networks and public GSM networks cover two basic scenarios:

- a) The cordless DECT terminal user is a GSM subscriber roaming to a private DECT network
- b) The cordless DECT terminal user is a user of a private DECT network roaming to a GSM network.

NOTE: Reference is made to the current work within BTC1 on a TCR-TR "Mobility interworking between private networks and public networks" [5] (stable draft, STC approval May 1996): This document provides basic requirements for internetwork roaming, and interworking examples for some basic mobility procedures for both scenarios (location handling, authentication, incoming call, outgoing call), using general terms for a "CTM user" (DECT or CT2) and "public network" (GSM or fixed networks (PSTN, IN-structured)). Support of supplementary services and charging issues are outside the scope of this document.

- 2a) Cordless DECT terminal user is a GSM subscriber roaming to a private DECT network:

The home network is a GSM network. The user has a subscription in a GSM network.

GSM services should be accessible by GSM subscribers using DECT equipment attached to GSM MSC via a PISN as an intermediate system.

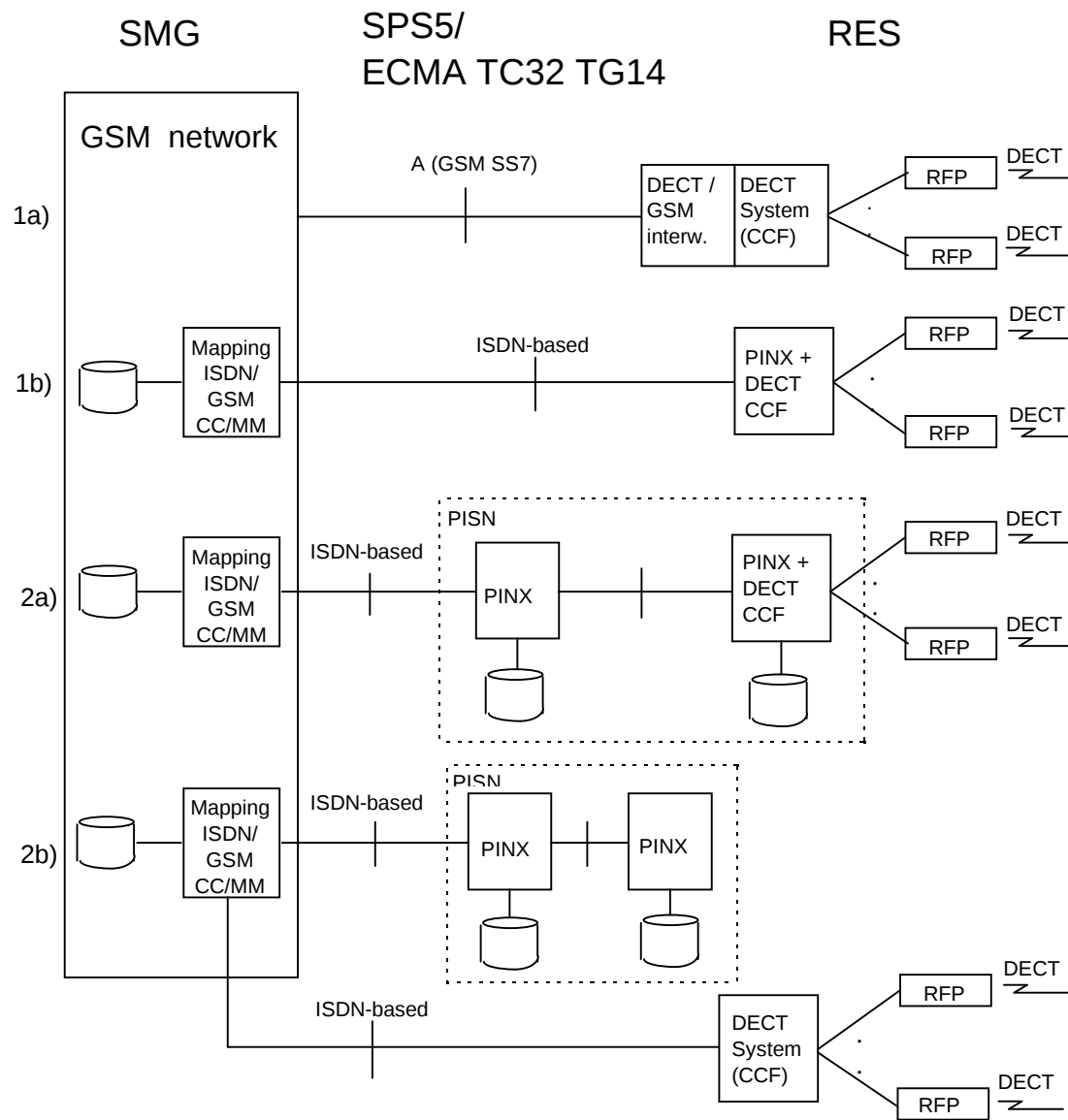
A GSM SIM card is inserted in the DECT terminal by the GSM subscriber when visiting a private DECT network. Alternatively, a DECT DAM card with GSM identification could be used. This causes the cordless DECT terminal to perform a registration procedure at the visited PABX on behalf of the GSM subscriber. The registration is stored in a visitor database defined as the "home" for all visitors from that particular GSM home network. This PINX sends the appropriate message via the ISDN-based interface to the home GSM network. The home GSM network invokes the GSM-internal registration procedure on behalf of the subscriber. Subsequently, the user can make and receive calls on the basis of his GSM number.

- 2b) Cordless DECT terminal user is a user of a private DECT network roaming to a GSM network:

The home network is a PISN.

PISN services should be accessible by PISN users via DECT equipment attached to MSC.

A DECT DAM card is inserted in the DECT terminal by the user of a private DECT network when visiting a GSM network. This causes the cordless DECT terminal to perform a registration procedure at the visited GSM network on behalf of the PISN user. The registration is stored in a visitor database. The GSM network sends the appropriate message via the ISDN-based interface to the home private DECT network. PISN internal registration procedure is invoked on behalf of the user. Subsequently, the user can make and receive calls on the basis of his PISN number.



CC / MM: Call Control / Mobility Management Function

Figure 1: ISDN - based DECT / GSM roaming scenarios

6.2 Dual mode application

Dual mode handsets comprising DECT and GSM in one handset allow the service area to be country-wide, and at the same time in-door coverage could be provided at appropriate costs. A roaming user could use either DECT or GSM radio coverage areas, where appropriate. Details of the dual mode application, e.g. MMI for basic call and supplementary services, identification, subscription, are ffs.

