DECT

The standard explained

(Standards are) Not Just for Experts

Abstract

Digital Enhanced Cordless Telecommunication (DECT), the technology originated as a European initiative is now rapidly conquering the telecommunications world. The benefits offered by this high quality access technology are recognised by more and more users, regulators, standardisation bodies, network operators, and equipment manufacturers. DECT has proven multiple applicability as a network access in residential, business and public environments showing easy mobility, speech quality comparable to wireline telephony, a high level of security through advanced digital technology and encryption, allowing for high subscriber densities, flexible bandwidth allocation, multiple service support, cost competitiveness, flexible deployment and simple installation.

This paper introduces the DECT standard and explains its main operating principles for all parties interested in DECT. The standardisation work in ETSI on the definition of application specific profiles and future evolutions in DECT is shortly explained.

Introduction

The Digital Enhanced Cordless Telecommunications (DECT) standard provides a general radio access technology for wireless telecommunications, operating in the preferred 1880 to 1900 MHz band using GFSK (BT = 0.5) modulation.

DECT has been designed to provide access to any type of telecommunication network thus supporting numerous different applications and services. The range of DECT applications includes residential, PSTN and ISDN access, wireless PABX, GSM access, Wireless Local Loop, Cordless Terminal Mobility CTM, Local Area Network access supporting voice telephony, fax, modem, E-mail, Internet, X.25 and many other services in a cost efficient manner.

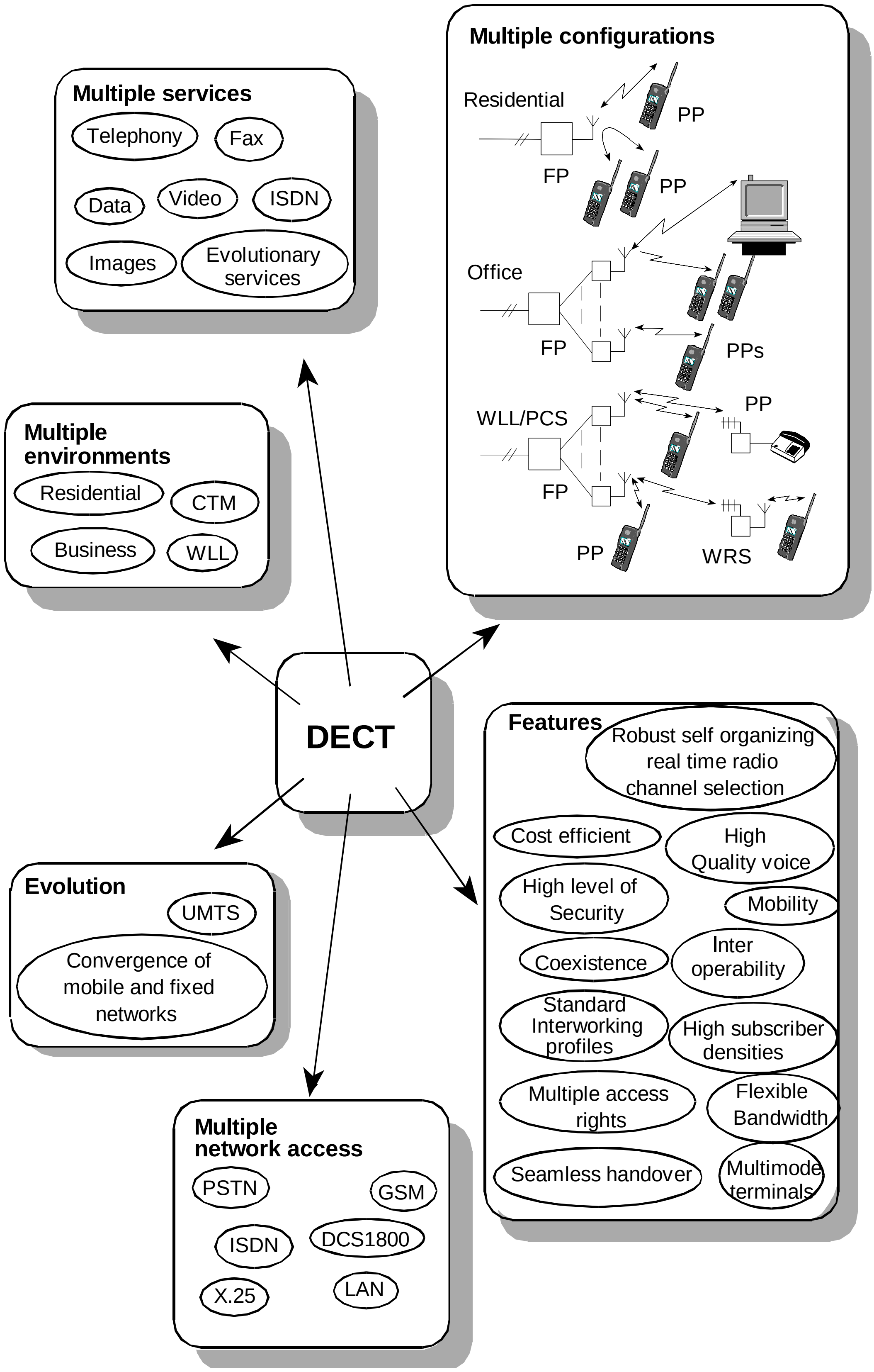


Figure 1. DECT application areas, services and features

The variety of applications supported by DECT finds its origin in the flexibility of the advanced protocol ‘toolbox’ that allows implementers to assemble virtually any application subset required. Mobility functions in the DECT protocol provide cordlessness to roaming users through a pico-cellular infrastructure of DECT base stations.