6.2.1 Double subscription

Each subscriber has two subscriptions / home data bases, i.e. one in the private DECT network and one in the GSM network. The mobility in the private DECT network is handled by DECT mobility procedures, and the mobility in the GSM network is handled as defined by GSM specifications. Also, the services are handled by each network independently, based on the own service profile and network capabilities. However, synchronization of some supplementary services between the private DECT network and the GSM network (e.g. Call Forwarding) is required.

The technical impact of double subscription is that each network needs to be informed when the user roams to a different radio coverage area, i.e. a logical relationship is needed between the HLR and the HDB. This relationship between the private DECT network and the GSM network allows the roaming user to be reachable by his MSISDN as well as by his PISN number independent from the actual location. Double subscription needs further consideration, as there are also commercial aspects. The GSM MoU should be asked for comments.

6.2.2 Single subscription

6.2.2.1 The roaming user is a user of a private DECT network

The user of a private DECT network who roams to GSM, having selected the GSM-Mode (GSM air-interface), then still is a user of a private DECT network, i.e. his service profile / parameters and current location need to be stored in the HDB of that private DECT network. As a consequence, the visited GSM network has to register the roaming user in its VLR. There are two alternatives:

- The private DECT network would have to act like a HPLMN. This would require the private DECT network to support GSM authentication, identification (according to E.212), and possibly numbering (according to E.164). It may also impact the GSM network to support e.g. Private Numbering Plans, Closed User Groups.
- The GSM network would have to act like a VPISN. This, however, would impact several GSM specifications, as DECT authentication, identification have to be supported via GSM air-interface.

It is not necessary that the roaming user is known by that network, i.e. the user of a private DECT network can roam to each GSM network which has a roaming agreement with the private DECT network.

6.2.2.2 The roaming user is a GSM subscriber

The GSM subscriber who roams to a private DECT network, having selected the DECT-Mode (DECT air-interface), then still is a user of the GSM network, i.e. his service profile / parameters and current location need to be stored in the HLR of that GSM network. As a consequence, the visited private DECT network has to register the roaming user in its VDB. This scenario has the same technical impacts on the interface between the GSM network and the private DECT network as Network Scenario 2a).

It is not necessary that the roaming user is known by that network, i.e. the GSM subscriber can roam to each private DECT network which has a roaming agreement with the GSM network.

7 Service aspects

It is to be investigated which GSM services can be offered to GSM subscribers using DECT equipment that may be attached to GSM via PINX equipment and/or via PISN as an intermediate system. Service requirements for DECT infrastructure connected to GSM via the GSM A-interface should be taken as reference [2].

It is also to be investigated which PISN services can be offered to PISN users via DECT equipment attached to the GSM network.

7.1 End user requirements

7.1.1 Overall mobility

The DECT technology shall offer a low cost access to GSM to enable users of cordless DECT terminals to roam between public GSM and private DECT networks (at work or in private commercial areas such as malls, airports).

Business cordless DECT terminal users will get an increased service level with the ability to roam to the GSM network. Public cordless DECT terminal users will get an increased service level with the ability to roam to some private networks.

7.1.2 Access / interworking requirements

As a consequence of the overall mobility requirements, there is a requirement to access different networks, GSM or private DECT networks, as well as interworking between them.

7.1.3 Roaming requirements

As a consequence of the access / interworking requirements, there is a requirement for a commercial roaming agreement between the networks involved.

7.1.4 Service requirements

It is an end user requirement to use the services subscribed to / allowed for, independent of the current location. Support of incoming and outgoing calls is the minimum. Other supplementary services depend on network support and roaming / accounting agreements between GSM and private DECT networks.

7.1.5 Security requirements

Non-authorized use of DECT terminals should be prohibited regardless of at which network the end user is registered.

7.1.6 Numbering requirements

Keeping the same number when roaming is very useful for the end user.

7.2 Network operator requirements

Interworking between DECT and GSM via ISDN-based interface allows to easily serve areas of high concentrated traffic volumes ("hot spots"). This will increase the penetration of cordless terminals and give revenue to public GSM network operators. The use of the DECT/GSM access profile is essential for the ability of a GSM subscriber to use the same cordless DECT terminal at different places and networks. (The DECT/GSM access profile also specifies the DECT GAP as a fall-back position.)

Also, business cordless DECT terminal users can extend their operational area via a GSM which provides them access to their home PISN. This roaming will depend upon the control of private network operators. The use of the DECT GAP is essential for the ability of a PISN user to use the same cordless DECT terminal at different places and networks.

7.3 Applications

Applications considered in this section cover teleservices and supplementary services.

7.3.1 Teleservices

Ideally all teleservices that are available on standardized GAP, and that are also available on specific networks should be supported. In any case, the telephony service for incoming and outgoing calls must be supported (ISDN speech at 64 kbps PCM).

7.3.2 Supplementary services

It is to be investigated how supplementary services offered by GSM to its subscribers can be supported by a visited PISN, and how supplementary services offered by a DECT-PISN to its users can be supported by a visited GSM network. The impact on further standardization is to be analyzed.

For this purpose the supplementary services standardized for GSM and PISN need to be considered. An attempt is made to qualify the supplementary services based on certain selection criteria, and to assign priorities (see table 3). The idea is to analyze standardized supplementary services with respect to usefulness for a roaming user, which supplementary services could be offered by the visited network to a roaming user, how different the specifications are for supplementary services standardized for both GSM and PISNs, whether there are charging implications, and how difficult the implementation would be. Although these criteria are sometimes conflicting, an overall evaluation should be included. As a result, a certain set of supplementary services that could be provided to a roaming user should be identified.

7.3.2.1 Standardised supplementary services.

In the following, the supplementary services standardized for GSM and PISNs, respectively, are listed (table 1). If there already exists an approved standard, this is indicated by the ETS number in brackets. If not, the supplementary service is either under study (indicated by an "x"), or not considered so far (indicated by a dash "-").

Table 1a: Supplementary services standardized in GSM (Phase 2) and for PISNs

Supplementary Services	specified in GSM	specified for PISNs
Advice of Charge	x (ETS 300 519)	x (ECMA 211)
Call Barring	x (ETS 300 520)	-
Call Hold	x (ETS 300 516)	x (ETS 300 239)
Call Intrusion	-	x (ETS 300 425)
Call Offer	-	x (ETS 300 361)
Call Waiting	x (ETS 300 516)	x (ETS 300 239)
Closed User Group	x (ETS 300 518)	-
Diversion (Call Forwarding on Busy)	x (ETS 300 515)	x (ETS 300 256)
Diversion (Call Forwarding on No Reply)	x (ETS 300 515)	x (ETS 300 256)
Diversion (Call Forwarding Unconditional)	x (ETS 300 515)	x (ETS 300 256)
Diversion (Call Forwarding When Not Reachable)	x (ETS 300 515)	-
Do Not Disturb	-	x (ETS 300 363)
Multi-Party	x (ETS 300 517)	-
Name Identification	-	x (ETS 300 238)
Number Identification (CLIP)	x (ETS 300 514)	x (ETS 300 173)
Number Identification (COLP)	x (ETS 300 514)	x (ETS 300 173)
Number Identification (CLIR)	x (ETS 300 514)	x (ETS 300 173)
Number Identification (COLR)	x (ETS 300 514)	x (ETS 300 173)
Recall	-	x (ECMA 213)

Table 1b: Supplementary services in GSM (Phase 2+) and for PISNs

Supplementary Services	specified in GSM	specified for PISNs
Call Completion (when Busy)	x (GSM 02.93)	x (ETS 300 365)
Call Completion (on No Reply)	-	x (ETS 300 365)
Call Interception	x	x (ECMA 220)
Call Transfer	x (GSM 02.91)	x (ETS 300 260)
Diversion (Call Deflection)	x (GSM 02.72)	x (ETS 300 256)
eMLPP	x (GSM 02.69)	-
MSP	x (GSM 02.97)	-
Support of Private Numbering Plan	x (GSM 02.95)	x (ETS 300 189)
User-to-User Signalling	x (GSM 02.87)	-

7.3.2.2 Selection of supplementary services

Certain criteria should be taken into account when deriving which supplementary services should be supported by the networks involved, for example, how useful the service is in the case where a user of a cordless DECT terminal roams from GSM to a private DECT network, and vice versa.

Problems occur where the visited network supports a specific supplementary service in a different manner, or where the visited network does not provide the supplementary service. Also, charging, complexity and standards need to be considered.

Selection criteria are (non-exhaustive)

- applicability of a supplementary service for a user who roams between different networks
- provision of the supplementary service in the visited network
- substantiality in difference where the same supplementary service is provided in the visited network
- charging implications
- implementation effort
- impact on standards

7.3.2.2.1 Applicability

This section considers the usefulness of the above-mentioned supplementary services from a user's perspective, when applied to the case of a user of a cordless DECT terminal who roams from GSM to a private DECT network, and vice versa.

Advice of Charge: It seems to be a useful supplementary service in the case where a user of a cordless DECT terminal roams from GSM to a private DECT network, and vice versa.

Call Barring: It seems to be a useful supplementary service in the case where a user of a cordless DECT terminal roams from GSM to a private DECT network, and vice versa.

Call Completion: It seems to be a useful supplementary service in the case where a user of a cordless DECT terminal roams from GSM to a private DECT network, and vice versa.

Call Hold: It seems to be a useful supplementary service in the case where a user of a cordless DECT terminal roams from GSM to a private DECT network, and vice versa.

Call Interception: This supplementary service allows an attendant to intercept a call, for example, if the dialled number is wrong. It seems to be a useful supplementary service in the case where a user of a cordless DECT terminal roams from GSM to a private DECT network, and vice versa.

Call Intrusion: This supplementary service adds a call to an existing active call at the called terminal. This supplementary service seems not to be important for a roaming user of a cordless DECT terminal.

Call Offer: This supplementary service allows the calling user when the called user is busy to indicate to the called user that a new call has arrived. It seems to be a useful supplementary service in the case where a user of a cordless DECT terminal roams from GSM to a private DECT network, and vice versa.

Call Transfer: It seems to be a useful supplementary service in the case where a user of a cordless DECT terminal roams from GSM to a private DECT network, and vice versa.

Call Waiting: This supplementary service allows for a busy called user to queue incoming calls. It seems to be a useful supplementary service in the case where a user of a cordless DECT terminal roams from GSM to a private DECT network, and vice versa.

Closed User Group: This supplementary service seems to be a useful supplementary service in the case where a user of a cordless DECT terminal roams from a private DECT network to GSM.

Diversion: It seems to be a useful category of supplementary services in the case where a user of a cordless DECT terminal roams from GSM to a private DECT network, and vice versa.

Do Not Disturb: This supplementary service seems not to be important for a roaming user of a cordless DECT terminal.

Multi-Party: It seems to be a useful supplementary service in the case where a user of a cordless DECT terminal roams from GSM to a private DECT network, and vice versa.

Name Identification: It seems to be a useful supplementary service in the case where a user of a cordless DECT terminal roams from GSM to a private DECT network, and vice versa.

Number Identification: It seems to be a useful category of supplementary services in the case where a user of a cordless DECT terminal roams from GSM to a private DECT network, and vice versa. For example, CLIP is useful for the called roaming user to decide whether to take a call when he is being charged for the part of the call that has been established in order to support his mobility.

Recall: This supplementary service is used in combination with the Call Transfer supplementary service. It allows the transferring party to be recalled in case the transferred-to party is busy or does not answer. This supplementary service seems may be useful for a roaming user of a cordless DECT terminal together with Call Transfer.

Support of Private Numbering Plan: It seems to be a useful supplementary service in the case where a user of a cordless DECT terminal roams from GSM to a private DECT network, and vice versa. For example, the private numbering plan of a user of a cordless DECT terminal who roams from that particular private DECT network to GSM could be supported by GSM.

User-to-User Signalling: This supplementary service seems not to be important for a roaming user of a cordless DECT terminal.

7.3.2.2.2 Provision in the visited network

Limitations are twofold. First, if the visited network does not provide a supplementary service this service cannot be accessed by the roaming user of a cordless DECT terminal even if he has subscribed to it in the home network. Second, although a supplementary service could be offered in the visited network, it seems not to be possible for a roaming user of a cordless DECT terminal to access this service, since there is no subscription to it. This second case, however, may be reconsidered in context with charging implications.

If above limitations hold, a GSM subscriber who roams to a private network, or a user of a private DECT network who roams to GSM, could be provided with the following supplementary services in the visited network:

- Advice of Charge
- Call Completion
- Call Hold
- Call Transfer
- Call Waiting
- Diversion
- Number Identification
- Support of Private Numbering Plan

Considering the case that the visited network would allow access to supplementary services not provided by the home network, the following supplementary services could be provided, see table 2 (common supplementary services are shadowed).

Table 2: Potential additional supplementary services available in the visited network.

GSM subscriber roaming to a private DECT network	User or a private DECT network roaming to GSM
Advice of Charge	Advice of Charge
-	Call Barring
Call Completion	Call Completion
Call Hold	Call Hold
Call Interception	-
Call Intrusion	-
Call Offer	-
Call Transfer	Call Transfer
Call Waiting	Call Waiting
Diversion	Diversion
Do Not Disturb	-
-	eMLPP
-	MSP
-	Multi-Party
Name Identification	-
Number Identification	Number Identification
Recall	-
Support of Private Numbering Plan	Support of Private Numbering Plan
User-to-User Signalling	-

7.3.2.2.3 Differences for the same supplementary service

Advice of Charge: For private network Advice of Charge the emphasis is on providing Advice of Charge on the basis of charges incurred in the use of other public networks. This is substantially different from public network standards.