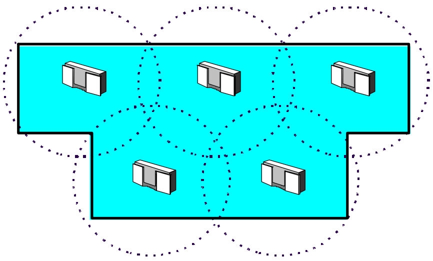


Figure 2. The pico-cellular structure of the DECT access network

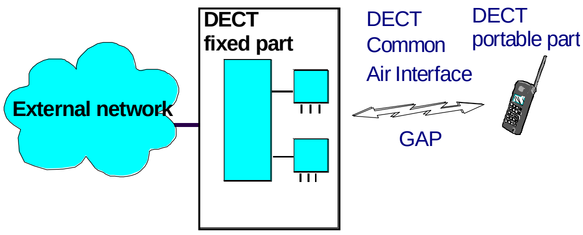
A DECT system comprises a DECT Fixed Part (FP), utilising one or more base stations (RFPs), and one or more DECT Portable Parts (PPs). There is no limit to the size of the infrastructure as far as the number of base stations and cordless terminals is concerned. Infrastructures using the DECT technology can support traffic densities up to 10000 Erlang/km^2, which is comparable to 100000 users in office environments.

In principle the DECT base standard (of which all parts are shown in Table 1) only covers the “air interface” between a DECT Fixed Part (FP) and a DECT Portable Part (PP), it provides a toolbox with protocols and messages from which selections can be made (profiles) to access any specific type of network. In addition to cordlessness, DECT makes available the network specific services and features (including mobility) to the user through the DECT common air interface transparently.

Its Multi Carrier, Time Division Multiple Access, Time Division Duplex (MC/TDMA/TDD) radio access method and continuous Dynamic Channel Selection and Allocation capability enable high capacity, pico-cellular systems, being utilised even in busy or hostile radio environments. These methods enable DECT to offer excellent quality of service without the need for frequency planning. DECT makes efficient use of the assigned radio spectrum, even when multiple operators and applications share the same frequency spectrum.

Figure 3. The DECT access technology using the GAP Common Air Interface

Standardised profiles have been defined for e.g. Generic Access (GAP; which is mandatory as a minimum requirement for all DECT voice telephony equipment as from October 1997), Radio in the Local Loop applications (RAP), ISDN and GSM interworking (GIP). Standard profiles encourage DECT equipment manufacturers to implement inter-



working with the network in a harmonised way. This creates interoperability between DECT equipment from different manufacturers and directs competition towards differentiation on non-technological features, providing consumers, and network operators with the luxury to choose from a variety of standard products. Standardisation of interworking also allows for mass production of system components, which in its turn provides significant cost benefits enabling highly attractive price/performance ratios for DECT equipment.

The North American Personal Wireless Telecommunications standards PWT and PWT/E (TIA) are based on DECT. PWT and PWT/E provide the same services as DECT; they use the same framing structure MAC, DLC, NWK layer and identities but an alternative modulation scheme and frequency allocation. The PWT operates in the US unlicensed band 1910 to 1920 MHz. PWT/E is an extension into the licensed bands 1850 - 1910 MHz and 1930 - 1990 MHz.

The DECT Standard

Introduction to DECT standardisation

The members of the European Telecommunications Standards Institute (ETSI) have developed the DECT standard. In ETSI Sub Technical Committee Radio Equipment and Systems 03 (STC RES-03), European telecommunications equipment manufacturers, system operators and regulators work together on the definition and evolution of the DECT standards.

In addition to ETSI, several other bodies are involved in the DECT standardisation process.

The Commission of the European Community provides considerable support by providing the legislation needed to establish (in conjunction with CEPT ERC) a common frequency allocation and (in conjunction with the ACTE committee) by enabling European wide harmonisation of the regulatory environment for DECT products.

After the first edition of the DECT standard was available in 1992, the DECT standardisation work concentrated on the definition of the Generic Access Profile (GAP) and other interworking profiles (DECT/GSM, DECT/ISDN, DECT/Radio Local Loop, CTM and several data profiles). This work and additional demands from the DECT market initiated several extensions and enhancements to the base standard enabling even more effective application of DECT products which led to the 2nd edition of the base standard being finalised by the end of 1995. Some examples of this are: inclusion of emergency call procedures to aid acceptance of DECT for public access applications, definition of the Wireless Relay Station (WRS) as a new system component to enable more cost efficient infrastructures and description of the optional direct portable to portable communication feature for DECT.

The DECT common interface standard has a layered structure and is contained in ETS 300 175, Parts 1 to 8 [1] to [8]. It is a comprehensive set of requirements, protocols and messages providing implementers with the ability to create network access profiles (protocol subsets) to be able to access virtually any type of telecommunications network.

To stimulate interoperability between DECT equipment from different manufacturers ETSI members started to work on the definition of standard interworking profiles by the end of 1993. The Generic Access Profile GAP [9] was the first profile, completed in 1994. It contains the protocol subset required for the basic telephony service in residential cordless telephones, business wireless PABX, and public access applications; it provides the basis for all other DECT speech profiles. Interoperability testing for GAP has been finished successfully.

Part	Title	Description
1	Overview	General introduction to the other parts of ETS 300 175
2	Physical layer	Radio requirements of DECT, e.g. carrier frequency allocation, modulation method, transmission frame structure, transmitted power limits, spurious emission requirements etc.
3	Medium Access Control layer	Description of procedures, messages, and protocols for radio resource management i.e. link set-up, channel selection, handover, link release and link quality maintenance etc.
4	Data Link Control layer	Description of provisions to secure a reliable data link to the network layer
5	Network layer	Description of the signalling layer with call control and mobility management functions and protocols.
6	Identities and Addressing	Description of the portable and fixed part identities requirements for all DECT application environments.
7	Security aspects	Procedures to prevent eavesdropping, unauthorised access and fraudulent use.
8	Telephony	Telephony requirements for systems supporting the 3.1 kHz speech service to ensure proper interworking with public telecommunications networks. Defines transmission levels, loudness ratings, sidetone levels, frequency response, echo control requirements etc.

Table 1. Parts 1 to 8 of the DECT CI standard ETS 300 175

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Basic Operating Principles

The principles as applied in the DECT standard have been designed to meet the following objectives:

- high capacity cellular structured network access
- allowing for network wide mobility
- Flexible and powerful identities and addressing
- high spectrum efficiency
- reliable - high quality and secure - radio access
- robustness even in hostile radio environments
- speech transmission quality comparable to the wired telephony service
- enabling cost efficient implementations of system components
- allowing for implementation of a wide variety of terminals like e.g. small pocketable handsets
- flexibility towards varying bandwidth needs (which is bandwidth on demand e.g. for ISDN and data applications)

Furthermore, the standard reflects a high degree of flexibility in the protocols to enable future extension.

Mobility

Although network-wide mobility is outside the scope of the DECT standard, the mobility functions in the DECT standard provide the ability to access the mobility capabilities of telecommunications networks through a (multi) cellular infrastructure giving tremendous flexibility to users roaming across their residence or business site.
Wireless users with authorised access to the network (subscribed users) can make and receive calls at any location covered by the DECT infrastructure (if the infrastructure supports mobility) and move around in this area even when in active communication. When the radio channel is interfered, the seamless handover capability of DECT assures an unnoticeable escape to a newly selected non-interfered radio channel.

The MC/TDMA/TDD principle

The DECT radio interface is based on the Multi Carrier, Time Division Multiple Access, Time Division Duplex (MC/TDMA/TDD) radio access methodology. Basic DECT frequency allocation uses 10 carrier frequencies (MC) in the 1880 to 1900 MHz range. The time spectrum for DECT is subdivided into timeframes repeating every 10 ms. Each frame consists of 24 timeslots each individually accessible (TDMA) that may be used for either transmission or reception. For the basic DECT speech service two timeslots - with 5 ms separation - are paired to provide bearer capacity for typically 32 kbit/s (ADPCM G.726 coded speech) full duplex connections. To simplify implementations for basic DECT the 10 ms timeframe has been split in two halves (TDD); where the first 12 timeslots are used for FP transmissions (downlink) and the other 12 are used for PP transmissions (uplink).

The TDMA structure allows up to 12 simultaneous basic DECT (full duplex) voice connections per transceiver providing a significant cost benefit when compared with technologies that can have only one link per transceiver (e.g. CT2). Due to the advanced radio protocol, DECT is able to offer widely varying bandwidths by combining multiple channels into a single bearer. For data transmission purposes error protected net throughput rates of n x 24 kbit/s can be achieved, up to a maximum of 552 kbit/s with full security as applied by the basic DECT standard.

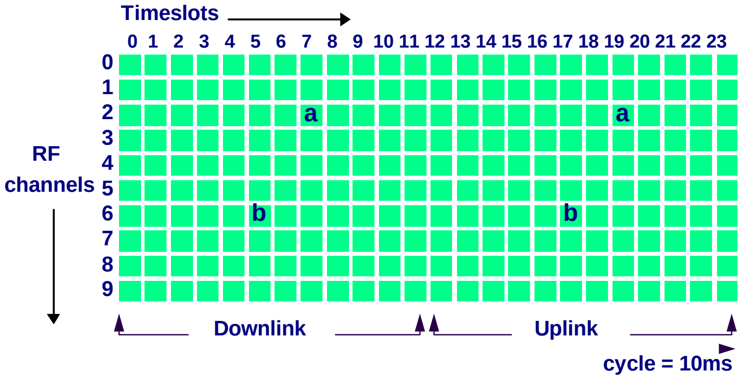

Figure 4. The DECT frequency/time spectrum

Use of the radio spectrum

Using the MC/TDMA/TDD principle for basic DECT (utilising both frequency and time dimensions) a total spectrum of 120 duplex channels is available to a DECT device at any instant location. When adding the third dimension (space) to the principle - given the fact that the capacity of DECT is limited by interference from adjacent cells and Carrier over Interference ratios of C/I = 10 dB can be achieved - a very low channel reuse factor (1) can be obtained. Different communication links in adjacent cells can use the same channel (frequency/timeslot combination. Therefore dense packing of DECT base stations (e.g. at a distance of 25 m in an ideal hexagonal coverage model) will allow for a traffic capacity of the basic DECT technology up to approx. 10000 Erlang/km^2/floor (see Note 1 below) without the need for frequency planning. Installation of DECT is reasonably simple since one only needs to consider radio coverage and traffic needs.