Call Completion: This category of supplementary services is specified for PISNs, and under study for GSM. Differences are to be clarified.

Call Hold: The notification of Call Hold is specified for PISNs within its generic mechanisms within a basic call. There are no substantial or technical differences. In GSM, only one call can be placed on hold.

Call Transfer: Differences concern the information flows. Details are to be clarified.

Call Waiting: The notification of Call Waiting is specified for PISNs within its generic mechanisms within a basic call. There are no substantial or technical differences.

Diversion: There are no substantial differences. Details are to be clarified.

Number Identification: Differences concern the information flows, which however does not lead to technical incompatibility. Details are to be clarified.

Support of Private Numbering Plan: This is considered as a supplementary service in GSM; private numbering plans are a basic feature of private networks, and as such are supported.

7.3.2.2.4 Charging implications

Advice of Charge: There are charging implication in the case where a user of a cordless DECT terminal roams from GSM to a private DECT network, and vice versa.

Call Completion: There are charging implication in the case where a user of a cordless DECT terminal roams from GSM to a private DECT network, and vice versa.

Call Hold: There are no charging implication in the case where a user of a cordless DECT terminal roams from GSM to a private DECT network, and vice versa.

Call Transfer: There are charging implication in the case where a user of a cordless DECT terminal roams from GSM to a private DECT network, and vice versa. This depends on the location of the transferred-to terminal.

Call Waiting: There are no charging implication in the case where a user of a cordless DECT terminal roams from GSM to a private DECT network, and vice versa.

Closed User Group: There may be charging implications

Diversion: A number of problems need to be solved depending on the forwarded-to destination, e.g. charging, feature interaction. As an example, an incoming call is first routed to the home network, then re-routed to the visited network. If the call is then diverted back to the home network, the user could be charged for two international calls.

Multi-Party: There may be charging implications for the different call legs depending on which network is involved in which leg.

Number identification: There are no charging implication in the case where a user of a cordless DECT terminal roams from GSM to a private DECT network, and vice versa.

Support of Private Numbering Plan: There are no charging implication in the case where a user of a cordless DECT terminal roams from GSM to a private DECT network, and vice versa.

7.3.2.2.5 Implementation effort

Advice of Charge: Based on the substantial differences in specifications for Advice of Charge in GSM and for PISNs the effort to implement this supplementary service is considered very high.

Call Completion: This supplementary service may be difficult to be provided for the case where a user of a cordless DECT terminal roams from GSM to a private DECT network, and vice versa. Difficulties concern the monitoring of events and queueing of calls. In particular, the impact on handover needs careful consideration.

Call Hold: There are requirements to the cordless DECT terminal to initiate this supplementary service. Otherwise, it should not be difficult to support this supplementary service. The impact on handover needs however careful consideration.

Call Transfer: It is necessary to avoid uncontrolled loops. There are requirements to the cordless DECT terminal to initiate this supplementary service. The effort to implement this supplementary service is considered to be medium.

Call Waiting: Difficulties may relate to queueing of calls.

Diversion: A number of problems need to be solved depending on the forwarded-to destination, e.g. charging, feature interaction. As an example, an incoming call is first routed to the home network, then re-routed to the visited network. If the call is then diverted back to the home network, the user could be charged for two international calls.

Number Identification: It should not be difficult to support this supplementary service.

Support of Private Numbering Plan: Substantial difficulties are expected to support a Private Numbering Plan in the case where a user of a cordless DECT terminal roams from a private DECT network to GSM.

7.3.2.2.4 Impact on standards

The impact on standards need further study. In general, it depends on which supplementary services are supported in the case where a user of a cordless DECT terminal roams from GSM to a private network, and vice versa. Some supplementary services may be useful for a roaming user which are currently not specified in standards, e.g. Call Barring, where no specification for PISNs exist. In that case, this should be investigated by the responsible standardization body.

In case transparency of supplementary services in the visited network is required, the mechanisms to convey the appropriate messages within the visited network need to be standardized.

7.3.3 Overall qualification

The following table (table 3) gives an overview of the selection criteria discussed in the previous sub-sections. An attempt is made to qualify those and to derive an overall qualification, denoted by the assignment of priorities.

The following denotations are used for the columns:

- * Specified in GSM / PISN:
 - x: yes (standard or under study)
 - : no (not studied yet or not intended to be studied at all)
- * Common set (specified for both GSM and PISNs):
 - x: yes (standard or under study). This set is shadowed in table 3
 - : no (specified in GSM only, or for PISNs only)
- * Usefulness (from a user's perspective):
 - x: yes
 - : not important in the case where a user roams between different networks
- * Differences (in specifications which exist for both GSM and PISNs):
 - xxx: substantially different
 - xx: not substantially different
 - x: similar specifications
- * Charging impl. (charging implications): Yes / No
- * Impl. effort (Implementation effort, for supplementary services of the common set):
 - xxx: very difficult to implement (e.g. considerable interaction problems)
 - xx: medium difficulty
 - x: not difficult to implement
- * Impact on Std (Impact on Standards): Yes / No (ffs)
- * Priority (overall perspective):
 - 1: high priority
 - 2: not a high priority
- * Remarks: refer to notes which provide additional information considered valuable.

Table 3: Supplementary Services qualified by Selection Criteria

Supplementary Service	Specified in		Common set	Usefulness	Differences	Charging. impl.	Impl. effort	Impact on Std	Priority	Remarks
	GSM	PISN								
Advice of Charge	x	x	x	x	xxx	yes	xxx		1	note 2
Call Barring	x	-	-	x						-
Call Completion (Busy / NR)	x	x	x	x	xxx	yes	xxx		2	-
Call Hold	x	x	x	x	x	no	x		2	note 1
Call Interception	-	x	-	x						-
Call Intrusion	-	x	-	-						-
Call Offer	-	x	-	x						-
Call Transfer	x	x	x	x	xx	yes	xx		2	note 1
Call Waiting	x	x	x	x	x	no	xx		2	note 1
Closed User Group	x	-	-	x		yes	xx		1	-
Diversion (Call Forw. on Busy)	x	x	x	x	x	yes	xx		1	note 1
Diversion (Call Forw. on NR)	x	x	x	x	x	yes	xx		1	note 1
Diversion (Call Forw. Uncond.)	x	x	x	x	x	yes	xx		1	-
Diversion (CF when Not Reach)	x	-	-	x						-
Diversion (Call Deflection)	x	x	x	x	xx	yes	xx		1	-
Do Not Disturb	-	x	-	-						-
eMLPP	x	-	-	-						-
MSP	x	-	-	-						-
Multi-Party	x	-	-	x						-
Name Identification	-	x	-	x						-
Number Identification (CLIP)	x	x	x	x	x	no	x		1	note 1
Number Identification (COLP)	x	x	x	x	x	no	x		1	note 1
Number Identification (CLIR)	x	x	x	x	x	no	x		1	note 1
Number Identification (COLR)	x	x	x	x	x	no	x		1	note 1
Recall	-	x	-	x						-
Support of Private Numb. Plan	x	x	x	x	x	no	xxx		1	-
User-to-User Signalling	x	-	-	-						-

NOTE 1: This supplementary service could be provided by the visited network.