Note 1: 1 Erlang represents an average traffic load caused by one basic DECT speech connection - using one frequency/timeslot pair - for 100% of time.

Continuous broadcast service

A DECT base station is continuously transmitting on - at least - one channel, thus providing a beacon function for DECT portables to lock-on to. The transmission can be part of an active communication link with a portable or a dummy bearer transmission. The base station's beacon transmission carries broadcast information - in a multi-frame multiplexed structure - on base station identity, system capabilities, RFP status and paging information for incoming call set-up. Portables locked-on to a beacon transmission will analyse the broadcast information to find out if the portable has access rights to the system (only portables with access rights are allowed to set-up a communication link), determine whether system capabilities match with the services required by the portable and - if a communication is required - whether the base station has free capacity for a radio link with the portable.

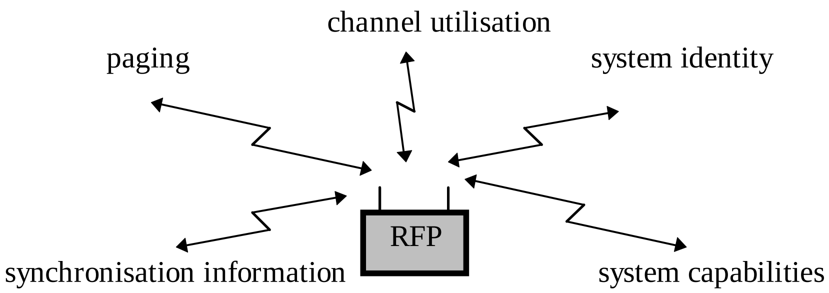

Figure 5. The DECT fixed part beacon function

Dynamic Channel Selection and Allocation

DECT features continuous Dynamic Channel Selection and Allocation. All DECT equipment is obliged to regularly scan - its local radio environment - at least once every 30 seconds. Scanning means receiving and measuring local RF signal strength on all idle channels. Scanning is done as a background process and produces a list of free and occupied channels (RSSI list; RSSI = Received Signal Strength Indication), one for each idle timeslot/carrier combination, to be used in the channel selection process. An idle timeslot is (temporarily) not in use for transmission or reception. Within the RSSI list, low signal strength values represent free and non-interfered channels, while high values represent busy or interfered channels. With the aid of the RSSI information, a DECT PP or FP is capable of selecting the most optimal (least interfered) channel to set-up a new communication link.

In a DECT portable part, the channels with highest RSSI values are continuously analysed to check if the transmission originates from a base station to which the portable has access-rights. The portable will lock onto the strongest base station, as mandated by the DECT standard. Channels with lowest RSSI value are used to set-up a radio link with the base station if the portable user decides to establish a communication or when an incoming call is signalled to the portable through the reception of a paging message.

In a DECT base station the channels with low RSSI values are used when selecting a channel to set-up a beacon transmission (dummy bearer).

The Dynamic Channel Selection and Allocation mechanism guarantees that radio links are always set-up on the least interfered channel available.

Call set-up

Portable user originated call set-up

The initiative to set-up radio links in basic DECT applications is always taken by the portable part. The portable selects (using its Dynamic Channel Selection) the best channel available for set-up, and accesses the fixed part on this channel. To be able to detect the PP's set-up attempts the fixed part must be receiving on the channel when the PP transmits its access request. To allow portables to use all 10 DECT RF carriers, the fixed part continuously scans its idle receive channels for portable set-up attempts in a sequential way. Portables synchronise to this sequence by means of the information transmitted through the FP continuous broadcast service. From this information portables can determine the exact moment when successful access the FP is possible on the selected channel.

Network originated call set-up

When a call comes in for a DECT portable, the access network will page the portable by sending a page message - containing the PP's identity - through its continuous broadcast service. A portable receiving a paging message with its identity included will set-up a radio link - to serve the incoming call - using the same procedure as used for the PP originated link set-up.

Handover

Due to the powerful Dynamic Channel Selection and Allocation and seamless handover capabilities of DECT, portables can escape from an interfered radio connection by establishing a second radio link - on a newly selected channel - to either the same (intracell handover as shown in figure 6) or to another base station (intercell handover as shown in figure 7). The two radio links are temporarily maintained in parallel with identical speech information being carried across while the quality of the links is being analysed. After some time the base station determines which radio link has the best quality and releases the other link.

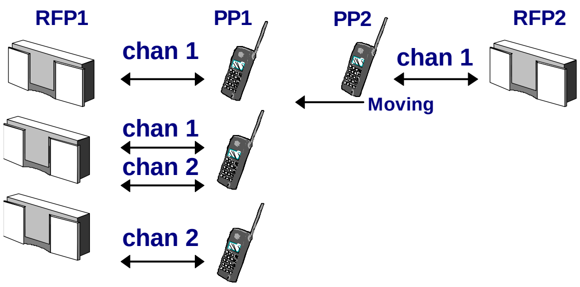

Figure 6. The DECT intracell handover function

If the DECT portable is moving from one cell area into another, the received signal strength - as measured by the portable's Dynamic Channel Selection and Allocation functions - of the base station will reduce gradually. The signal strength of the base station serving the cell towards which the portable is moving will gradually increase. At the moment the new base station's signal becomes stronger than the signal from the old base station, a seamless handover (as described above) will be performed to the new base station (see figure 7.).
The seamless handover is a fully autonomous initiative from the DECT portable part, which the user will not notice.