NOTE 2: Advice of Charge considered on an information level.

7.4 Network features and capabilities

7.4.1 Roaming

Identification and authentication of the GSM and private DECT networks, including cordless DECT terminals, DECT terminal location handling, DECT user data handling must be defined to support roaming between GSM and private DECT networks. Roaming between the networks which are under the responsibility of different authorities should be under control of these authorities. The mechanisms to be defined should take into account available standards and current work of all the involved parties.

7.4.2 Charging, billing and accounting

Charging, billing and accounting principles developed for GSM networks and PISNs should be used as a basis for the study. It should be examined whether the current charging flexibility inherent to GSM can serve the charging requirements of all the network scenarios. Currently, according to GSM MoU it would be necessary to join the MoU to cope with charging, billing and accounting, which is not applicable to private DECT networks. This new requirement needs to be solved, unless left to the particular roaming agreement.

Calling users should have an indication that a special charge may apply to the call, and the expected charge may be indicated. The principles for split of charges should be defined.

It should also be possible that the called mobile DECT terminal user can be charged for the part of the call that has been established in order to support his mobility. In that case the Calling Line Identification Presentation Supplementary Service should be supported for the called DECT terminal user to decide if it likes to take that call. It should then be possible to charge the called user for the associated signalling costs, if it decides not to take the call.

Transfer of charging information between GSM and private DECT networks should be considered. In GSM networks, the invocation of any supplementary service could cause charges, which in the case where a GSM subscriber roams to a private DECT network would require the private DECT network to supply a Call Detail Record on request from the home GSM network.

7.4.3 Handover

Handover within a visited network (intra-cell and intra-cluster) is assumed to be provided under the authority of the visited network operator.

Inter-network handover is out of scope.

7.5 Numbering, addressing, identification and routing

7.5.1 Numbering and addressing

7.5.1.1 General aspects

One aspect of mobility between different networks is the different numbering plans that have to be considered.

The GSM number is the number to be dialled, according to E.164.

In private networks there is a greater variety of numbering plans. The general principles of these are described in [7], e.g. according to E.164 or implicit numbering plans. It is possible for a private network user to have a private network number used within the private network, and a public network number used by callers outside the private network.

A DECT terminal may have several numbers, either belonging to the same numbering plan or to different numbering plans.

7.5.1.2 Aspects related to incoming calls

The dialled number should not depend on the current location of the user of a cordless DECT terminal.

7.5.1.3 Aspects related to outgoing calls

It is desirable that the user of a cordless DECT terminal is able to use the home network numbering plan when visiting another network. Depending on the roaming agreement outgoing calls may be handled by the home network or by the visited network. The visited network, in the latter case, would require the visited network to either request a number translation from the home network or to have the necessary data available. This would then also require support by the ISDN-based inter-network signalling.

The calling line identity should not depend on the current location.

7.5.1.4 Operator aspects

When the user of a cordless DECT terminal is registered, the network operator will assign a number to that terminal. This could be independent of radio specific identities assigned to the DECT terminal.

7.5.2 Identification

The identify structure (IMSI) for GSM is described in E.212.

The identity for a user's DECT terminal is the IPUI. The IPUI-type R incorporates an IMSI. The best for GSM would be to use the IMSI in the DAM card. As a result, the private DECT network would be required to map the identities, since no IMSIs are defined for private networks.

For the identity of a user of a private DECT network, the best would be the IPUI-S which incorporates an E.164 number. As a result, the GSM network would be required to map the identities.

7.5.3 Routing

When the called party is visiting another network the called party's home network will be involved. Similarly, if the calling party is visiting another network the calling party's home network could also be involved in the call. In the ideal case, the home networks will only have to deal with database enquiries, and the actual routing is done by the calling and called party's network.

7.5.3.1 Aspects related to incoming calls

The routing of incoming calls to roaming DECT terminal users could be influenced by the charging mechanisms used by the networks. Depending on the charging mechanisms adopted the call charges incurred by the calling user could depend on the routing of the call.

7.5.3.2 Aspects related to outgoing calls

Outgoing calls from roaming DECT terminal users do not necessarily involve the home network. If the DECT terminals users' service profile is known by the visited network, and authentication is done by the visited network, normal call handling procedures could be used by the visited network.

7.5.3.3 Operator aspects

The use of optimized routing, the benefits, costs and tariff implications, are for further study. In particular, the extent to which GSM databases can be interrogated by private DECT networks, and vice versa, is to be addressed.

7.6 Privacy and security

The security of radio paths, terminals, and network infrastructure is required.

The philosophy to manage security in GSM and in DECT (encryption, authentication, confidentiality) is similar, but the algorithms or the security procedures may not be the same or really compatible.

As far as access to GSM is aimed, GSM security mechanisms must be supported. However, the problem of the interconnection between networks and accesses with their own security and privacy guaranteed, may require enhancements to GSM security protocols. The possibility for GSM to optionally provide DECT security algorithms for DECT-GAP terminals should be considered.

7.7 Management aspects

Management information to be transferred between the GSM and private DECT network include identities, software updates, black-white list and their changes, barred telephone numbers, voice or display prompts, data (needed for authentication procedures, subscriber data, billing data), etc. Currently, this is under MoU responsibility.

7.8 DECT Access Profiles

The DECT-GAP is a minimum requirement. A DECT/GSM access profile built on GAP is specified for accessing GSM networks.

7.9 SIM/DAM

Dual mode handsets comprising DECT and GSM in one handset allow the service area to be country-wide, and at the same time in-door coverage could be provided at appropriate costs.

The DECT DAM or GSM SIM card could be used to store authentication information and perform the necessary calculations for authentication. This is a standard way to access the GSM network with GSM subscription. It is not required for GAP, but for DECT/GSM access profile.

There is a need to address SIM services.

8 Network aspects

8.1 Radio interfaces

The network architecture should support the DECT access standard. The access profile supported should build upon the DECT GAP.