Although a handover is always initiated by the DECT portable part, it may also be the uplink (from PP to FP) that suffers from poor quality. For this case, DECT has signalling protocols that enable the fixed part to signal the perceived link quality to the PP, that can subsequently initiate the handover.

Diversity

Handover in DECT is a mechanism to escape from interfered or channels with low signal level. Handover is however not sufficiently fast to counteract fast fading situations. For this purpose the DECT base station can be

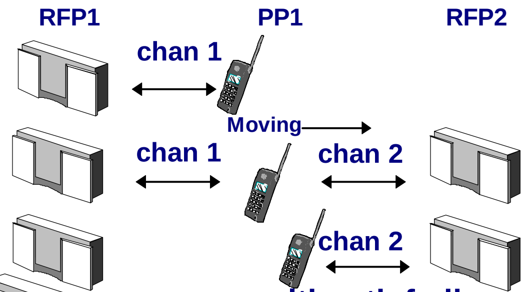

Figure 7. The DECT intercell handover function

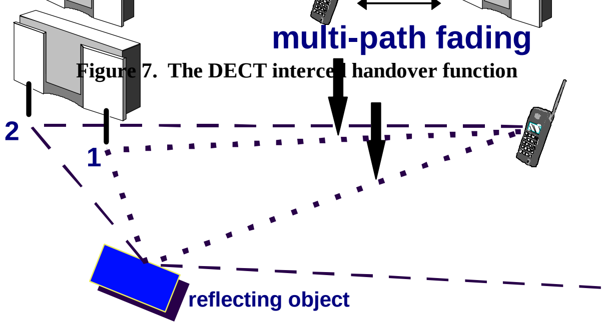

Figure 8. Antenna diversity from 1 to 2

equipped with antenna diversity (see figure 8). A signalling protocol is available in the standard to control FP antenna diversity from the portable. Due to the TDD nature (symmetry) of the radio link between the FP and PP, the FP antenna diversity not only improves the uplink quality but also the downlink quality, at slow speed.

Coexistence

The coexistence properties of radio access technology mainly rely on the ability to escape (handover) - in the frequency domain - from the interfered radio link, not relying on information transferred over the original (interfered) channel. MC/TDMA/TDD, continuous Dynamic Channel Selection and Allocation and the handover procedures in the DECT standard show excellent coexistence properties even under heavy interference conditions.

Security

The use of a radio access technology providing mobility includes considerable risks with respect to security. The DECT standard provides the measures to counteract the natural security flaws that generally appear when applying cordlessness. Effective subscription and authentication protocols have been included to prevent unauthorised access and an advanced ciphering concept provides protection against eavesdropping.

Subscription

The subscription process is the process by which the network opens its service to a particular portable.
The network operator or service provider provides the portable user with a secret subscription key (PIN code), that will be entered into both the fixed and the portable part before the procedure starts. Before the handset initiates the actual subscription procedure it should also know the identity of the fixed part to subscribe to (for security reasons the subscription area could even be limited to a single designated - low power - base station of the system). The time to execute the procedure is usually limited and the subscription key can only be used once, this to further minimise the risk of misuse.
Subscription in DECT can be done “over the air,“ a radio link is set-up and both ends verify that they use the same subscription key. Handset and network identities are exchanged, and both sides calculate a secret authentication key to be used for authentication at every call set-up. The secret authentication key is not transferred over the air.
A DECT portable may have multiple subscriptions. With every subscription session, the portable will calculate a new secret authentication key associated with the network to which it subscribes. New keys and network identities are added to a list - kept in the portable - which is used in the locking process. Portables will only lock to a network where it has access rights (network identity is contained in the list).

Authentication

Authentication of a handset may be done as a standard procedure at every call set-up. During the authentication session, the base station checks the secret authentication key without sending it over the air.
The principle for hiding the identity information in the air is as follows: the base station sends a random number to the handset that is called the ‘challenge’. The handset calculates a ‘response’ by combining the authentication key with the random information and transmits the ‘response’ to the base station. The base station also calculates the expected ‘response’ and compares it with the received ‘response’. Figure 9 illustrates the authentication mechanism. The comparison results into a continuation of the call set-up or a release.
If somebody is eavesdropping on the air interface, in order to steal the authentication key he needs to know the algorithm to recalculate the key from the ‘challenge’ and the ‘response’. This ‘reverse’ algorithm demands for a huge amount of computing power. So the cost of retrieving the key by eavesdropping of the authentication procedure is made extremely high.