8.2 Network architecture

8.2.1 Reference configurations

The philosophy behind the following end-to-end reference interworking configuration is to keep the GSM internal functionalities / information exchange unchanged by assuming a gateway connected to the private DECT network to handle all additionally required mapping, and similarly, to keep the PISN internal functionalities / information exchange unchanged by assuming a gateway connected to the GSM network to handle all additionally required mapping.

For simplicity, one gateway of a particular private DECT network is connected to one gateway of a particular GSM network, with which a roaming agreement exists, via an ISDN-based interface.

Local data bases, the content being of temporary nature, are assumed to be co-located with each gateway.

One local data base would represent the „virtual visitor location register“ (VLR') for a GSM subscriber who roams to a private DECT network, and would store data of his actual location (G-PINX), in order to deal with incoming calls to that GSM subscriber, currently roaming outside of the home network.

One local data base co-located with the gateway of the private DECT network would represent a "virtual home data base" (HDB') for a GSM subscriber who roams to that private DECT network, and would store data of the actual visited node (V-PINX) in addition to the identity of the user, in order to deal with incoming calls to that GSM subscriber currently roaming in the private DECT networks.

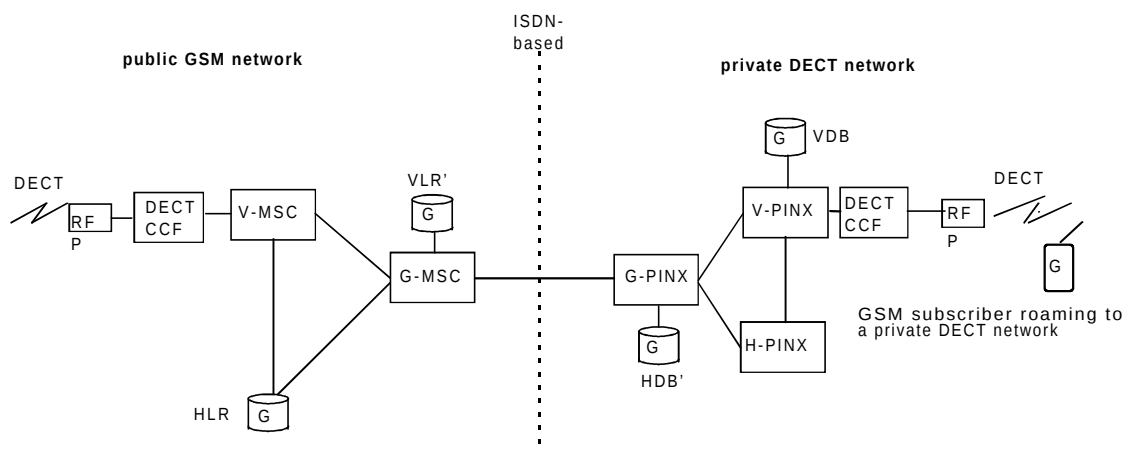


Figure 2a: End-to-end Interworking Reference Configuration - Scenario 2a

One local data base co-located with the GSM gateway would represent a „virtual home location register“ (HLR') for a user of a private DECT network who roams to that GSM network, and would store data of the actual visited node (V-MSC) in addition to the identity of the user, in order to deal with incoming calls to that user of a private DECT network currently roaming in the GSM network.

One local data base would represent the „virtual visited data base“ (VDB') for a user of a private DECT network who roams to a GSM network, and would store data of his actual location (G-MSC), in order to deal with incoming calls to that user of a private DECT network, currently roaming outside the home network.

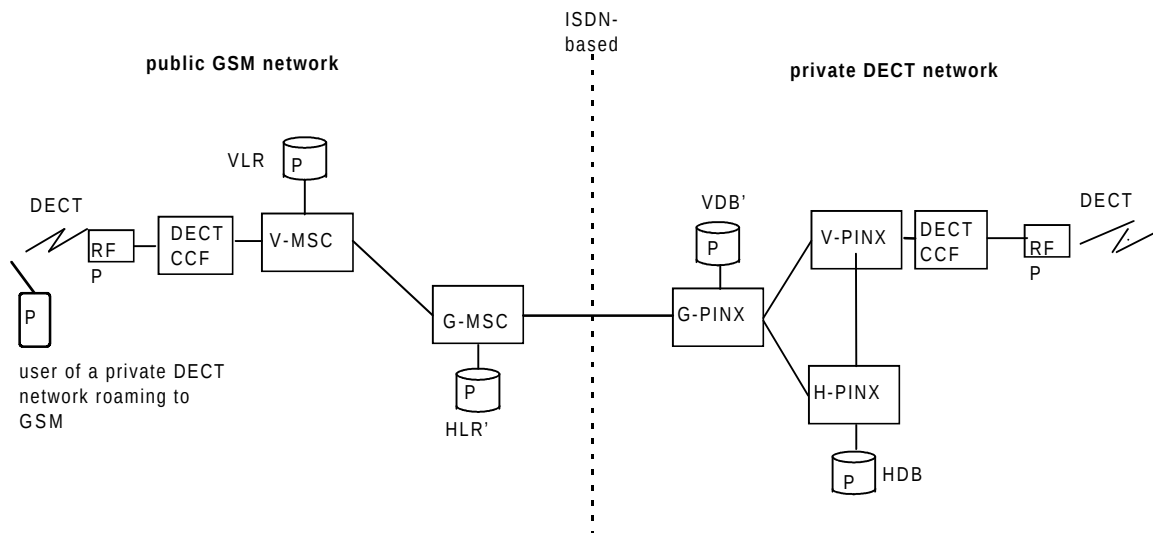


Figure 2b: End-to-end Interworking Reference Configuration - Scenario 2b

It was assumed that the advantage of keeping each networks internal procedures unchanged would make up for the disadvantage that data consistency is a problem. It is, however, important to note, that the proposed end-to-end interworking reference configuration does not imply its implementation. It is up to the GSM operator to decide whether to implement a gateway with local data bases or find other means, as long as the information that needs to be exchanged across the network boundaries via the ISDN-based interface is supported. The same applies to the administrator of a private DECT network.

The following entities are used:

- CCF: A Cluster Control Function controls the Cell Site Functions associated with one cluster, i.e. a logical grouping of one or more cells.
- G-MSC: Gateway-MSC at the ISDN-based interface, switches a call to or from another network, and includes functionality necessary to allow interworking between GSM and private DECT networks; required to convert protocols used inside GSM to those used on the ISDN-based interface.
- G-PINX: Gateway-PINX at the ISDN-based interface, switches a call to or from another network, and includes functionality necessary to allow interworking between GSM and private DECT networks; required to convert protocols used inside the private DECT network to those used on the ISDN-based interface.
- HDB: The Location Data Base where the current location and all associated parameters of user P are stored.
- HDB': Data Base associated with the G-PINX, representing the virtual "home" for user G who roams in a private DECT network.
- HLR: GSM Home Location Register, where the current location and all associated parameters for user G are stored.
- HLR': Data Base associated with the G-MSC, representing the virtual "home" for user P who roams in GSM.