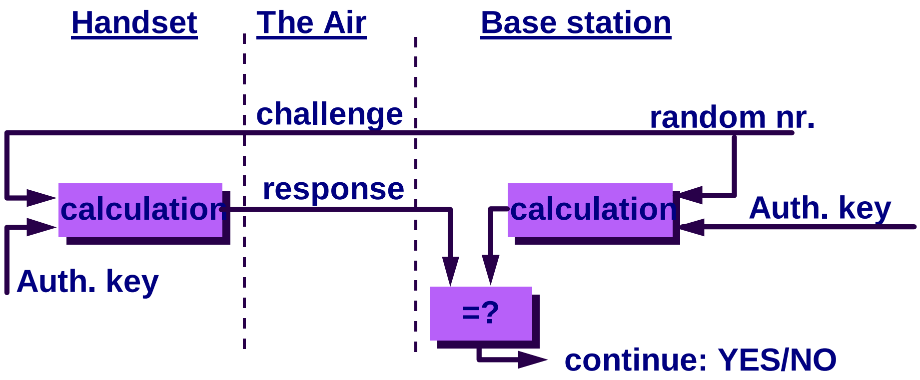

Figure 9. DECT authentication : challenge and response

Encryption

The authentication process uses an algorithm to calculate the 'response' from a 'challenge' and the authentication key in handset and base station. This is in fact a way to send the identity of the user in an encrypted form over the air in order to preventing theft of the identity. Looking at user data (e.g. speech) the same principle can be applied. During authentication, both sides also calculate a cipher key. This key is used to cipher the data sent over the air. At the receiving side the same key is used to decipher the information (see figure 10.). In DECT, the ciphering process is part of the standard (however not mandatory).

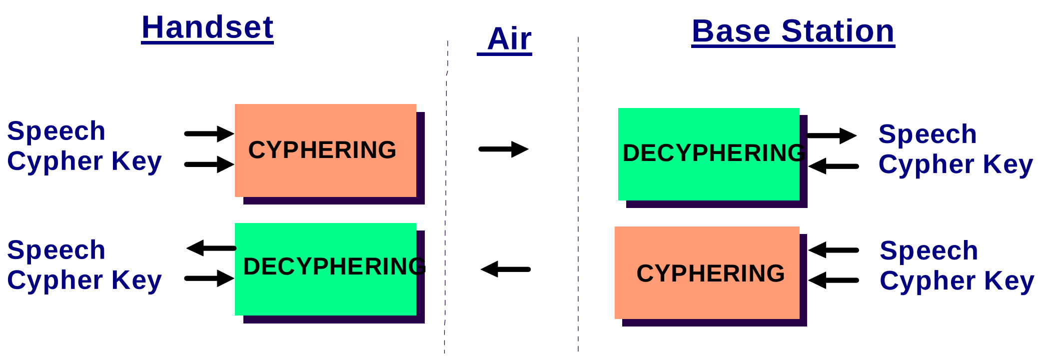

Figure 10. The DECT cyphering function

DECT Application Profiles

Application profiles contain additional specifications defining how the DECT air interface should be used in specific applications. Standard message and protocol subsets have been derived from the base standard's toolbox tailored for specific applications with the aim to achieve maximum interoperability between DECT equipment from different manufacturers. In addition to the profiles, profile conformance test specifications have been developed by ETSI that enable harmonised testing of DECT equipment designed to meet the profile requirements.

Generic Access Profile (GAP)

The Generic Access Profile (GAP) [9] is the basic DECT profile and applies to all DECT portable and fixed parts that support the 3.1 kHz telephony service irrespective of the type of network accessed. It defines a minimum mandatory set of technical requirements to ensure interoperability between any DECT GAP fixed part and portable part.
Procedures are described to establish, maintain, and release 3.1 kHz speech connections and mobility management procedures are included to support incoming and outgoing calls for roaming users. The GAP is the basis for all other (future) DECT speech profiles.

DECT/GSM Interworking Profile (GIP)

Since DECT is an access technology and network-wide mobility is outside the scope of the standard, the DECT GIP [10] is a powerful addition providing mobility in DECT infrastructures distributed over multiple sites through GSM mobility functions.
The DECT/GSM interworking profile for basic 3.1 kHz speech service ETS 300 370 [10] (together with ETS 300 499 [11] and ETS 300 703 [12]) defines the protocol requirements to interwork a DECT PP - through a DECT FP - to the GSM network where the DECT FP is directly connected to the A-interface of the GSM MSC. Interworking is done in such a way that the GSM network does not know that it is being accessed through DECT.

When compared with GAP, the DECT/GSM interworking profile contains additional requirements due to:

- the use of GSM cipher keys
- the use of GSM identities
- PP support of GSM authentication procedures (which are different from the DECT procedures)

DECT portables compliant with GIP are able to interoperate with GAP fixed parts.

As an alternative to the GSM A-interface the ETSI CTM working group developed the DSS1+ protocol that allows interworking between GSM mobility functions and DECT through the ISDN. The DSS1+ protocol (DE/SPS-05121) is based on DSS1 with enhancements to support mobility functions.

ISDN interworking Profiles (IAP and IIP)

For interworking between an ISDN network and a DECT system two profiles have been defined, the DECT/ISDN profile for end system configurations ETS 300 434 (IAP) [13] and the DECT/ISDN profile for intermediate system configurations DE/RES-03039 (IIP) [14].
The IAP applies when DECT FP and PP together constitute an ISDN terminal (ISDN services and supplementary services are offered at the DECT PP).
The IIP applies where a DECT FP and a DECT PP together constitute a transparent gateway between an ISDN network and one or more ISDN terminals connected to an S_0-interface at the DECT Intermediate Portable System (DIPS). The IIP supports ISDN basic access and all network defined services i.e. 3.1 kHz speech, 64 kbit/s unrestricted, ISDN packet data and supplementary services.
In the DECT/ISDN (and also in the RAP) profiles the use of the spectrum - in terms of efficiency - has been optimised to fit to the needs of the tele-services offered, which means that: a single full slot (basic DECT voice) bearer is used for each 3.1 kHz speech channel only if it is active and a double slot bearer is used for each active “unrestricted 64 kbit/s” channel. The ISDN D-channel (containing signalling or user data) only requires additional spectrum (max. one full slot

bearer) if there is no other channel active between the FP (DIFS) and PP (DIPS). If there is an active channel, the ISDN D-channel is incorporated in this channel.