- RFP: A generic term for any one of the distributed elements of a DECT fixed system. An RFP contains one or more radio end points, but can only connect to one cell.
- VDB: The Location Data Base where some, or all, of the relevant parameters concerning user G are stored as long as user G is in the area served by the VDB.
- VDB': Data Base associated with the G-PINX, representing the virtual "VDB" for user P who roams in GSM.
- VLR: GSM Visitor Location Register, where some, or all, of the relevant parameters concerning user P are stored as long as user P is in the area served by the VLR.
- VLR': Data Base associated with the G-MSC, representing the virtual "VLR" for user G who roams in a private DECT network.

8.2.2 Interfaces

The interface between DECT equipment or private DECT networks and GSM MSC is an ISDN-based interface which includes the required enhancements for mobility management message transfer.

Responsibility for standardization: SPS5, ECMA TC32 TG14

8.3 Mobility Management protocols

In order to manage mobility in the case where a user of a cordless DECT terminal roams from GSM to a private DECT network, and vice versa, it is necessary to provide mobility management protocols on both the access interfaces between the DECT network and the databases of GSM, and on the inter-network interfaces between the home and the visited network including their home and visited databases. This is currently under MoU responsibility.

8.4 Mapping requirements

The information transported on the ISDN-based interface in the case where a user of a cordless DECT terminal roams from GSM to a private DECT network, and vice versa, need to be mapped to GSM internal information, and to PISN internal information, respectively.

Note: The mapping requirements on the private DECT network side of the interface are under responsibility of BTC1. Therefore, only the mapping requirements on the GSM side of the interface is addressed in the following.

This information includes:

- user identification
- terminal authentication
- location registration
- incoming calls
- outgoing calls
- supplementary services
- user's data handling
- charging information
- interrogation of databases

8.4.1 User identification

In the case that a user of a private DECT network roams to GSM, and vice versa, the identity must be mapped. The user identity must be unambiguous, e.g. for the GSM subscriber the "IMSI" or "TMSI plus Location Area Identity", and for the DECT user the "IPUI" or "Network Assigned Identity plus Location Area Identity", respectively.

8.4.2 Terminal authentication

8.4.2.1 Scenario 2a: GSM subscriber roaming to a private DECT network

Authentication of the cordless terminal may be performed in the visited private DECT network or home GSM network. No session key mechanism for DECT is used.

8.4.2.1.1 Authentication when performed in the visited private DECT network

A request is sent from the visited private DECT network to the home GSM network to send authentication parameters. The triple (RAND, Kc, SRES) is provided in the response from the home GSM network. The visited private DECT network forwards the RAND to the cordless terminal. The RES received from the handset is compared with the SRES received from the home GSM network.

8.4.2.1.2 Authentication when performed in the home GSM network

The home GSM network sends an authentication request to the visited private DECT network, including the authentication parameters needed in the cordless terminal (RAND), and optionally the Kc to encrypt the air interface. The visited private DECT network forwards the RAND to the cordless terminal, and returns the RES received from the cordless terminal to the home GSM network. The home GSM network runs the authentication algorithms, and checks the RES calculated with the RES received from the visited private DECT network.

8.4.2.2 Scenario 2b: user of a private DECT network roaming to a GSM network

Authentication of the cordless terminal may be performed in the visited GSM network or home private DECT network.

8.4.2.2.1 Authentication when performed in the visited GSM network

A request is sent from the visited GSM network to the home private DECT network to send authentication parameters. Two alternatives exist:

- The sessions key (KS) and parameter RS are provided in the response from the home private DECT network. The visited GSM network creates a RAND and forwards the set (RS, RAND) to the cordless terminal. The RES is calculated in the visited GSM network, using KS and RAND, (DECT algorithms are available on request via ETSI) and compared with the RES received from the cordless terminal.
- The triple (RS, RAND, RES) and DCK is provided in the response from the home private DECT network. The visited GSM network forwards the set (RS, RAND) to the cordless terminal. The RES received from the handset is compared with the RES received from the home private DECT network.

8.4.2.2.2 Authentication when performed in the home private DECT network

The home private DECT network sends an authentication request to the visited GSM network, including the authentication parameters needed in the cordless terminal (RS, RAND). The visited GSM network forwards the pair to cordless terminal, and returns the RES received from the cordless terminal to the home private DECT network. The home private DECT network runs the authentication algorithms, and checks the RES calculated with the RES received from the visited GSM network.

8.4.3 Location registration

If the user is not yet registered, an Update Location request is sent from the visited to the home network. The home network needs to store the information received, to retrieve information of the previously visited location, and to perform a cancel procedure.

8.4.3.1 Scenario 2a: GSM subscriber roaming to a private DECT network

The GSM subscriber who roams to a private DECT network performs a location registration request to the V-PINX, using its identification. If the TMSI plus Location Area Identity is used for identification, the IMSI has to be obtained from the previous Location Area. The IMSI is used to associate the appropriate G-PINX connected to the relevant G-MSC. An internal mechanism may be used to replace the IMSI by a temporary number (T_PISNN), assigned by the G-PINX from its own range, for identification and routing purposes as long as the GSM subscriber is roaming in that private DECT network. The IMSI (and T_PISNN) is stored in the VDB associated with the V-PINX. The G-PINX stores the IMSI (and T_PISNN) and the V-PINX address in its data base (HDB'). The G-PINX forwards the location registration request to the G-MSC, including the IMSI. The G-MSC stores the IMSI and the G-PINX number in its data base (VLR'). The G-MSC forwards the location registration request to the HLR, including the IMSI and G-MSC address. The HLR stores the IMSI and the G-MSC address (and initiates deletion procedures of previous location). The location registration is confirmed via G-MSC and G-PINX back to the GSM subscriber who roams to a private DECT network.

8.4.3.2 Scenario 2b: user of a private DECT network roaming to a GSM network

The user of a private DECT network who roams to a GSM network performs a location registration request to the V-MSC, using its identification. If the Network Assigned Identity plus Location Area Identity is used for identification, the IPUI has to be obtained from the previous Location Area. The IPUI is used to associate the appropriate G-MSC connected to the relevant G-PINX. A mapping of the IPUI to a temporary identification may be required to allow for GSM-internal procedures. The IPUI (and temporary identifier) is stored in the VLR. The G-MSC stores the IPUI (and temporary identifier) and the V-MSC address in its data base (HLR'). The G-MSC forwards the location registration request to the G-PINX, including the IPUI. The G-PINX stores the IPUI and the G-MSC number in its data base (VDB'). The G-PINX forwards the location registration request to the H-PINX, including the IPUI. The H-PINX stores the IPUI and the G-PINX address in the HDB (and initiates deletion procedures of previous location). The location registration is confirmed via G-PINX and G-MSC back to the user of a private DECT network who roams to a GSM network.