Radio local loop Access Profile (RAP)

The DECT Radio Local Loop provides a cost efficient means to establish the final drop in a public telecommunication network. With DECT RLL technology, telecommunications operators can serve their customers with relatively low investments in comparison with wired local loop technologies. In developing countries, DECT RLL technology can stimulate penetration of public telephony significantly. In developed markets at places where it is not economic or impractical to install wired public telephony, RLL technology can provide a cost effective solution and in countries that allow for competition in the local loop, new operators can easily enter the market by using DECT RLL technology.

The DECT Radio local loop Access Profile ETS 300 765 (RAP) [15] defines the DECT protocol subset needed to deliver public network services to their end users. The RAP is divided into two parts:

Part 1 of the profile defines delivery of the basic telephony service (POTS, 64 kbit/s bearer service and “over-the-air” Operation, Administration and Maintenance (OA&M) services).

Part 2 describes ISDN services and broadband packet services (incl. data port).

In general, the services are provided through a standard telephone socket at a Cordless Terminal Adapter (CTA). The CTA (fixed version of a portable part) employs the radio connections with the DECT fixed part, which is directly connected to the public infrastructure.

When the CTA and the FP are operated under Line Of Sight conditions and equipped with the maximum allowed 12 dBi gain antennae, radio ranges up to 5 km are feasible. Application of a Wireless Relay Station (WRS) - in the same constellation - extends the radio range by another 5 km.

The WRS is a cost effective infrastructure building block providing improved or extended coverage in low traffic density applications (both indoor and outdoor).

A WRS can be equipped with one directional antenna (directed towards the RFP) and one omni-directional antenna to provide cost efficient public network access to users in remote areas. Coverage gaps caused by obstacles or building reconstruction can easily be repaired by using a WRS.

The WRS concept is specified in ETS 300 700 [17], detailed application information can be found in ETR 246 [18].

In public applications (RLL and CTM) DECT RFPs are installed in a DECT Access Site (DAS), which may comprise 6 to 12 DECT radios equipped with sectorised antennae. In a multi site environment a DAS can support 40 to 60 Erlang (see note 1) at 1% Grade Of Service. This enables a single DAS to serve 400 to 600 subscribers with 100 mE (milli Erlang) average traffic each.

An extensive study on traffic capacity and spectrum requirements for multi-system and multi-service DECT applications is reported in ETR 310 [19].

CTM Access Profile (CAP)

The Cordless Terminal Mobility (CTM) service allows users of cordless terminals to roam within and between networks. Where radio coverage is provided and the cordless terminal has appropriate access rights the user is able to make and receive calls at any location within the fixed public and/or private networks, and may move without interruption of a call in progress. CAP is similar to the DECT-GSM interworking with the difference that CAP is not limited to the mobility functions of the existing GSM network but may interwork - in a standardised manner - with any network providing mobility functions.

The CAP profile aims at maintaining compatibility with GAP; in fact, it can be seen as an extension to GAP stimulating the use of DECT for public applications

Data Service Profiles -
(A, B, C, D, E, F, Internet interworking**)**

A family of data transfer profiles is developed by ETSI to ensure interoperability for data communication equipment being connected through the DECT air interface. Each member of the profile family is optimised for a specific service. The table below shows a list of data profiles as currently planned.

Profile	Reference	Application
A/B.1	ETS 300 435	Generic frame relay for interworking with Ethernet and Token ring LANs at up to 552 kbit/s. Forms the basis for the C and F profiles.
A/B.2	ETS 300 701	Supports similar services as ETS 300 435 for mobile applications and provides direct interworking with the Internet Protocol (IP).
C.1	ETS 300 699	Generic data link service built upon the generic frame relay service of the A/B profile for applications that need a high degree of data integrity. It includes interworking with V.24 interfaces.
C.2	ETS 300 651	The C.2 profile extends the Data Stream service into environments where mobility is required. It contains interworking with V.24 and connection oriented bearer services.
D.1	not yet finalised	Provides transparent and isochronous transfer of synchronous data services for Closed User Groups.
D.2	not yet finalised	Similar to D.1 for mobile applications.
E.2	ETS 300 757	Low Rate Messaging service for roaming applications. Providing both point-to-point and point-to-multipoint messaging (e.g. alphanumeric paging) using the signalling channels.
F.2	ETS 300 755	Multimedia Messaging Service for mobile applications (Fax, E-mail, WWW access, SMS).

Table 2. DECT data profiles

Two mobility classes have been defined for the data profiles; Class 1 supporting no mobility and class 2 providing mobility functions across FP's enabling private and public roaming applications.

Application areas and markets

DECT handsets and base stations are available on the market since summer 1993; GAP compliant DECT equipment is available since spring 1996.
The DECT product shipments were 0.5 M until the end of 1994, 1.5 M in 1995, and 5 M in 1996 (Source: DECT Forum meeting in Paris, January 1997).

The majority of DECT product shipments are in the residential and business applications. DECT has proven to be cost effective for the low-end consumer market, showing potential for further cost reductions. Most of the shipments in this market segment concern single base station and single handset configurations. The prices for these configurations have reached a level at which DECT becomes extremely interesting for the consumer market. Consumers start to replace their old inferior quality (CT0 and CT1) cordless phones by a DECT product or buy their first fully digital DECT cordless phone because they feel confident about its quality, security level and flexibility. The perspective that a DECT cordless telephone can easily be transformed in a "home PABX" by just adding extra handsets is extremely attractive.

The initial interest in DECT has come from the wireless PABX market. Superior Dynamic Channel Selection and Handover procedures of DECT have proven to be efficient and reliable for large office and industrial installations both indoor and outdoor with 4000 to 5000 users per installation.
The main benefits experienced in this application area are cordlessness and transparency of DECT for PABX features offering increased productivity, lower call back costs because there are no unnecessary unanswered calls and reduced reconfiguration costs

A large number of DECT RLL installations with totally several 100,000s of subscribers are in operation all over the world. Line Of Sight ranges beyond 5 km with perfect speech are consistently reported. Booked orders have passed 0.5 M lines at the end of 1996. Growth rates indicate that RLL may become a dominant DECT application.

DECT products can efficiently provide public pedestrian cordless type of services wherever the need arises. Test installations are currently in operation in several countries showing excellent performance, Finland already runs systems in commercial operation. During the last year, DECT industry received substantial orders for DECT public pedestrian systems. This is now speeding up the delivery and development of DECT infrastructure, base stations and handsets especially designed for outdoor pedestrian environments.

Future developments and evolutions

Future developments of the DECT standard will be initiated by the market for DECT equipment and services as encountered by those involved in the standardisation process. Evolution of DECT due to new applications may lead to additions to the existing toolbox or new standard subsets (profiles).

Applications that have been recognised for the near future are:

- Modifications to the DECT radio part definition to achieve higher data rates. A study has been started on a modified radio (with 2 Mb/s capability) that co-exists with the “normal” DECT radio without decreasing the overall performance.
- Dual mode terminals supporting DECT and GSM, DECT and DCS1800 (or even triple mode terminals).
- Use of DECT in the evolution towards UMTS.
- Interworking with primary rate ISDN and broadband ISDN.

References

[1] ETS 300 175-1: "Radio Equipment and Systems (RES); Digital European Cordless Telecommunications (DECT) Common Interface Part 1: Overview".

[2] ETS 300 175-2: "Radio Equipment and Systems (RES); Digital European Cordless Telecommunications (DECT) Common Interface Part 2: Physical layer".

[3] ETS 300 175-3: "Radio Equipment and Systems (RES); Digital European Cordless Telecommunications (DECT) Common Interface Part 3: Medium access control layer".

[4] ETS 300 175-4: "Radio Equipment and Systems (RES); Digital European Cordless Telecommunications (DECT) Common Interface Part 4: Data link control layer".

[5] ETS 300 175-5: "Radio Equipment and Systems (RES); Digital European Cordless Telecommunications (DECT) Common Interface Part 5: Network layer".

[6] ETS 300 175-6: "Radio Equipment and Systems (RES); Digital European Cordless Telecommunications (DECT) Common Interface Part 6: Identities and addressing".

[7] ETS 300 175-7: "Radio Equipment and Systems (RES); Digital European Cordless Telecommunications (DECT) Common Interface Part 7: Security features".

[8] ETS 300 175-8: "Radio Equipment and Systems (RES); Digital European Cordless Telecommunications (DECT) Common Interface Part 8: Speech coding and transmission".

[9] ETS 300 444: "Radio Equipment and Systems (RES); Digital European Cordless Telecommunications (DECT) Generic Access Profile (GAP)".

[10] ETS 300 370: "Radio Equipment and Systems (RES); Digital European Cordless Telecommunications (DECT); DECT/GSM Interworking Profile".

[11] ETS 300 499: "Radio Equipment and Systems (RES); Digital European Cordless Telecommunications (DECT); DECT/GSM Interworking Profile; FP to MSC interconnection".

[12] ETS 300 703: "Radio Equipment and Systems (RES); Digital European Cordless Telecommunications (DECT); DECT/GSM Interworking Profile; phase 2 supplementary services".

[13] ETS 300 434: "Radio Equipment and Systems (RES); Digital European Cordless Telecommunications (DECT) and Integrated Services Digital Network (ISDN) inter-working for end system configuration; Part 1: Inter-working specification and Part 2: Access profile".

[14] DE/RES-03039: "Radio Equipment and Systems (RES); Digital European Cordless Telecommunications (DECT); DECT/ISDN Interworking for Intermediate System Configuration, Part 1: Interworking Specification and Part 2: Access profile".

[15] ETS 300 765-1/2: “Radio Equipment and Systems (RES); Digital Enhanced Cordless Telecommunications (DECT); Radio in the local loop (RLL) Access Profile (RAP); Part 1: Basic telephony services and part 2 : Advanced Telephony Services”.

[16] ETR 178: “Radio Equipment and Systems (RES); Digital Enhanced Cordless Telecommunications (DECT); A high level guide to the DECT standardisation”.

[17] ETS 300 700: “Radio Equipment and Systems (RES); Digital European Cordless Telecommunications (DECT); Wireless Relay Station (WRS)”.

[18] ETR 246 “Radio Equipment and Systems (RES); Digital Enhanced Cordless Telecommunications (DECT); Application of DECT Wireless Relay Station (WRS)”.

[19] ETR 310: “Traffic capacity and spectrum requirements for multi-system and multi-service DECT applications co-existing in a common frequency band.“

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