8.4.4 Incoming calls

An incoming call to a user of a cordless DECT terminal who roams to a visiting network will be routed to the home network, and re-routed to the visited network.

8.4.4.1 Scenario 2a: GSM subscriber roaming to a private DECT network

An incoming call to a GSM subscriber who roams to a private DECT network will cause the GSM network to interrogate the HLR for the current location of the user. The HLR requests a Roaming Number within the GSM network from a gateway (G-MSC). The G-MSC associates a roaming number with the IMSI of the GSM subscriber, and returns this number to the HLR. Call processing continues until the G-MSC forwards the call to the G-PINX (number obtained during registration of the GSM subscriber who roams to a private DECT network), including the IMSI. The G-PINX may perform internal mapping of the IMSI to a temporary identification / number (T_PTTN) and retrieves the V-PINX address from the HDB'. The call is forwarded inside the private DECT network to the actually visited node (V-PINX), and to the GSM subscriber who roams to a private DECT network.

8.4.4.2 Scenario 2b: user of a private DECT network roaming to a GSM network

An incoming call to the user of a private DECT network who roams to a GSM network will cause the private DECT network to interrogate the home database (HDB) for the current location of the user. Using internal procedures, the call is forwarded to the G-PINX. The call is sent to the G-MSC, including the identifier of the user of a private DECT network who roams to a GSM network (IPUI). The G-MSC uses this identifier to retrieve the V-MSC address from the HLR'; the HLR' is co-located with the G-MSC (and has been updated in parallel with the registration of the roaming user in the VLR). The G-MSC performs a request for a Roaming Number to the V-MSC which is forwarded to the VLR. Based on the roaming number received the call is forwarded by the G-MSC via the V-MSC to the user of a private DECT network who roams to a GSM network.

8.4.5 Outgoing calls

An outgoing call from a user of a cordless DECT terminal who roams to a visiting network can be handled in the visited network. In this case either the user's service profile needs to be made available to the visited network, or an interrogation of the home network's database could indicate to the visited network, that the user can make outgoing calls.

8.4.5.1 Scenario 2a: GSM subscriber roaming to a private DECT network

Two alternatives exist for handling outgoing calls. Either the home network (Alternative a) or the visited network (Alternative b) could handle outgoing calls, depending on the roaming agreements between the networks involved. Alternative a) is appropriate for small private DECT networks which do not have the capability to perform a more complex dialled digit analysis. Alternative b) could be used by larger private DECT networks. However, alternative b) would allow a more optimized routing.

Alternative a:

The GSM subscriber who roams to a private DECT network indicates his intention to make a call. The V-PINX establishes a connection to the G-MSC via G-PINX, using the G-MSC number (obtained his identifier during registration procedure), and optionally an Operator Code, if required. The GSM subscriber who roams to a private DECT network dials a called party number. The called party number is transparently forwarded to the G-MSC via G-PINX. The G-MSC initiates GSM internal procedures to handle the call.

Alternative b:

The GSM subscriber who roams to a private DECT network indicates his intention to make a call, and dials a called party number. The V-PINX analyzes the dialled digits. This information is used to further route the call.

8.4.5.2 Scenario 2b: user of a private DECT network roaming to a GSM network

Two alternatives exist for handling outgoing calls. Either the home network (Alternative a) or the visited network (Alternative b) could handle outgoing calls, depending on the roaming agreements between the networks involved. Alternative b) would allow a more optimized routing.

Alternative a:

The user of a private DECT network who roams to a GSM network indicates his intention to make a call. The V-MSC establishes a connection to the G-PINX via G-MSC, using the G-PINX number (obtained from his identifier during registration procedure), and optionally an Operator Code, if required. The user of a private DECT network who roams to a GSM network dials a called party number. The called party number is transparently forwarded to the G-PINX via G-MSC. The G-PINX initiates internal procedures to handle the call.

Alternative b:

The user of a private DECT network who roams to a GSM network indicates his intention to make a call and dials a called party number. The V-MSC analyzes the dialled digits. This information is used to further route the call.

8.4.6 Supplementary Services

It is assumed that the roaming agreement between the networks involved includes a list of supplementary services that could be provided to roaming users. How these are supported and by whom (visited or home network) depend also on the mapping capability in each network.

8.4.7 User's data handling

Transfer of user's data needs to be considered.

8.4.8 Charging information

Transfer of charging information needs to be considered.

8.4.9 Interrogation of databases

Interrogation of databases needs to be considered.

9 Conclusions

The conclusion of this report is that network support for the network scenarios identified, giving the user the possibility to roam with his DECT terminal between public and business areas, is feasible and that standardization should be initiated in areas not covered by other standardization works. To implement these technical scenarios it is a prerequisite that regulatory issues are sorted out and that commercial agreements exist between GSM and DECT operators, which also requires that standards on charging are elaborated.

Network Scenario 1a) is covered by DECT/GSM interworking profile standards via A-interface.

Network Scenario 1b) is covered by RES3/ISDN work on "DECT access to GSM via ISDN"

Network Scenarios 2a) and 2b) are covered in principle by current CTM works, however, not considering GSM as a representative of a public network. Thus, there is a need to study ISDN-based DECT/GSM interworking and the network impact.

Proposed actions

Service Aspects

Inter-network roaming between GSM and private DECT networks should be standardized. Functions required are identification, authentication, location registration and subscriber data handling. Basic telephony services, incoming and outgoing calls, including technical aspects of charging and accounting, and an appropriate set of supplementary services for roaming users in public and business environment shall be studied.

Responsibility for service descriptions (stage 1) has to be identified. SMG1 proposes that this responsibility is assigned to SMG1.

Associated work for consideration: CTM service descriptions (NA1, BTC1), RES3

Network Aspects

The inter-network scenarios require co-operative mobility management and call control which shall be supported by an ISDN-based interface between the GSM and private DECT networks.

Interworking functionality is required at both sides of the ISDN-based interface to map the ISDN-based protocol to internal protocols, thereby limiting the impact on existing standards to the necessary enhancements identified in this report. The information to be transported on the interface includes user identification, terminal authentication, location registration, support of incoming and outgoing calls and supplementary services, user's data handling, and interrogation of databases.

Responsibility for network aspects (stage 2) has to be identified. SMG1 proposes that this responsibility is assigned to SMG3.

Associated work for consideration: RES3, BTC1

Interface

Responsibility for stage 3 aspects: SPS5, ECMA TC32 TG14

History

Document history	
June 1996	Creation of Version 5.0.0
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